GEOPAK Road 2004

For Bridge

MoDOT

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Chapter 1

Introduction

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1.1 Overview

GEOPAK is a comprehensive software package that covers every project phase from conceptualization to final quantities. The software works within the MicroStation graphic environment providing true *interactive design*. For example, a horizontal alignment can be created graphically, it can be calculated with the coordinate geometry component of GEOPAK or some interactive combination of the two. Dynamic on-screen design provides immediate interpretation of plan view geometrics for making design choices through visualization.

Using GEOPAK helps ensure consistency and accuracy of design work and generate significant timesaving in the overall effort of producing construction plans.

For GEOPAK support, please contact the CADD Support Center.

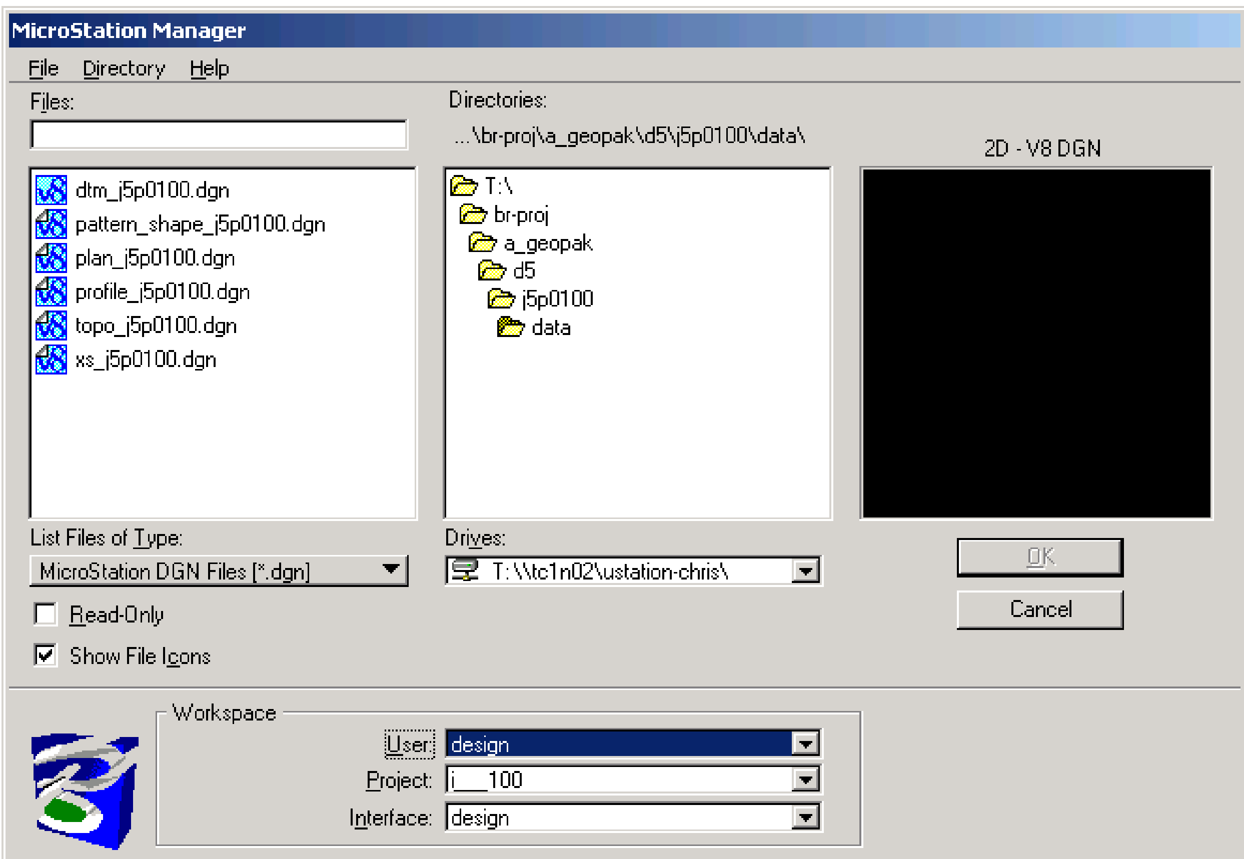
1.2 File Names

GEOPAK uses and/or creates files during the design process. The files you need to be familiar with are listed below:

job###**.gpk**	This binary file is created when the user starts a coordinate geometry (COGO) session for the first time or through Project Manager and may be appended to during the design process. All coordinate geometry elements are stored in this file. Multiple users can access this file at the same time, and only one file should be created for each project. The "###" is the only variable in this name. It represents a job number (up to 3 alphanumeric characters) unique to a project and is defined by the user upon creation. MoDOT users should use the last 3 digits of the job number. Example J1P0999 -> job999.gpk
fname**.inp**	Any ASCII input file for running GEOPAK processes. Name is user defined with a .inp extension. Example: **shape.inp**
fname.**log**	ASCII file used to capture results from processing input files, proposed cross sections, and earthwork.
fname###.**i**oc	ASCII input file for loading data during a COGO session. "###" represents the job number and "oc" is the operator code (users initials). Example: **align999.icu**
fname###.**o**oc	ASCII output file created by GEOPAK during a COGO session. Variables are the same as defined above. Example: **align999.ocu**
fname.**dat**	A binary file that contains string and point information to be used for digital terrain model construction.
fname.**tin**	A binary file containing triangular surfaces also known as the digital terrain model (DTM).
project.**prj**	Binary file resulting from the creation of a new project.

1.3 Accessing GEOPAK Road

GEOPAK is started upon entering a MicroStation File with **User:** set to **design**, as shown in the following dialog. This setting is very important for two reasons. First, GEOPAK is configured to work in the design **Interface**. Second, MicroStation stores all elements in meters and converts those values to the working units for the design file (Settings > Design File…). Design user files are set to use the U.S. Survey foot (0.304800609601219 meters per U.S. Survey foot), which is the basis for the Modified State Plane Coordinates used by the State of Missouri for all survey related work including highway alignments. Bridge user files use the International foot (0.3048 meters per International foot), which is the standard for structural drawings. Since GEOPAK Road is used for alignment work, files set to the U.S. Survey foot should be used.



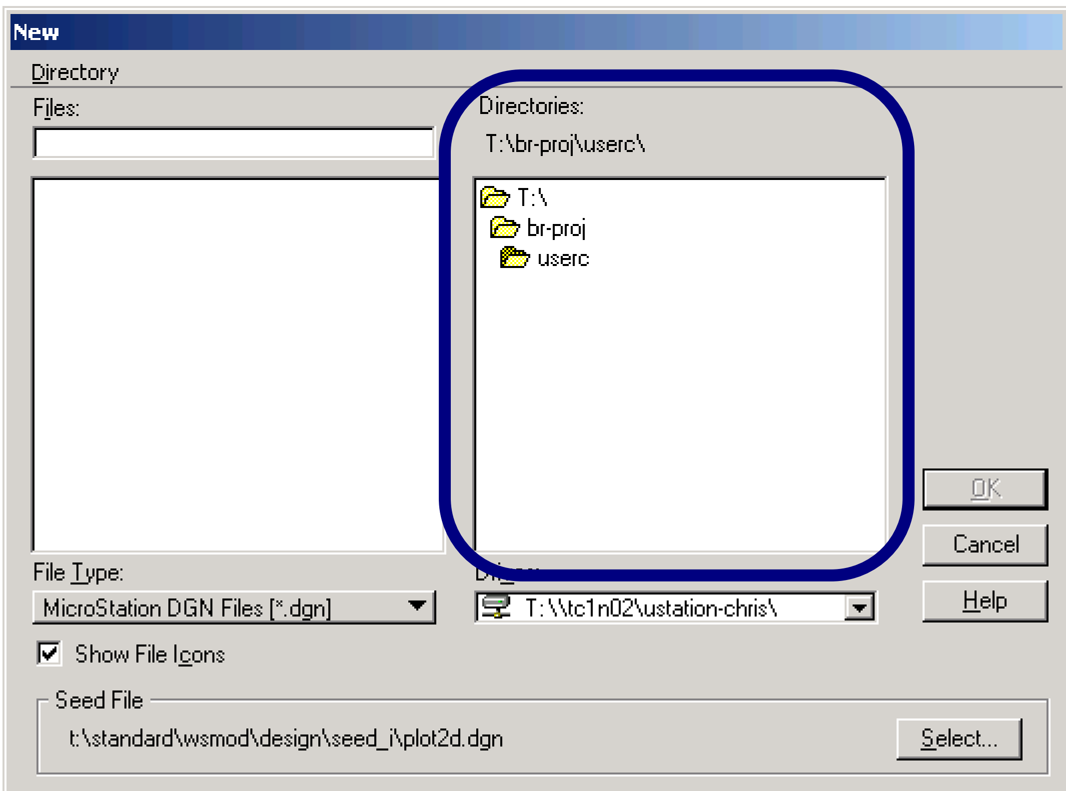
Activate GEOPAK by going to the MicroStation pull-down **Applications > GEOPAK > Activate GEOPAK**. Once GEOPAK is active, the Applications menu expands to show all installed products including **GEOPAK Road**. When each tool is selected, the corresponding dialog appears. To utilize the full potential of GEOPAK, GEOPAK dialogs may be interspersed with generic MicroStation commands. Several dialogs may be opened simultaneously.

To close a dialog, simply click the X in the upper right corner of the dialog. In addition, the Coordinate Geometry dialog and Design and Computation Manager may be closed by selecting the **File > Exit** option. Other various dialogs will have a **Cancel** button, which will exit the dialog. Exiting the MicroStation file automatically closes all GEOPAK dialogs.

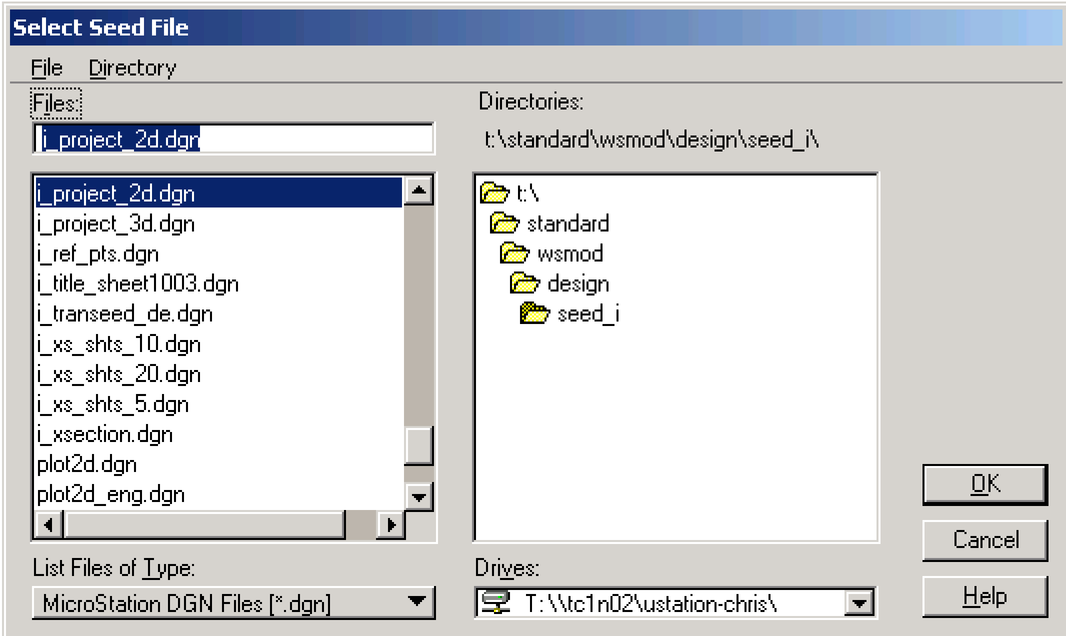
1.4 Starting A New MicroStation File For Use With GEOPAK

As stated in the previous section, GEOPAK Road as used at MoDOT utilizes the actual Modified State Plan coordinates assigned to the project. This coordinate system uses the U. S. Survey Foot as the master unit. For consistency, the MicroStation design file should also use the same master unit. For this to occur, the MicroStation seed file should be selected from the following location: t:\standard\wsmod**design**\seed_i. The rest of this section guides you through the steps to manual create a new two-dimensional drawing using the U. S. Survey Foot as the master unit.

To create a new MicroStation design file, select **File > New** from the pull down menu or click on the new file icon shown to the right. This will bring up the following dialog:



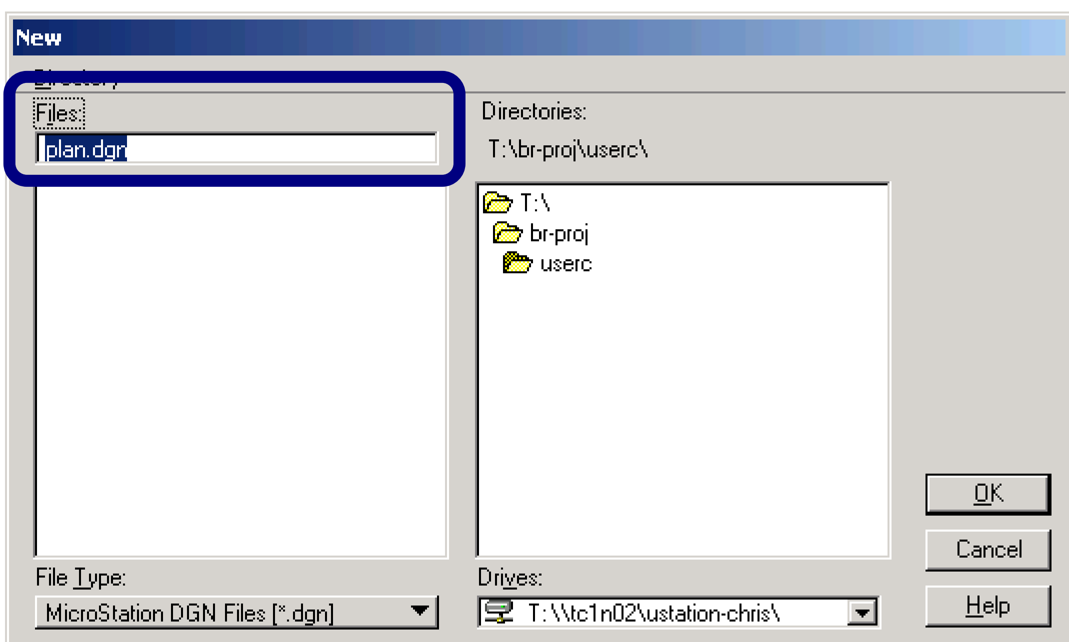
On the right side of the dialog is the **Directories** portion, which is outlined above. Use it to navigate to the folder for the location of the new file. Next, go to the bottom of the dialog and make sure the desired **Seed File** is listed. If it is not, as is the case above, press the **Select** button in the lower right hand corner of the dialog to bring up the Select Seed File dialog shown on the next page:



As shown above in the **Select Seed File** dialog, use the **Directories** portion to navigate to t:\standard\wsmod**design**\seed_i.

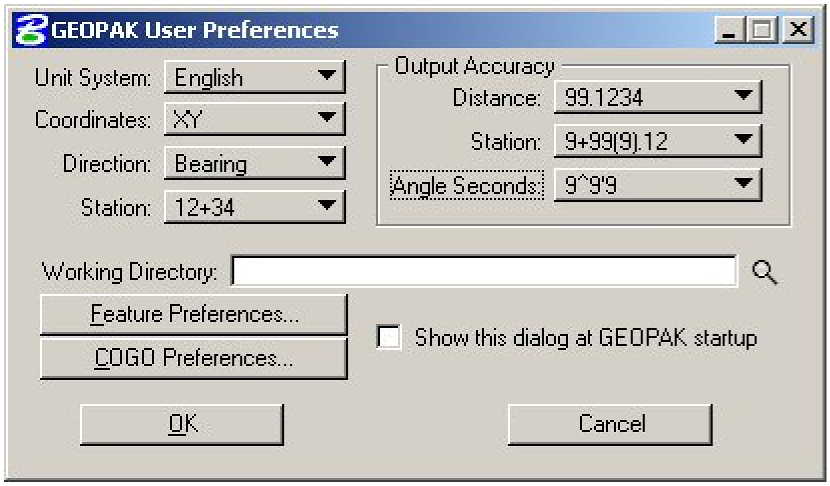
Select **i_project_2d.dgn** from the **Files** list on the left side of the dialog as shown above and click **OK**.

This will return you to the **New** dialog. Type the name for the new file in the **Files:** field, which is outlined in the following figure, and click **OK** to create the file.



1.5 User Preferences

The **User Preferences** dialog is used to set items that determine how distances, directions, and stationing is displayed and calculated, as well as the units that are used. The **User Preferences** dialog can be accessed from **Applications > GEOPAK Road > User Preferences**. The following dialog appears.

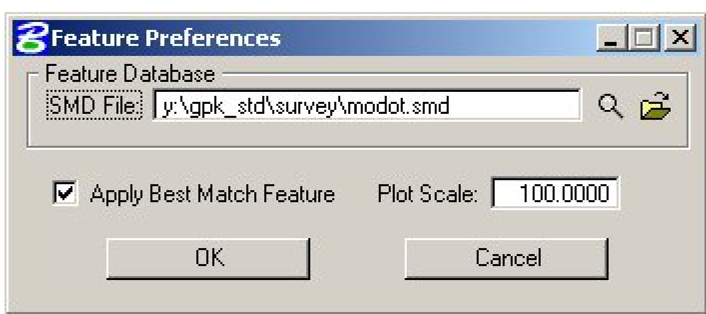


Most of the settings in this dialog will be set when the project is setup.

The **Working Directory** is used to tell GEOPAK where the data files for a particular project can be found. If a user does not want to work within a specific project, they can delete the information out of this field, and GEOPAK will use the directory that the open MicroStation file is located in.

1.5.1 Feature Preferences

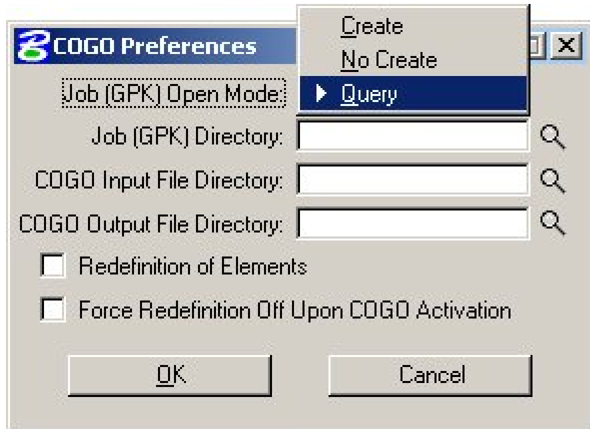
The **Feature Preferences** button activates the following dialog.



The **SMD File** is used to control the symbology of survey elements. Users will not be able to edit the **SMD File**, however, the **Edit SMD…** button can be used to view the feature codes. The **Apply Best Match Feature** toggle should be checked to allow for proper import of survey data. The scale of the features can be controlled using the **Plot Scale**. This should be set to the scale of the plan sheets to be created.

1.5.2 COGO Preferences

The **COGO Preferences** button will activate the following dialog.



The **Job (GPK) Open Mode** allows the user to set certain constraints used upon creation of a new coordinate geometry data file. So each time the Coordinate Geometry window is invoked for a job number that does not correspond with a job###.gpk file in the specified working directory, GEOPAK creates a new job###.gpk file based on the constraints set up in the COGO Preferences. The three constraints are **Create**, **No Create**, and **Query**. The **Create** mode automatically creates a new .gpk file without giving the user any warning. The **No Create** mode does not allow the creation of a new .gpk file and gives the user a warning. The Query mode gives the user a warning that this job###.gpk file does not exist in the current working directory as well as giving the user the option to proceed with the creation of the file or cancel it. The default MoDOT Mode is set to **Query**.

The **Job Directory** must be set to indicate the location of the coordinate geometry database (.gpk), which is automatically placed in the **working directory** when a GEOPAK job is first created. If this field is not set, GEOPAK Survey will not run correctly. The **COGO Input File Directory** and **COGO Output File Directory** can be set to indicate the location of the COGO input and output files respectively. If these fields are not set, GEOPAK will look in the **Job Directory**. If the **Job (GPK) Directory is not set**, GEOPAK will look for the files in the working directory. If the **Working Directory is not set** in the GEOPAK User Preferences dialog, GEOPAK will look for the files in the directory where the active MicroStation file is located.

The **Redefinition of Elements** toggles on or off the COGO redefine option. This option is discussed further in Chapter 5. The **Force redefinition off at Cogo Activation** will turn the COGO redefine toggle off whenever GEOPAK's coordinate geometry tools are activated.

Chapter 2

Start Job

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2.4 Start Job Dialog 2-1

2.1 Objectives

- Be able to start a new GEOPAK job with the **Start Job** dialog.
- Be able to add a new user to an existing GEOPAK job with the **Start Job** dialog.

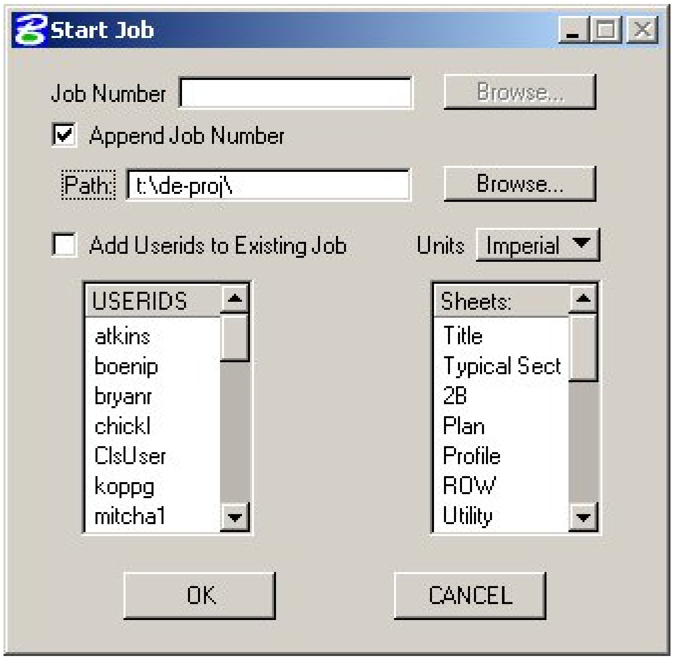
2.2 Definition

Start Job is a tool that will set up a GEOPAK job for a user, or add users to an existing job. **Start Job** creates the job directories and copies default MicroStation files to the directories. **Start Job** also appends the job number to the end of the copied MicroStation files if that option is activated. Once a job has been created, **Start Job** adds a user to the job. **Start Job** is only available in the design user interface in MicroStation.

2.3 Accessing

Start Job can be accessed from the MicroStation menu **MoDOT > Start GEOPAK Job/Add User**.

2.4 Start Job Dialog



Once the user has accessed the **Start Job** dialog box, shown right, the tool can be used to either create a new job or add users to an existing job.

If the user is creating a new job, do not check the **Add Users to Existing Job** toggle. The user then types in the appropriate number in the **Job Number** field. Note that the **Browse** button for selecting a job number is ghosted out. This is because the job doesn't exist yet. The user needs to specify the path in which the job will be placed. The **Browse** button can be selected to navigate through the path. The next step is to choose the **userids** of the people that will be working on the job. The user can select one or multiple user ID's.

In addition, for a new job, select the **Units** and the **Sheet** types that will be used for the job. This will create a directory for each **Sheet** type selected to place the sheets into as they are created.

If a job already exists, and users are being added to the job, check the **Add Users to Existing Job** toggle. Note that the **Path, Units, and Sheets** options will ghost out, and the **Job Number Browse** option will become available. Because the job already exists, the user can browse through the job directory to select the **Job Number.**

Once all fields have been filled in, select the **OK** button. The job directories will be set up as shown below.

```
T:\
 └── br-proj\
      └── A_Geopak\
           └── D# (last digit of district number) \
                └── job number\
                     ├── data\
                     │    ├── dtm.dgn
                     │    ├── pattern_shape.dgn
                     │    ├── plan.dgn
                     │    ├── profile.dgn
                     │    ├── topo.dgn
                     │    ├── xs.dgn
                     │    ├── job###.gpk (### = last three letters of the job number)
                     │    ├── MoDOT.lpf
                     │    └── MoDOT.ols
                     ├── plan_sheets\
                     │    ├── 100
                     │    └── 20
                     └── project\
                          └── job number.prj (Project Name / Number)
                              projdbs\
                               ├── job number.rpt (User Preferences)
                               └── userid\
                                    ├── job number.003 (Proposed Cross Sections)
                                    ├── job number.004 (Earthwork)
                                    ├── job number.005 (Cross Section Sheets)
                                    ├── job number.006 (Survey)
                                    ├── job number.008 (Define-Working Alignment)
                                    ├── job number.009 (Existing Ground Profile)
                                    ├── job number.00a (Vertical Alignment)
                                    ├── job number.00c (Limits of Construction)
                                    ├── job number.00d (Existing Ground-DTM)
                                    ├── job number.00e (Existing Ground Cross-Sections)
                                    ├── job number.00f (Reports and XS Quantities)
                                    ├── job number.010 (Model)
                                    ├── job number.011 (Draw Pattern)
                                    ├── job number.012 (Calculate Superelevation)
                                    ├── job number.014 (Plan / Profile Sheets)
                                    └── job number.ifo (User Id)
```

The **data** directory contains any project data. This is the directory that contains the MicroStation drawings, the GEOPAK coordinate geometry database (.GPK), and any input or output files. The **plan_sheets** directories contain the detail sheets drawn at specific scales for the project. The **project** directory contains the GEOPAK project manager file (.PRJ), and the userid directories. The **userid** directories contain the user runs for the job.

Chapter 3

Project Manager

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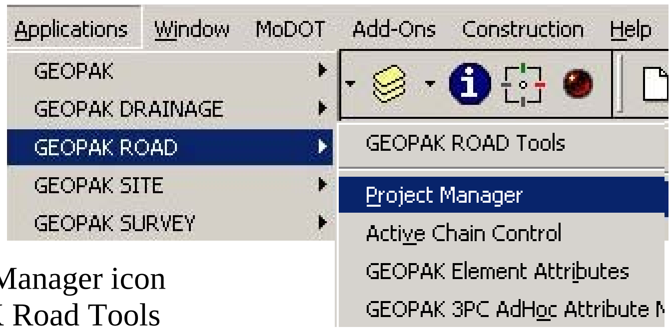
3.1 Objectives

- Learn how to set up a project using **Project Manager**.
- Learn how to utilize **Project Manager** as a workflow guide.
- Learn how to access GEOPAK dialogs from the **Project Manager**.

3.2 Definitions

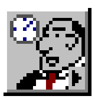
Project Manager is a GEOPAK tool that associates a project with its respective **gpk** job number, users, working directories and project files. Project Manager provides the user with an easy workflow system that keeps records of processes run throughout the design of a project.

3.3 Accessing



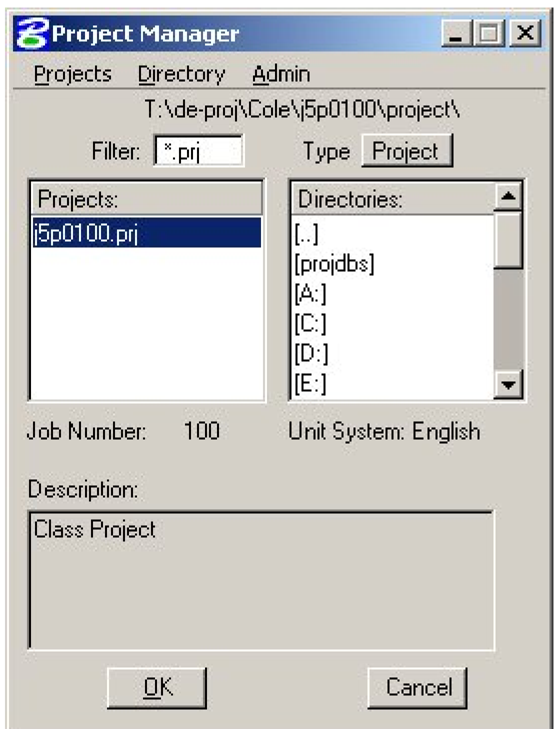
To access Project Manager:

- Select **Applications** >> **GEOPAK Road** >> **Project Manager** (as shown in the figure to the right) or



- Select the Project Manager icon from the GEOPAK Road Tools (both are shown to the left), which are opened by selecting **Applications** >> **GEOPAK Road** >> **GEOPAK Road Tools**.

The following dialog depicted to the right appears:



3.4 Project Manager Dialog

3.4.1 General Description

The current directory is displayed at the top of the dialog box, which can be changed by navigating to a different directory in the **Directories** list box. **This navigation is the first step in selecting an existing project or creating a new one.** Project files (.prj) are displayed in the **Projects** list box. The project files should be located in the t:\br-proj\A_Geopak*district**jobnumber***project** directory.

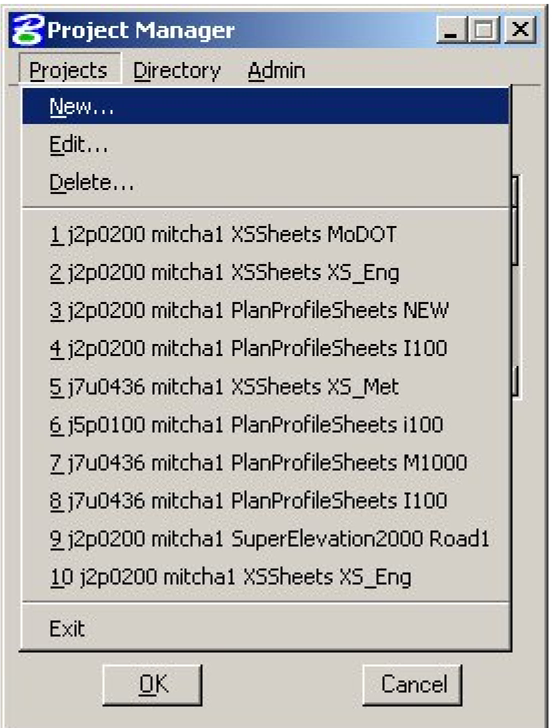
The remainder of the Project Manager dialog box displays information after a project has been selected from the **Projects** list box. At the bottom of the dialog are the **OK** and **Cancel** buttons.

If the user wishes to exit Project Manager, the **Cancel** button should be selected. To continue in the Project Manager process, the **OK** button should be selected.

3.4.2 Project Manager Menu Bar

There is three pull down choices on the Menu Bar: **Projects**, **Directory**, and **Admin**. Each of these choices has options contained in the pull down.

3.4.2.1 Project Tools



There is four choices under the **Projects** pull down: **New**, **Edit**, **Delete**, and **Exit** as shown below.

As can be seen from this dialog box, the Windows motif also keeps track of the last few processes that have been executed. These may be recalled as needed by selecting the desired process.

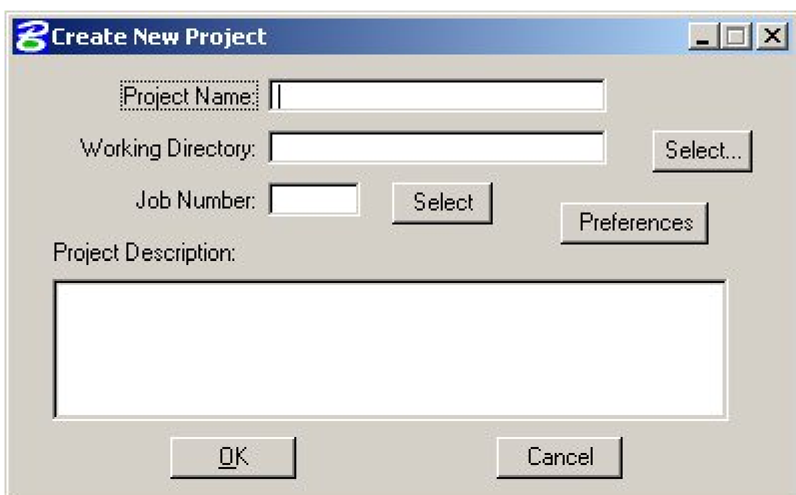
3.4.2.1.1 New…

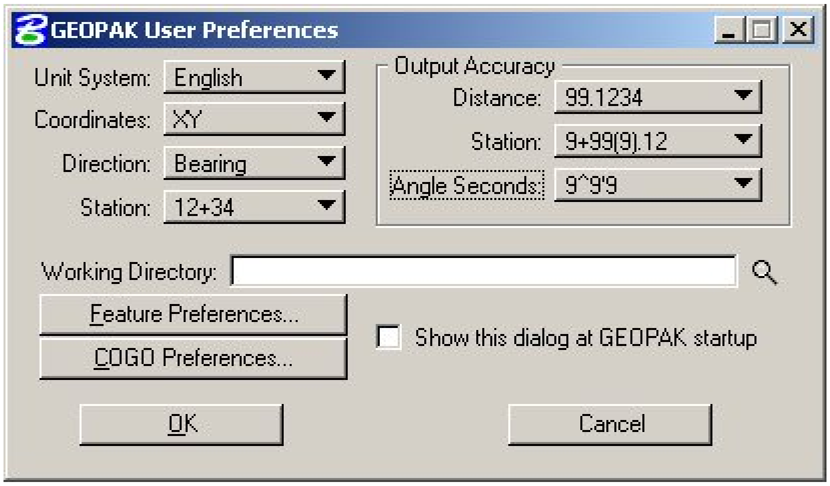
The **New** menu option is used to create a new project. The .prj file will be stored in the directory shown in the Directory path at the top of the Project Manager dialog box. When the **New** menu option is selected, the **Create New Project** dialog appears (shown at the bottom of the page).

The **Project Name** can be any number of alphanumeric characters. For MoDOT projects, the **Project Name** needs to be the same as the job number. (i.e. j1p0999.prj) The **Working Directory** specifies the location of the project data files. The **Working Directory** may be keyed in or the **Select** button may be chosen and the appropriate directory selected. For MoDOT Bridge, the **Working Directory** should be set to t:\br-proj\A_Geopak*district**jobnumber***data**.

The next field is for typing in the COGO job number, or the **Select** button may be chosen and the appropriate COGO job number selected.

Next the **Preferences** button should be chosen and the **Project Preferences** dialog appears, which is depicted on the following page.

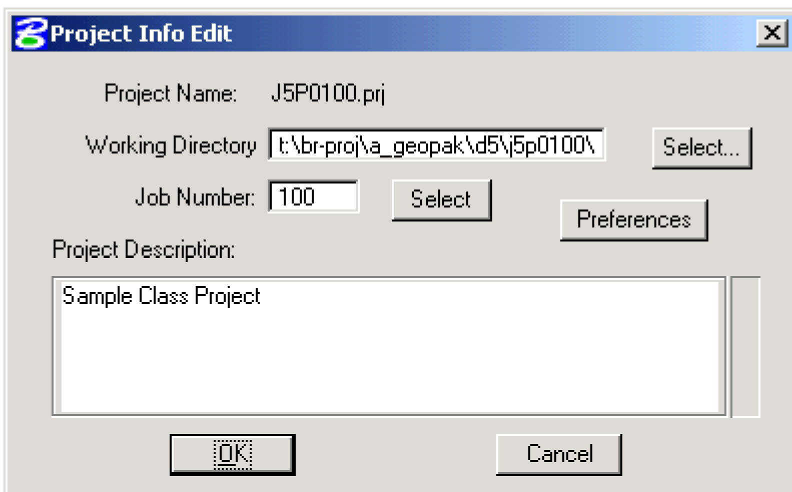




The user may set the particular parameters for each project as well as the **Working Directory**. This keeps the user from re-setting them when changing projects since the project's preferences are recalled when entering the project. After all of the information is entered, select **OK** to accept the changes, or **Cancel** to reject them. For more about **User Preferences**, see **Section 1.5** in Chapter 1.

Shown below is a sample project that includes a project description, which may be keyed in at the bottom of the **Create New Project** or **Project Info Edit** dialog box. The **Working Directory** is set to:

t:\br-proj\a_geopak\d5\j5p0100\data.



3.4.2.1.2 Edit…

The **Edit** menu option is used to change any settings associated with the currently selected project. When chosen, the **Project Info Edit** dialog box shown above appears.

3.4.2.1.3 Delete…

The **Delete** menu option is used to delete any project that has been stored. The user highlights the project in the **Projects** and selects **Delete**.

3.4.2.1.4 Exit

The **Exit** menu option closes the Project Manager and writes the settings to a resource file.

3.4.2.2 Directory Tools

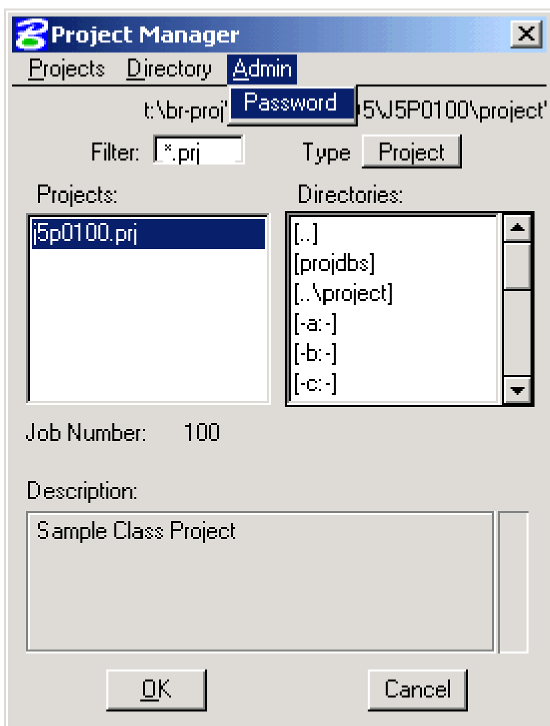
There are two options under the **Directory** pull down, **Create New Directory** and **Current Working Directory** as shown below.

The **Create New Directory** option creates a new directory on the disk.

If the **Current Working Directory** option is chosen, the directory path in Project Manager is changed to that directory.

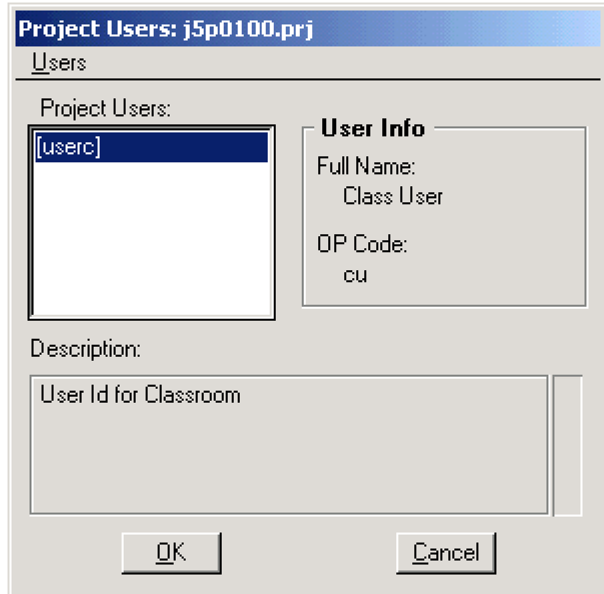
3.4.2.3 Administration Tools

The **Administration** menu option is used to set a password on a project. It is recommended that a password **not be used** since the project will need to be accessed by more than one user.



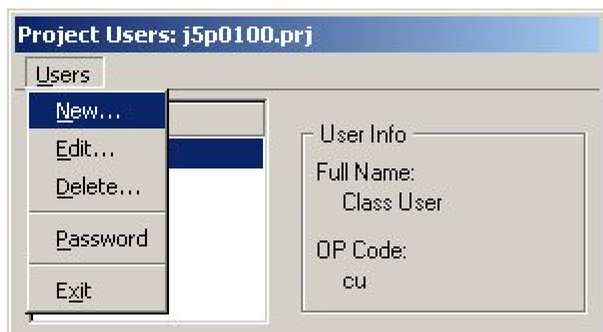
3.5 Project Users Dialog

Once a project is highlighted and **OK** is selected, the **Project Users** dialog appears.



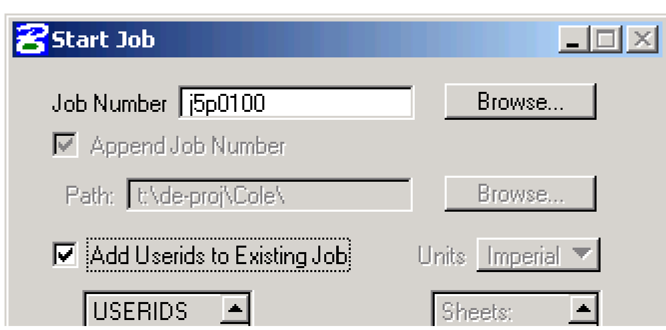
This dialog has three sections: **Project Users**, **User Info**, and **Description**. The **Project Users** list displays a list of users that have been created to work with any project that resides in the current projects home directory. The names shown in **Project Users** will be the userid's of the people working on that project as specified in the **Start Job** dialog. Within the **User Info** group box, the **Full Name** field further identifies the user, and displays the full name of the user that is currently selected. The **OP Code** field displays the GEOPAK Operator Code of the currently selected user. The GEOPAK Operator Code is used for all coordinate geometry operations during this session. The Operator Code, along with the Job Number, will be utilized whenever an input or output file is created by the software. The Operator Code will be the user's first and last initials. The **Description** field displays the description of the currently selected user.

Four tools are supported on the Project Users pull down as depicted in the exploded view to the right.



3.5.1 New

The New pull down menu option creates new users. **This option is not to be used in MoDOT.** To create a new user for a project, use **Start Job/Add User** under the MoDOT menu with **Add Userids to Existing Job** activated, as show in the following figure. Start Job/Add User must be used for the user to have the default MoDOT runs.



3.5.2 Edit

The **Edit** pull down menu option allows the user to change any of the parameters of the currently selected user. (Note: The User cannot be changed. This will change the user information for the current project only.)

3.5.3 Password

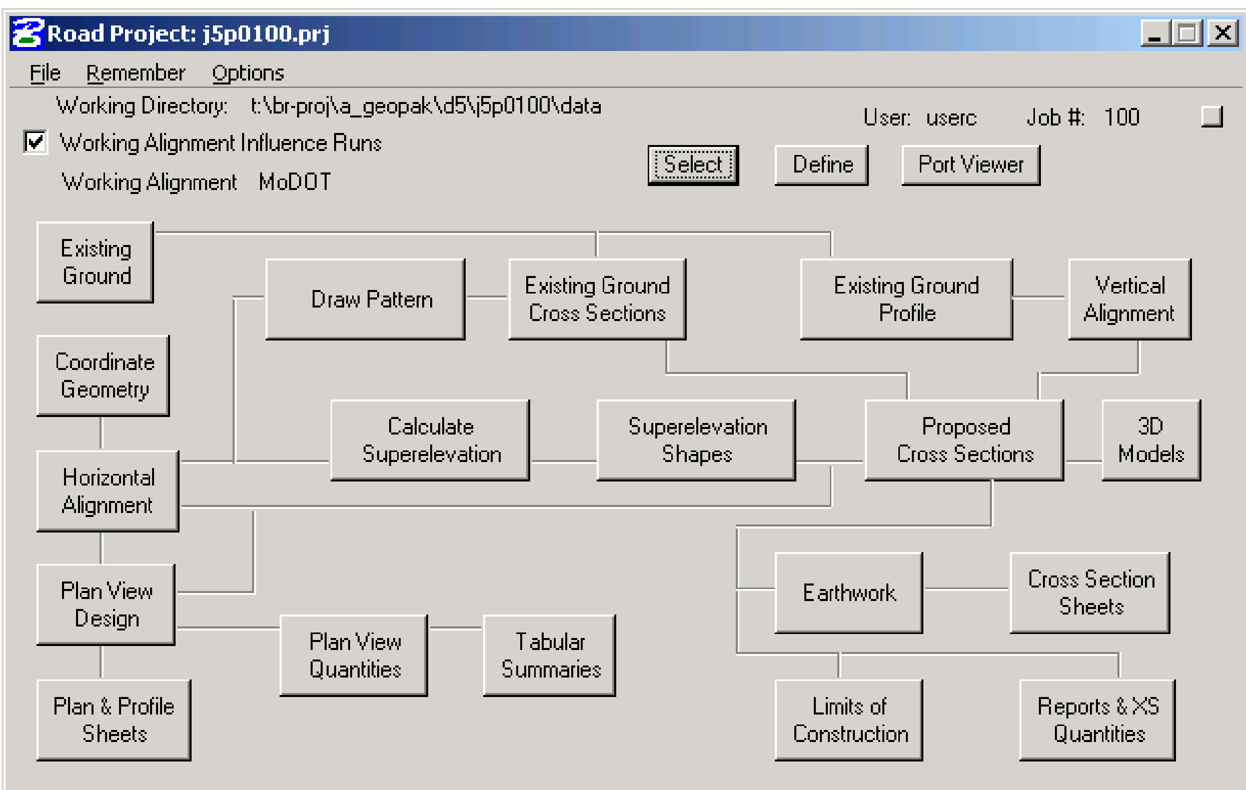
The **Password** tool creates or modifies a password for the selected user. If the selected user already has a password, the user is prompted to enter the current password before continuing.

3.5.4 Exit

The **Exit** option closes the User dialog and returns back to the Project Manager dialog.

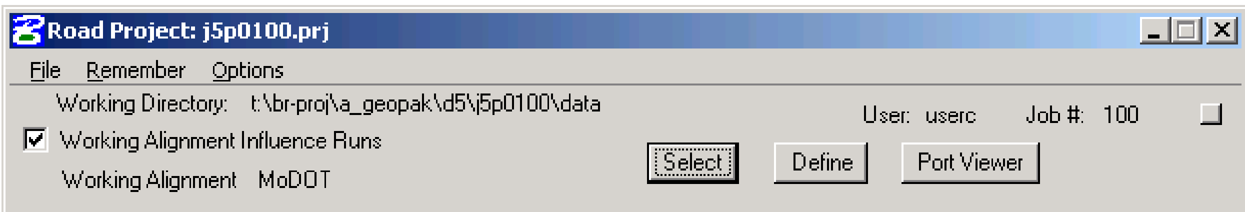
3.6 Road Project Dialog

After a minimum of one user has been defined, selecting the **OK** button on the lower left corner of the Project Users dialog or double clicking on a Project User will open the Road Project dialog.



3.6.1 General Description

The top of the dialog displays the **Working Directory**, **Working Alignment** (if defined), **User** and **GEOPAK Job Number**. In addition, a toggle for **Working Alignment Influence Runs** is also supported. The bottom portion of the dialog box displays the various processes supported during the design process. The small square in the upper right corner (to the right of the Job Number) will condense the dialog as depicted in the graphic below.

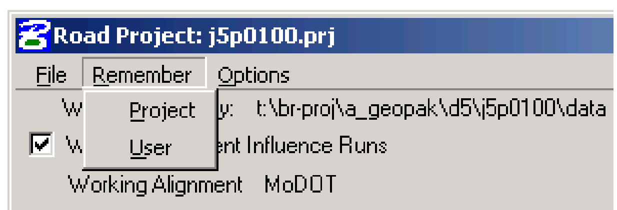


3.6.2 Road Project Dialog Menu Bar

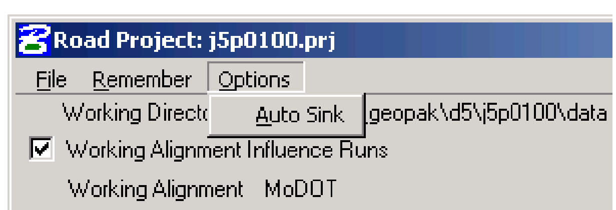
The three pull down menu bar options are: **File**, **Remember**, and **Options**. When the **File** option is selected, the choices are **Close** and **Exit**.

If the **Close** option is selected, the user is returned to the **Project Manager** dialog. If **Exit** is selected, the user is exited from Project Manager.

When the **Remember** option is selected, the user can instruct the software to remember the **Project** or the **User** in subsequent sessions. For example, if all both toggles are activated, and the Project Manager is completely closed, the invocation of the Project Manager immediately invokes the Road Project dialog (flow chart) and utilizes the project name, username, etc., which were active when the **Remember** toggles were selected. If only the **Project** toggle is activated, the user is returned to the Project Users dialog in subsequent sessions. If only the **User** toggle is activated, the user is returned to the Project Manager dialog in later sessions, but will skip the Project Users dialog. This option is particularly useful when the user is working on more than one project but always enters Road using a single user id.



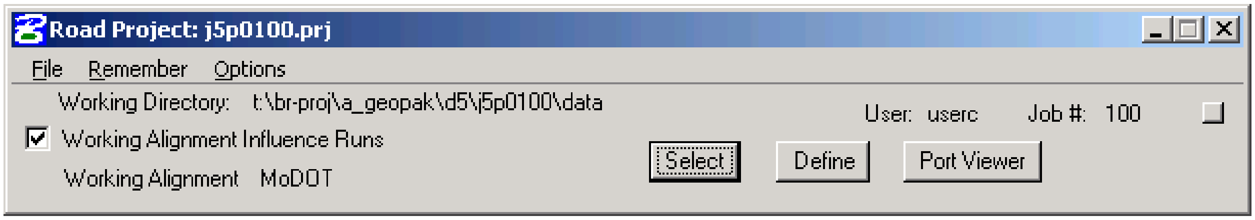
The **Options** menu allows the user to toggle on the **Auto Sink** option. When toggled on, this option sinks (move behind the open drawing views) the Road Project Manager dialog when a tool is chosen from the Project Manager. When a tool is closed, the Road Project Manager dialog becomes the active dialog.



3.6.3 Working Alignment

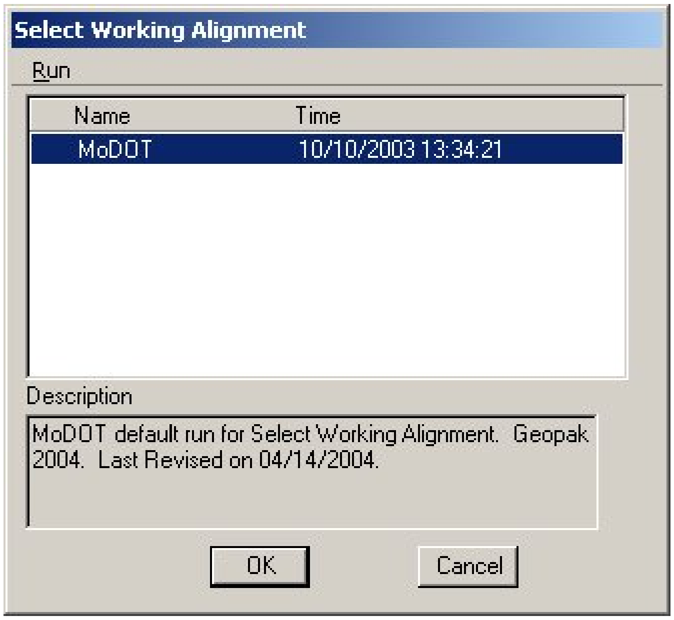
The concept of a working alignment enables the designer to organize a project and to access project information without continually typing the required information. On a simple project, only one working alignment may be needed. However, on a more complicated project, an unlimited number of working alignments may be defined. The designer can easily change from one working alignment to another by highlighting the desired alignment listed in the **Select** dialog. Three tools relating to working alignments are located at the top of the Road Project dialog:

- **Select Button**
- **Define Button**
- **Working Alignment Influence Runs** (toggle on left side of dialog)



3.6.4 Select Option

When the **Select** button is pressed, the **Select Working Alignment** dialog appears as depicted to the right. If no working alignments have been defined, MoDOT appears in the Run List box. If working alignments have been defined, they are listed with the last run time. The description of the working alignment can be seen in the bottom of the dialog when each Name is highlighted. To select a previously defined working alignment, highlight the run from the list then press the **OK** button at the bottom of the dialog. Double clicking on the Name also selects a previous working alignment for subsequent processing. Pressing the **Cancel** button closes the **Select Working Alignment** dialog without any working alignment change. Several file option are supported as depicted in the exploded view below. These include **New**, **Copy**, **Rename**, and **Delete.**

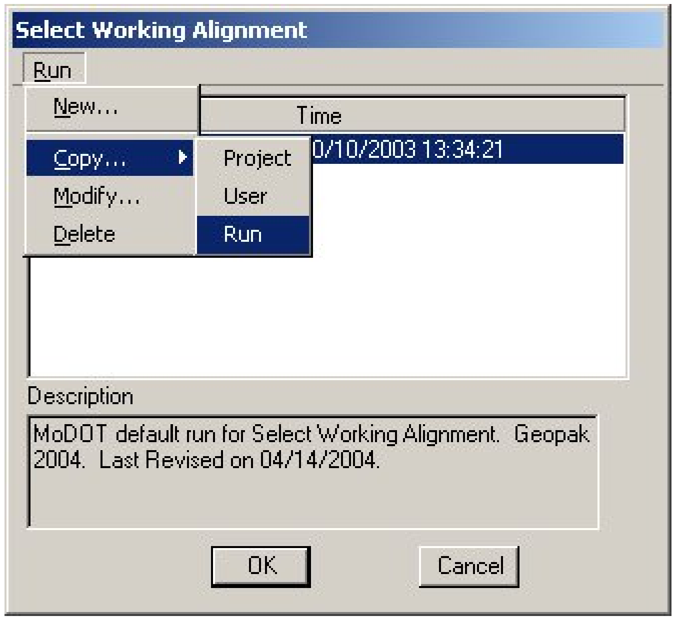


- **Run > New –** allows the user to create a new working alignment. (Do not use this option as it will not copy the default MoDOT settings for the working alignment. Instead, use Run>>Copy>>Run to copy the MoDOT run.)

- **File > Copy –** allows the user to copy an existing Project, User or Run.

- **File > Rename –** allows the user to change the name of the existing working alignment.

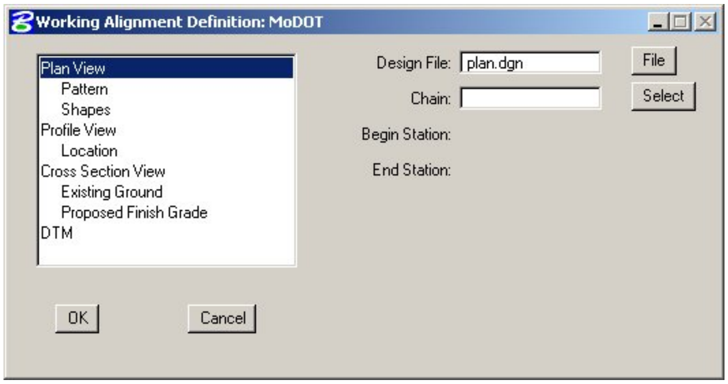
- **File > Delete –** allows the user to delete an existing working alignment.

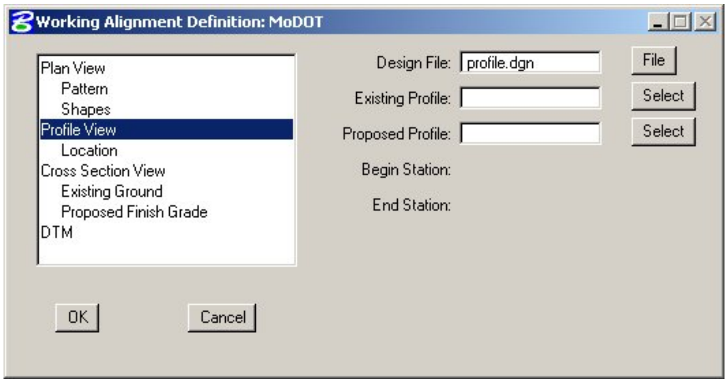


3.6.5 Define Option

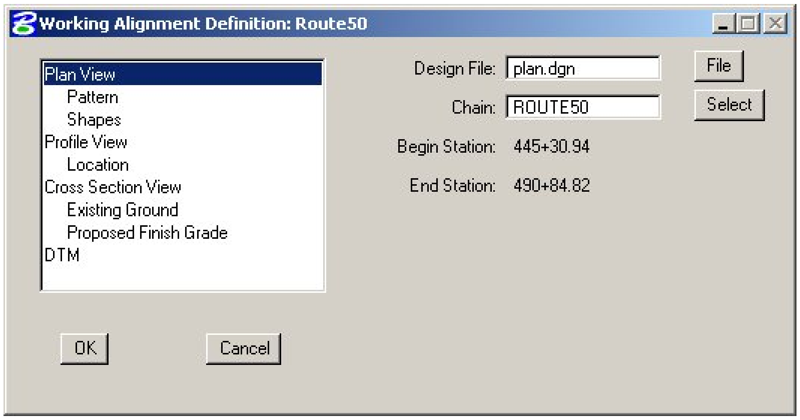
Once a Working Alignment is selected, pressing the **Define** button invokes the dialog depicted to the right. The information that can be associated with a working alignment is listed in the left portion of the dialog box. As each option is chosen, the right side of the dialog box changes to reflect the information needed as can be seen in the dialog box to the right after Profile View was selected.

All information entered in these fields can be used in subsequent processes run from Project Manager. In the beginning of a project, much of this information is not known but, as the user goes through the design process, it can be added to the working alignment definitions.





For example, as soon as the chain has been stored in COGO, the user can enter that information in the Plan View fields as depicted to the right. For a more complete explanation of each option shown, please see the on line *GEOPAK Help* by going to the MicroStation menu path: **Applications > GEOPAK Road > Help**.



3.6.6 Port Viewer

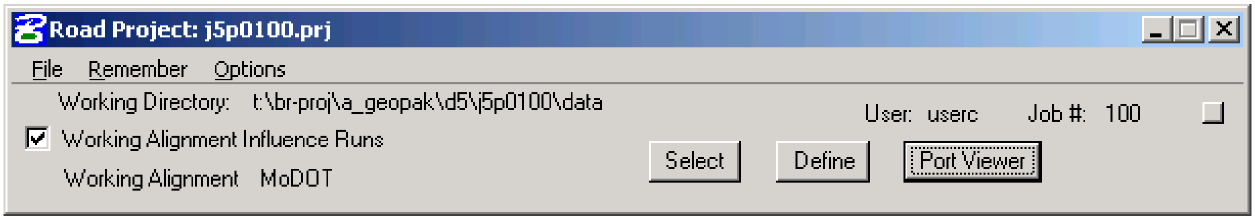
The **Port Viewer** is a tool that enables the user to view all three major aspects of a road design simultaneously even though they are located in different files. The three views include:

- **Plan**
- **Profile**
- **Cross Section**

As a prerequisite to invoking the **Port Viewer**, a working alignment must be defined with the following information.

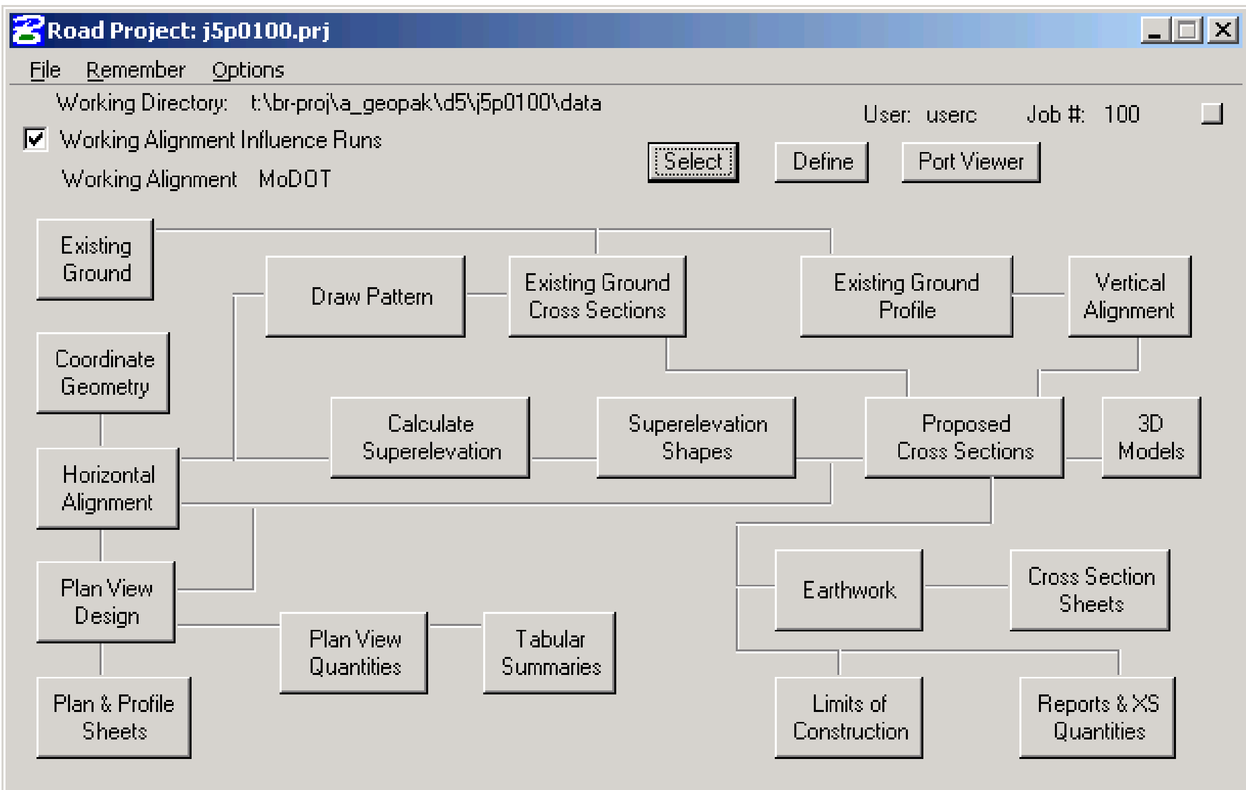
- **Alignment Specification**
- **Plan View Design File and Chain**
- **Profile Information**
- **Cross Section File**
- **Digital Terrain Models**

The **Port Viewer** is covered in more detail in Chapter 16 of the manual. The tool is invoked by clicking on the accented button in the following figure. A error message is generated if all of the prerequisite information is not defined prior to activating the tool.



3.7 Project Manager Process

The primary **Road Project** dialog is depicted below. The advantage of utilizing the **Road Project** dialog rather than selecting functions directly from the **Road** menu is that pertinent information stored within the **Project Manager** is automatically displayed within the invoked dialog. Therefore, job numbers, chain names, stationing, file names, and data associated with the project do not have to be typed in each time a dialog is utilized. However, the user can change information in the fields.

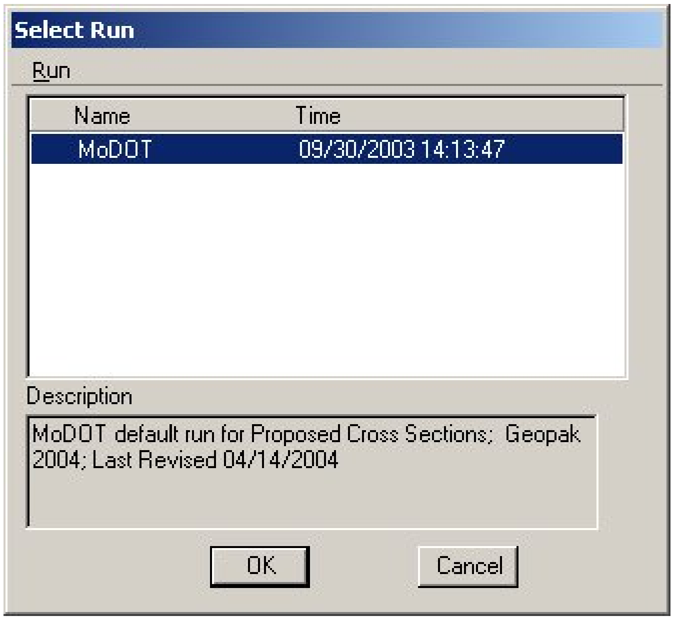


Many of the **Project Manager** processes function identically to their corresponding dialog's invocation from the Road menu. However, some of the procedures invoke the **Select Run** dialog prior to invoking the actual dialog. The **Select Run** dialog allows the user to set up different options to use in alternative design choices.

Each of the Road Project dialog processes is covered individually in the remaining chapters.

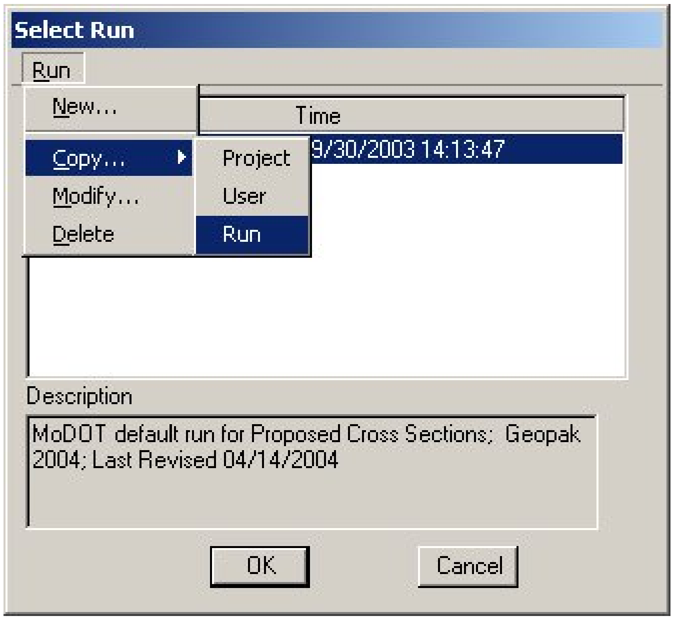
3.7.1 Select Run Option

When certain procedures are selected from the **Project Manager** dialog, the **Select Run** dialog is invoked. The **Select Run** dialog allows the user to save the settings for each procedure in a **Run** that can then be recalled whenever the user needs to execute that same procedure. With the individual runs, a user can keep a history of the project, and can access the various procedures



with the settings that were previously used. This way a user can repeat various procedures with the same settings previously used.

When the **Select Run** dialog is invoked, MoDOT appears in the Run List box. (Some Select Run boxes will display default run names such as English, Metric, I100, I20, etc.) If **Runs** have been defined, they are listed with the last run time. The description of the **Runs** can be seen in the bottom of the dialog when each Name is highlighted. To select a previously defined **Run**, highlight the run from the list, and then press the **OK** button at the bottom of the dialog. Double clicking on the Name also selects a previous **Run** for subsequent processing. Pressing the **Cancel** button closes the **Select Run** dialog without any run settings change. Several file option are supported as depicted in the exploded view below. These include **New**, **Copy**, **Rename**, and **Delete.**



- **File** > **New** – allows the user to create a new run. (Do not use this option as it will not copy the default MoDOT settings for the procedure selected. Instead, use Run>>Copy>>Run to copy the MoDOT run.)
- **File** > **Copy** – allows the user to copy an existing Project, User or Run.
- **File** > **Modify** – allows the user to change the name of the existing Run or its description.
- **File** > **Delete** – allows the user to delete an existing Run.

Exercise 3-1

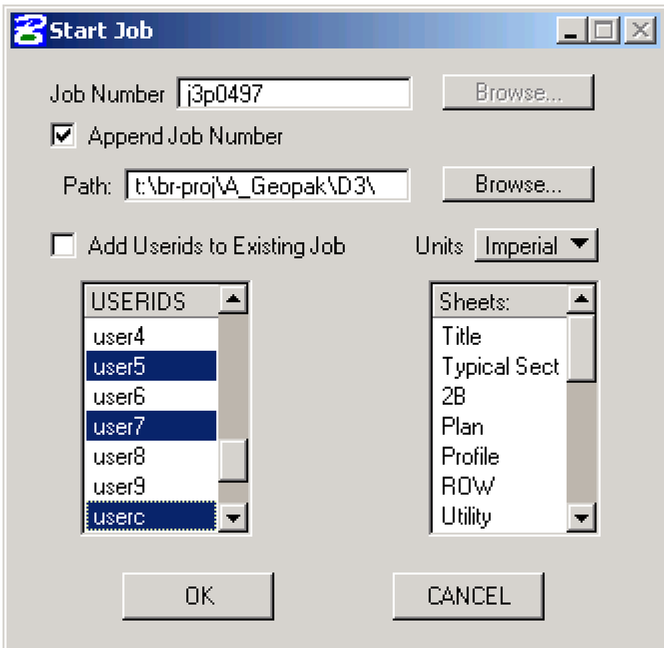
This is an individual exercise to practice setting up the directory structure and files for a new GEOPAK job.

1. Open any MicroStation file.

2. Create the following job with the **Start Job** dialog (MicroStation menu path:

   MoDOT > Start GEOPAK Job/Add User).

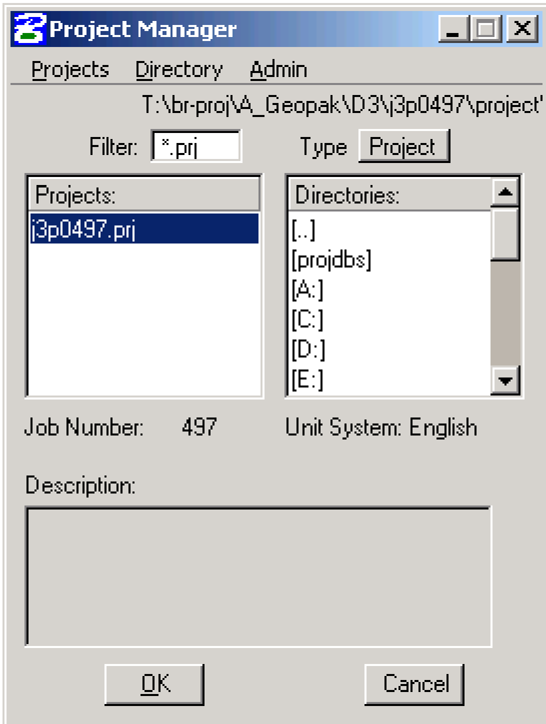
   Use the settings shown in the following dialog.



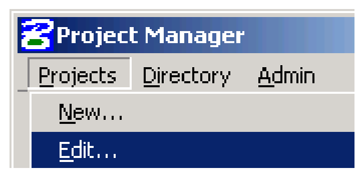
3. Review the directory structure and the files created in the directory.

4. Use the **Project Manager** dialog to review the following project:

   Go to the directory **t:\br-proj\A_Geopak\D3\j3p0497\project**

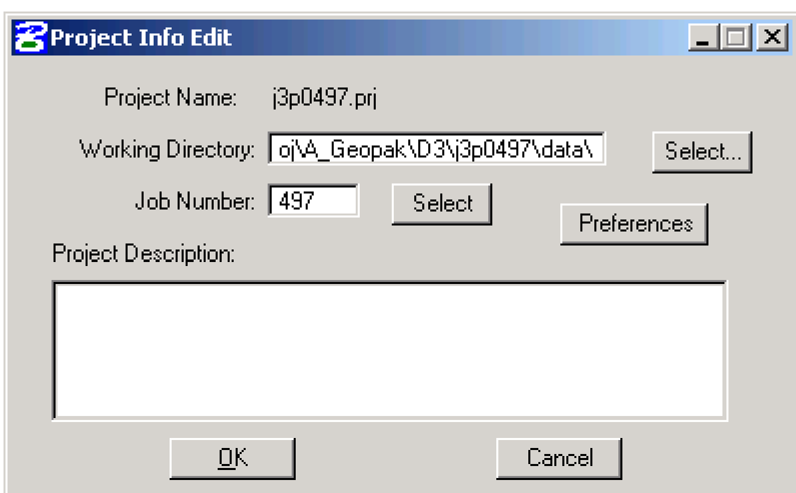


   Choose **Projects > Edit…** as shown to the right:

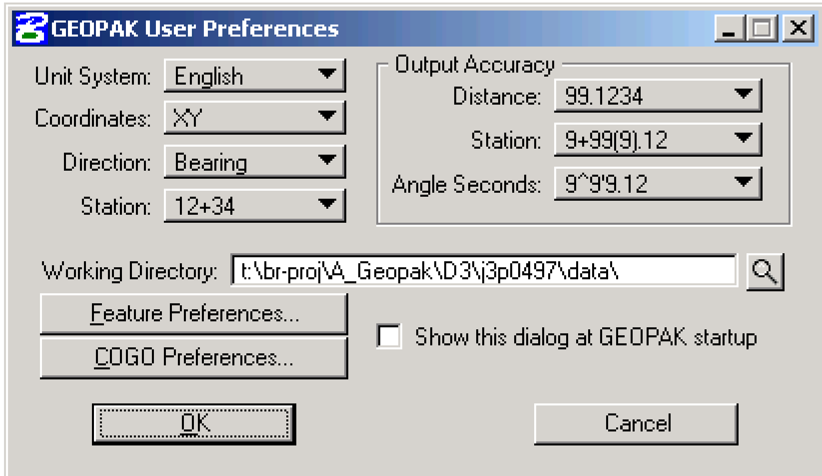


   Compare the information in the **Project Info Edit** dialog to that shown below.

Project name:	**j3p0497**
Working Directory:	**t:\br-proj\A_Geopak\D3\j3p0497\data**
Job Number:	**497**



   Set up the **Preferences** as shown below:

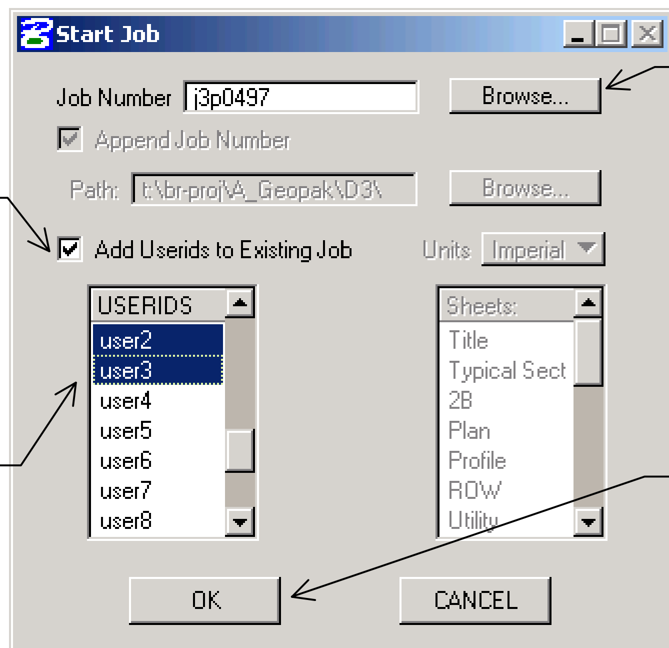


Click **OK** to accept the changes.

5. Add User2 and User3 as users to the project.

A) Start by toggling on **Add Userids to Existing Job**.

C) Select the **USERIDS** to be added.



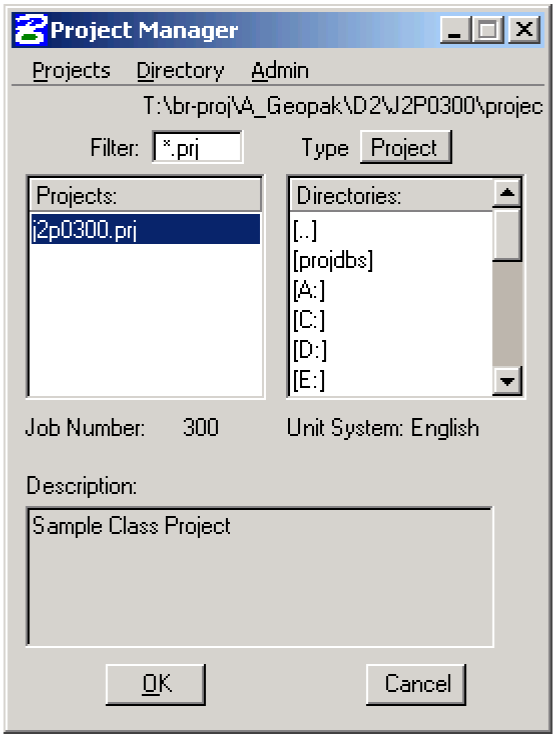
B) Continue by using this Browse button to choose the **Job Number** and **Path**.

D) Click **OK** to finish the process.

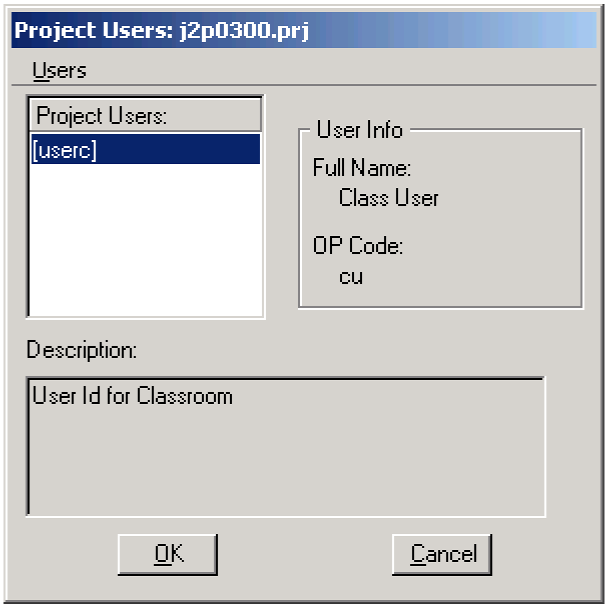
Exercise 3-2 This is an individual exercise to practice setting up a new working alignment.

1. Open the Microstation file **t:\br-proj\a_geopak\d2\j2p0300\data\topo_j2p0300.dgn**.

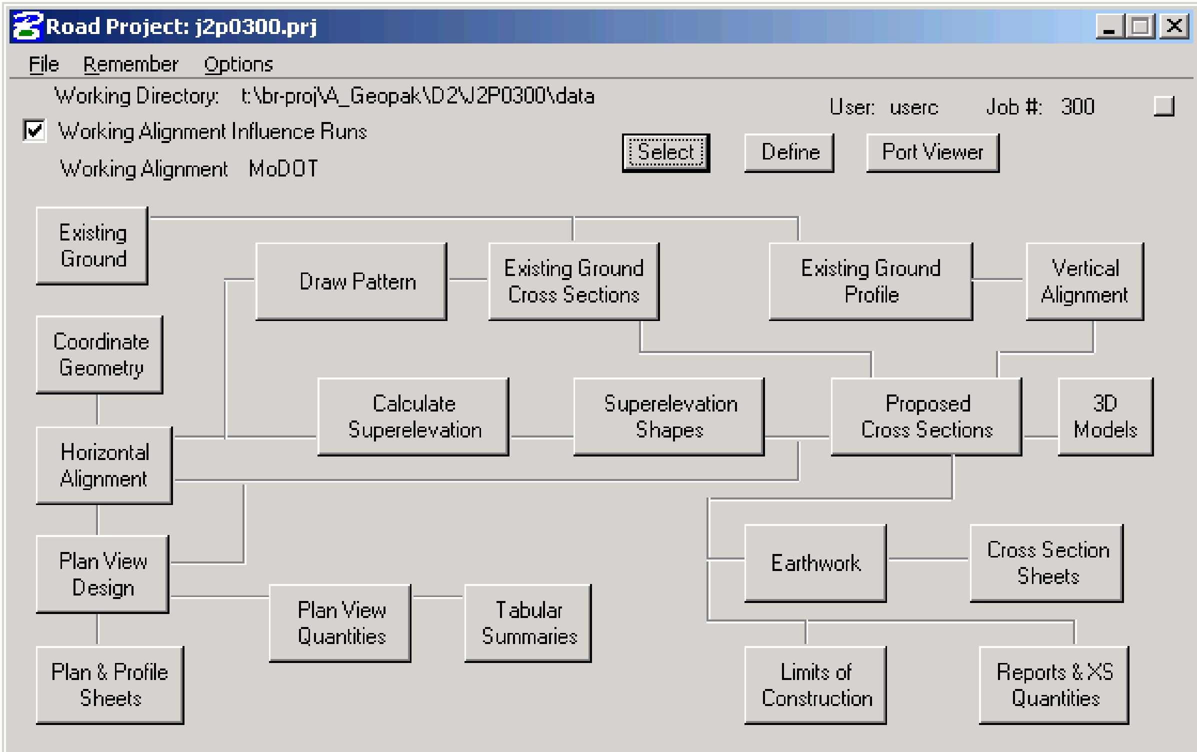
2. Open the project **t:\br-proj\a_geopak\d2\j2p0300\project\j2p0300.prj**.



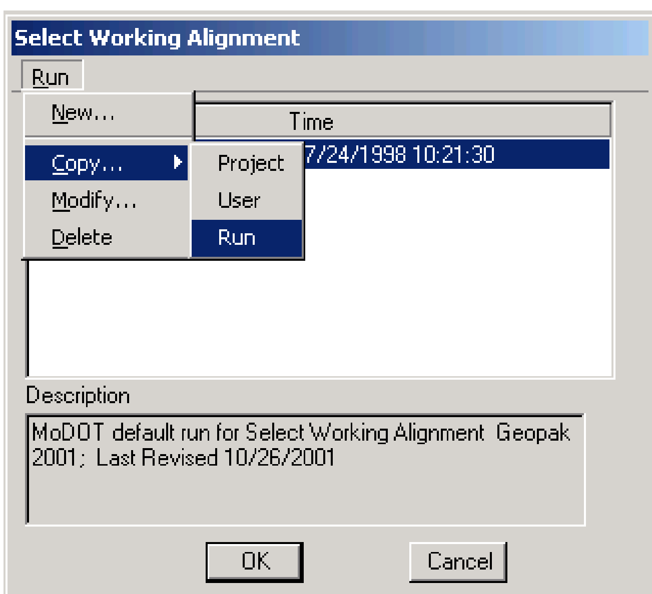
3. Select **userc** as the Project User.



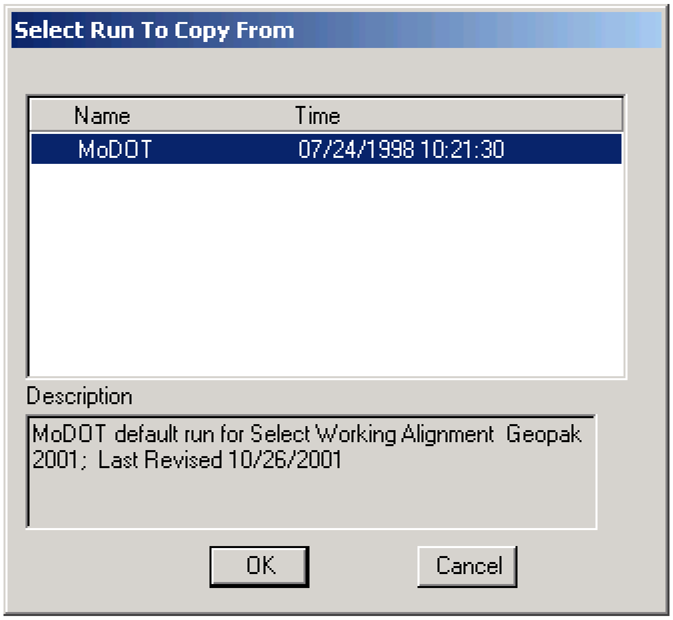
4. Click on **Select** button at the top of the Road Project dialog as depicted below.



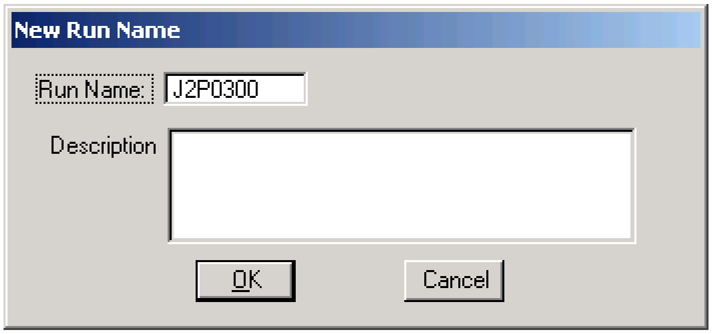
In the Select Working Alignment dialog that appears, select the menu option:
Run > Copy… > Run.



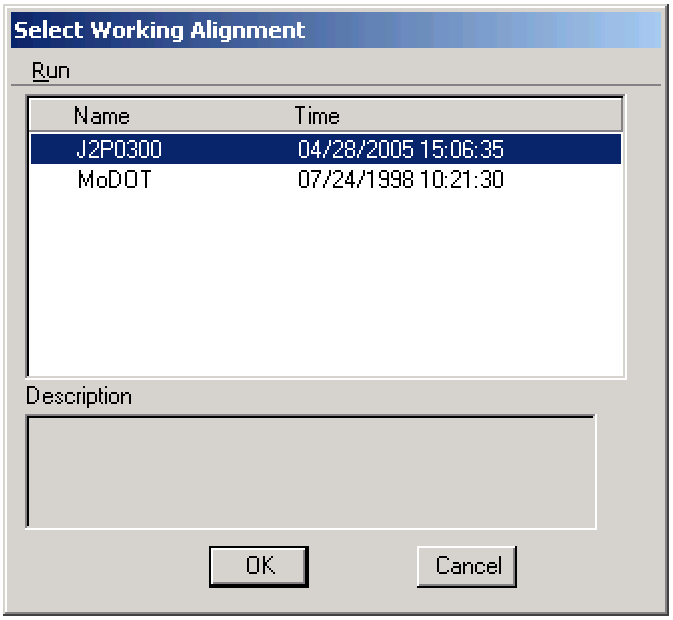
This will display the **Select Run to Copy From** dialog shown to the right. Select the default MoDOT run and click **OK**.



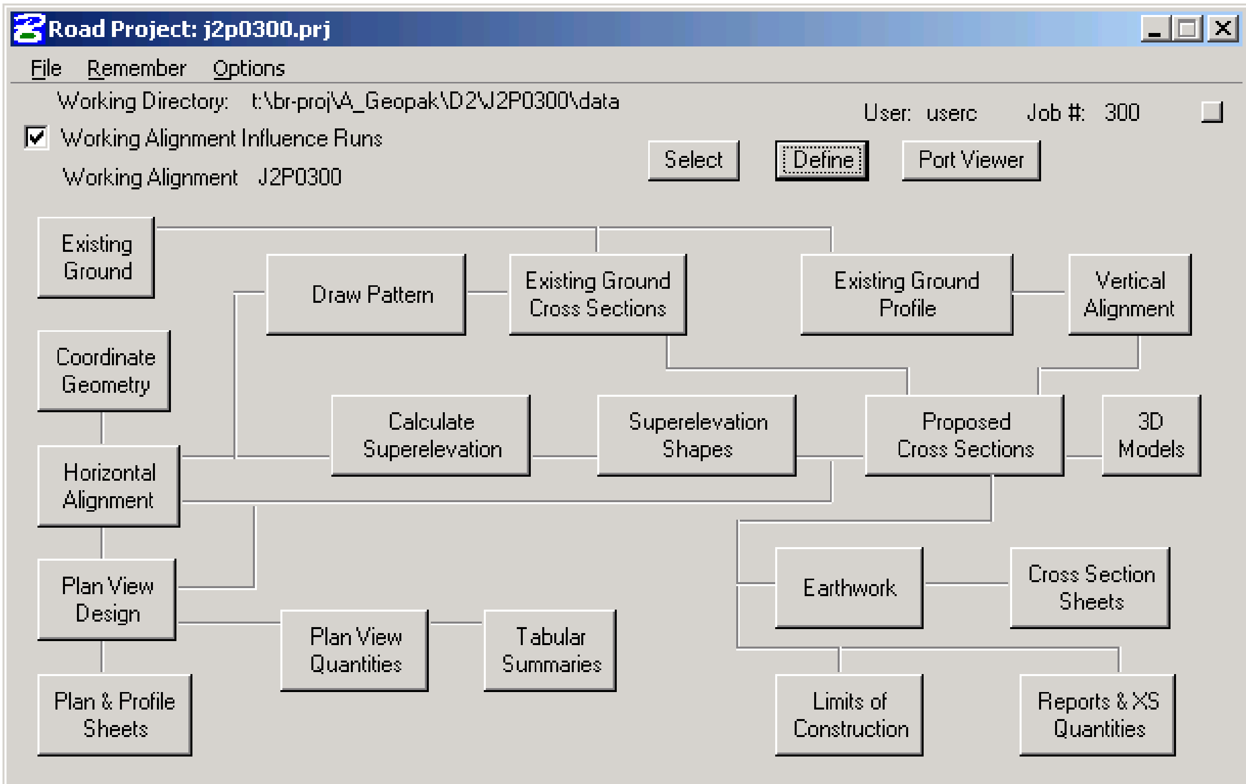
Enter **J2P0300** in the new **Run Name** field as depicted in the figure to the right and click **OK** to create the new run.



Select the **J2P0300** working alignment as shown below and enter the alignment by clicking **OK**.

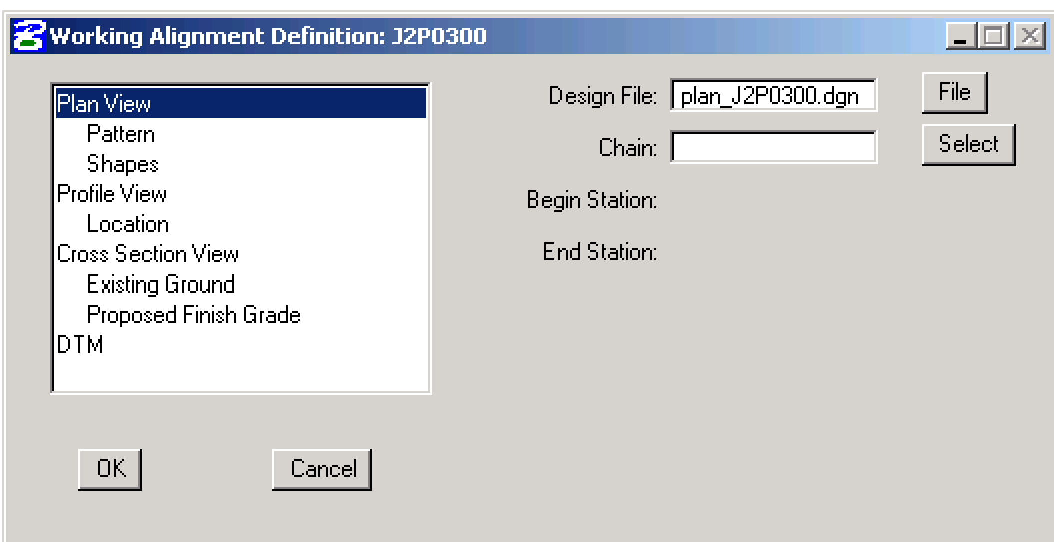


5. Enter the working alignment definition by clicking on the **Define** button to the right of the Select button in the Road Project dialog as shown below.

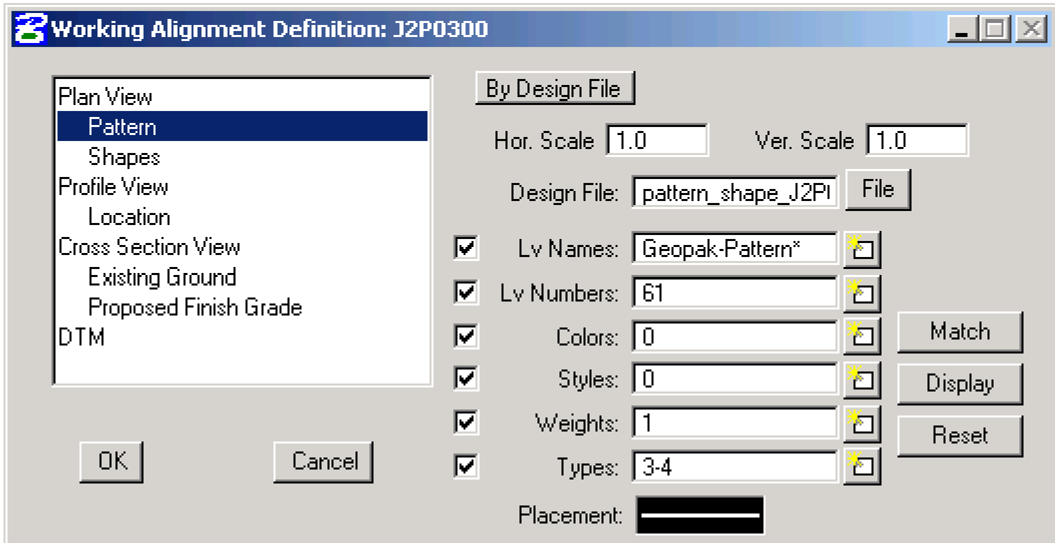


6. Set up the default DGN files for the J2P0300 project as shown below:

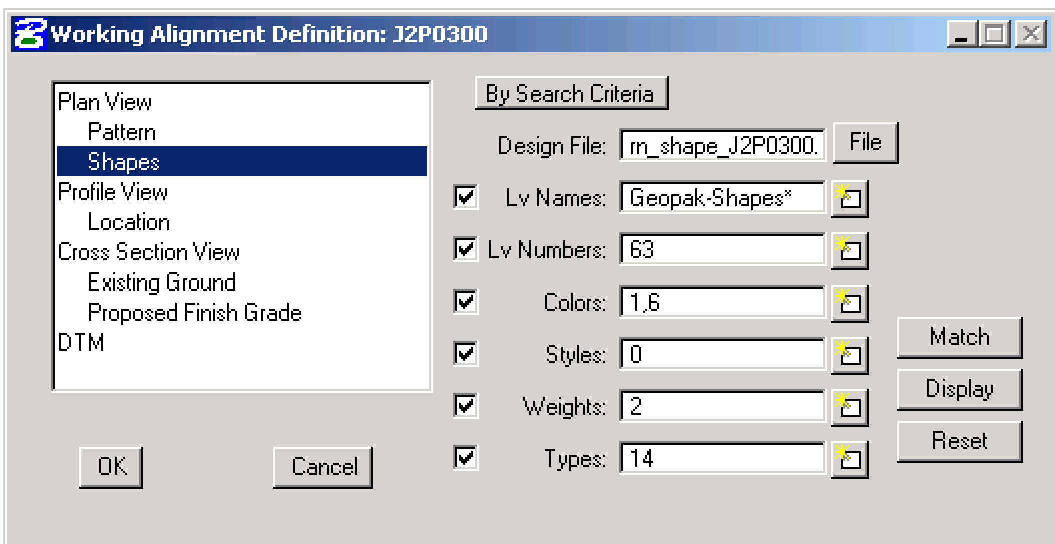
In the **Plan View** section, change the Design File to **plan_j2p0300.dgn**.



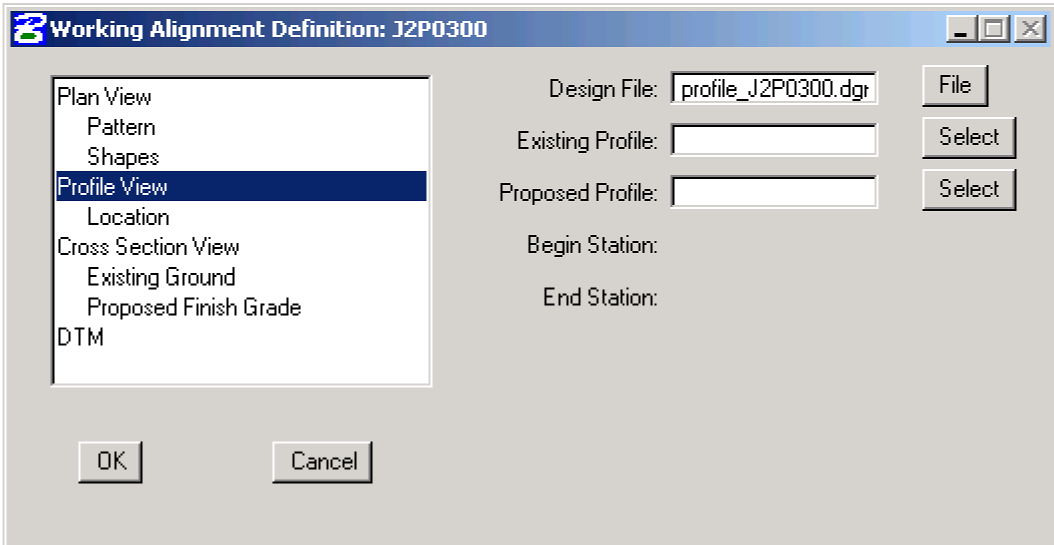
In the **Pattern** section, change the Design File to **pattern_shape_j2p0300.dgn**.



In the **Shapes** section, change the Design File to **pattern_shape_j2p0300.dgn**.



In the **Profile View** section, change the Design File to **profile_j2p0300.dgn**.



Save the changes to the working alignment definition by clicking **OK**. This default alignment for the project will be modified and used as the basis for other parts of the project in later exercises.

Chapter 4

Digital Terrain Modeling

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4.1 Objectives

- Understand Digital Terrain Models (DTM's)
- Learn how to analyze a digital terrain model

4.2 Definitions

A **Digital Terrain Model (DTM)** represents the topography of a project in the form of a triangulation network. The DTM can be drawn in a three-dimensional file, and rotated to see the existing surface of the project area.

Digital Terrain Models can be generated from various sources including MicroStation Elements, survey data, photogrammetry data, **GEOPAK** cross-sections, and geometry data.

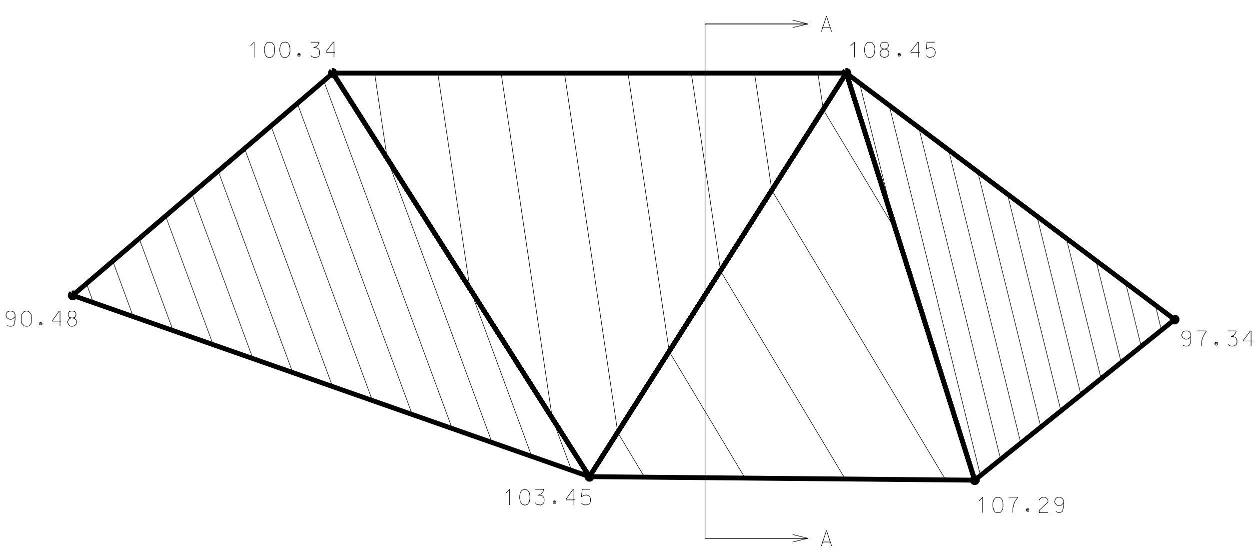
Triangulation is a mathematical process applied to stored elevation points and stored elevations along DTM break lines to create surfaces. The result of triangulations is the creation of a .tin file from which original ground profiles and original ground cross sections can be generated.

Digital Terrain Models (DTM) are made up of a network of triangles. A triangle is used because three points define a particular plane in space. This triangle then represents a slope on the existing ground passing through these three points.

The DTM is made up of several types of elements including points, breaklines, boundary, voids, and islands.

4.2.1 Points

Points represent a particular location with an X, Y, and Z coordinate. Each of these points will represent a vertex on a triangle in the digital terrain model. Below is an example of a digital terrain model made from a set of points.

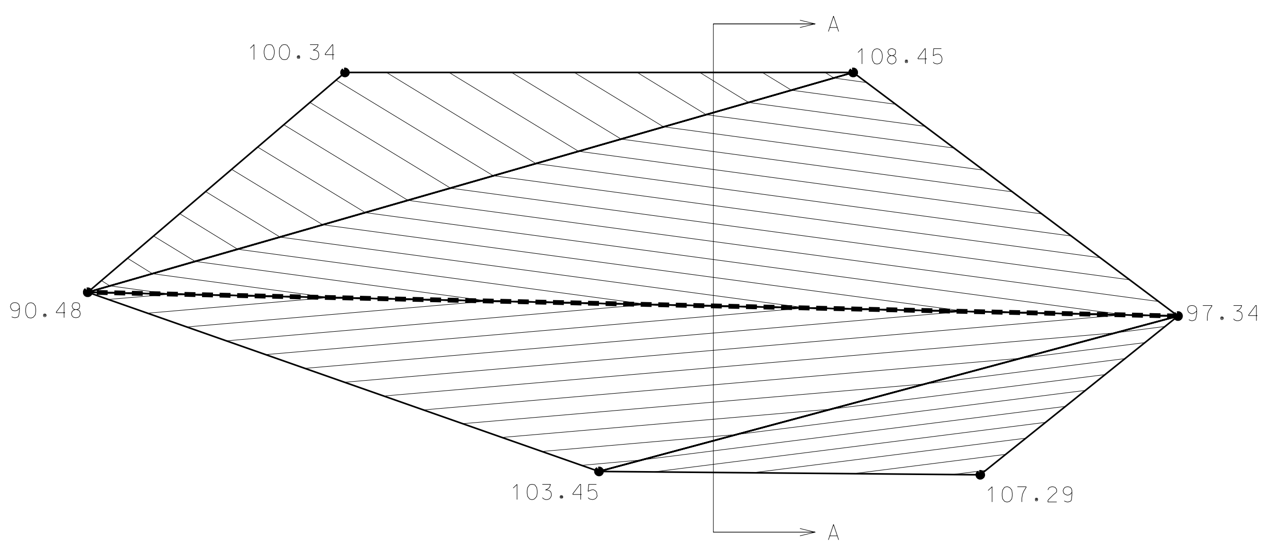


If a section is cut through this digital terrain model at the location A-A, where the elevation of the triangle leg as linearly interpolated between the triangle vertices is plotted along the distance of the section, the section would look as shown in the picture below.

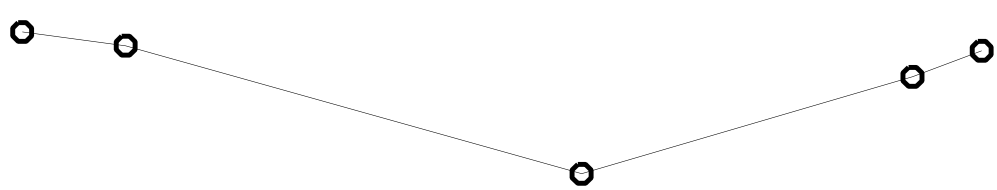
4.2.2 Break Lines

Break lines represent a line along a change in slope. Examples of breaklines may include the edge of shoulder, the toe of a slope, or the flow line of a ditch. A triangle cannot cross a breakline. If a triangle crosses a breakline, it is split into multiple triangles so that no triangle leg will cross the break line, and the triangles adjacent to the breakline will have a leg that lays on the breakline.

Adding a breakline to the same set of points used above will produce the digital terrain model as shown below.



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

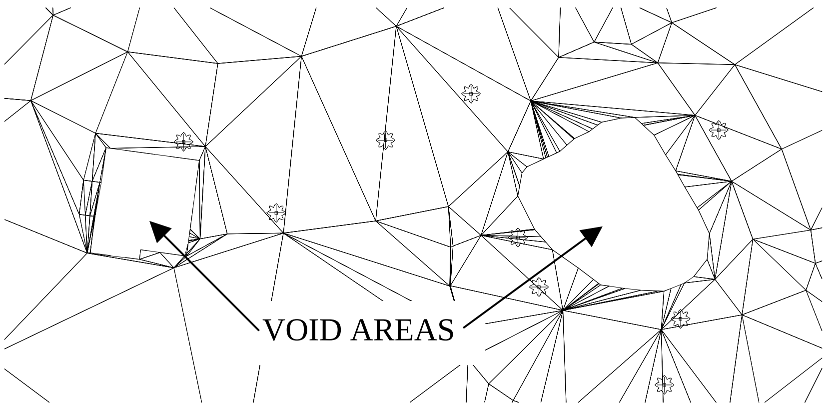


4.2.3 Boundary

A boundary is the maximum external limits a digital terrain model can extend. No triangles will be created outside of this boundary.

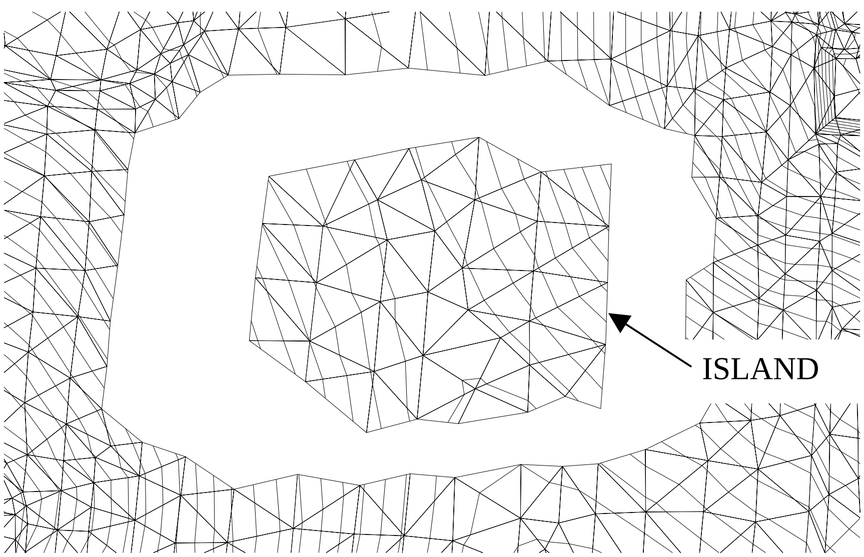
4.2.4 Voids

A void is an area where no contours can pass through. Examples of voids include ponds, lakes, buildings, concrete pads, etc.



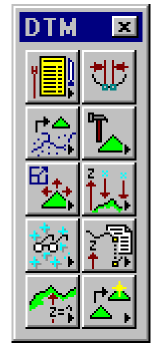
4.2.5 Islands

An island represents an area inside a void that contains contours.



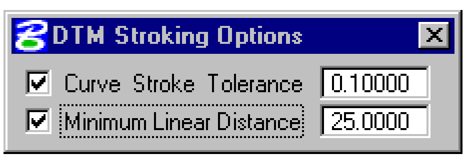
4.3 Accessing

Selecting the Existing Ground push-button from Project Manager or the DTM Tools icon, and selecting a run will bring up the tool palette shown to the right. All of the DTM tools can be accessed from the tool palette or from the DTM menu that can be accessed from the first icon in the tool palette.



4.4 Settings

Two user-defined stroking values need to be defined before graphics can be extracted to create a DTM. Stroking is the process of automatically adding shots to the DTM Input file by interpolating new shots from the linear and curved sections of the data. If the source topography data is mapped in a 3D-design file, stroking may be applied. Stroking is not available if the topography data resides in a 2D-design file.

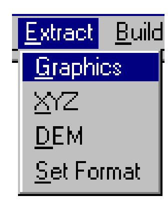


Curve Stroke Tolerance The maximum distance between the arc and the chord used to approximate the arc in the DTM.

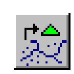
Minimum Linear Distance If a linear segment is greater than the Minimum Linear Distance, points are interpolated and added to the segment such that the distance between the points is not greater than the Minimum Linear Distance.

4.5 Extract Graphics

The Extract Parameters tool translates MicroStation elements into DTM input data. The dialog box shown below can be accessed from the GEOPAK DTM pull down by single clicking **Extract >> Extract Graphics** or from the Extract Graphics icon in the DTM toolbox.



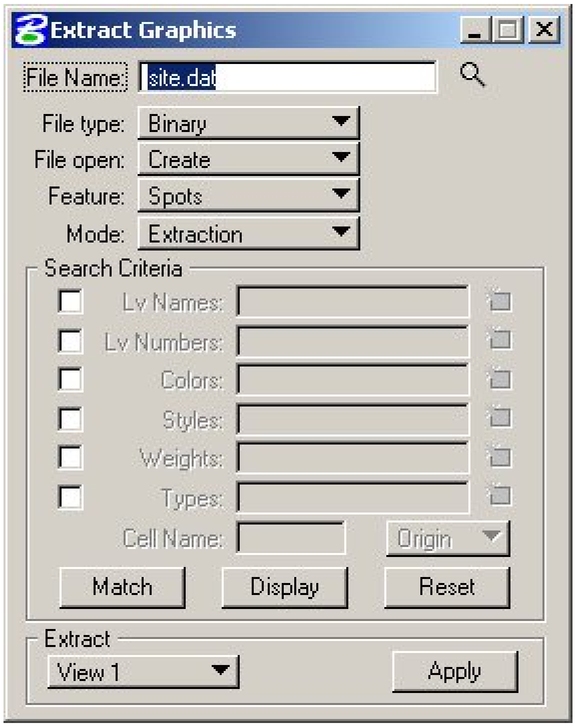
the



File Name specifies the name of the file to be created for storing the input data. If file already exists, it may be found using the **Files** button.

File Type specifies the format of the new file. Either format will produce the same results. The difference between the two is ASCII files can be viewed and edited with a text editor while Binary files process faster. For ASCII files, the number of decimal places can be chosen.

File Open indicates if you are creating a new file or appending data to an existing file.



Feature Type determines the type of feature to extract from a design file.

Spots – random survey points. Can be vertices of a line or line string.

Breaks – designate linear features such as edges of pavements, ditch bottoms, ridges, etc.

Boundary – the external boundary of the digital terrain model.

Contours – for use in extracting digitized or otherwise imported contours.

Void – closed shapes representing an area with no contours. (i.e. ponds, headwalls, concrete pads, etc.)

Islands – an area within a void that contains contours.

Graphic Triangles – for use in extracting triangles from a TIN model that has been otherwise created or imported.

Drape Void – same as void, except uses the elevation from the triangulated model.

Break Void – same as void except edges are inserted as breaklines instead of drapelines.

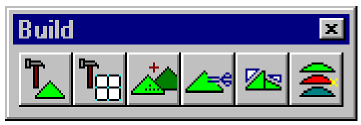
Mode the extraction mode calculates XYZ data directly from the coordinate values of 3D MicroStation elements. The interpolation mode produces XYZ data by interpolating between spot elevations along linear MicroStation elements. This mode works in both 2D and 3D files.

Select Criteria provides ways to specify the features to be extracted. When an "X" is placed in the box next to Levels, the Select box is activated. You may then click the Select button to indicate only those levels you want GEOPAK to search for when extracting data. If the Levels box is not turned on, GEOPAK will search all levels. The same procedure is true for the other criteria selections. The three buttons located at the bottom of the **Select Criteria** group box **Match**, **Display**, and **Reset** will assist you in interactively defining the search criteria.

Extract there are four options for data extraction. **Complex Chain** reads those elements along adjoining MicroStation elements. **Selection Set** uses a MicroStation Selection Set to define elements for extraction. **Fence** will extract all elements within a fence boundary. **View 1** etc. will extract all the elements displayed in the selected view.

4.6 Build

Included under the **Build** pull down and icons are options for creating, manipulating, and merging DTM models.



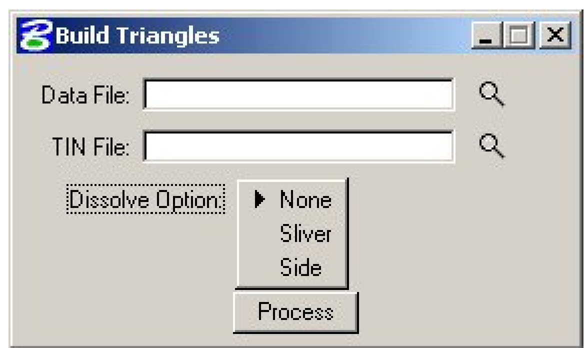
4.6.1 Build Triangles

Build > **Triangles** processes the information stored in a DTM input file (.dat) to create a triangulated model (.tin). The file extension represents a triangular irregular network.

Data File is the name of the DTM input file where the extracted topological features are stored.

TIN File is the name of the file in which the triangulated model will be stored in binary format.

In either of the above cases, you do not have to enter the file extension with the file name and you can always navigate to an existing file using the **magnifying glass** button.



The **Dissolve Option** eliminates external triangles that are not representative of the surface. The three options are:

- **None** – no external triangles are dissolved.
- **Sliver** – long, thin triangles are dissolved.
- **Side** – external triangles whose external side is longer than a user specified length are dissolved. (Recommended Option)

4.6.2 Additional Build Options

Build > **Lattice** creates a grid (**.lat**) that can be draped over the triangulated data (.tin) to create a three dimensional visual display of the topography.

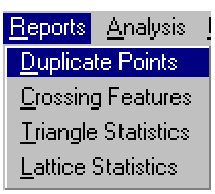
Build > **Merge** allows two triangulated models to be merged together as long as the boundary of one model overlaps the other. This process will create a third model (**.tin**) from the combination of the two existing models.

Build > **Clip** creates a new model (**.tin**) from a clipped portion of an existing model. The area is defined as internal or external to a user defined clip polygon.

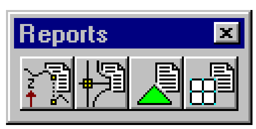
Build > **Pad** defines a pad (such as a building slab) and integrates the pad into the existing terrain with a variety of slope options.

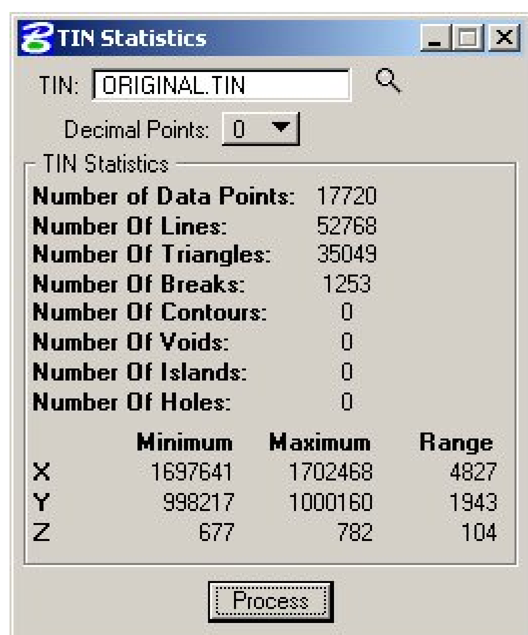
Build > **Delta Surface** creates a new model based on the difference between two other models, or a model and elevation surface. The Z value in the model that is created is equivalent to the difference between the two specified models, or model and surface.

4.7 Reports



The options under the **Reports** pull down and icons include a way to check for duplicate points or crossing breaklines, and the ability to generate statistics associated with a **.tin** file.



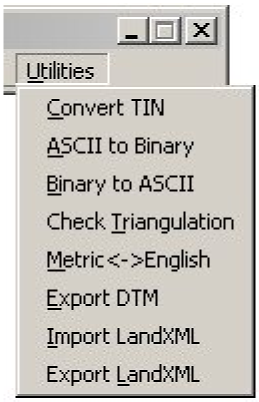


Duplicate Points – reports points with the same x and y coordinates.

Crossing Features – reports intersecting breaklines or contours.

Triangle Statistics and Lattice Statistics - displays a summary indicating the total count of each element type and minimum and maximum X, Y, Z ranges for the specified **.tin** or **.lat** file.

4.8 Utilities



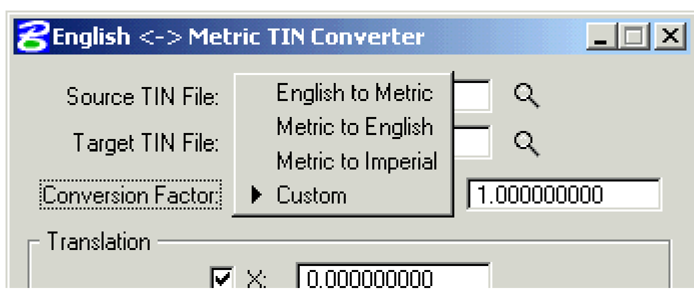
Options under the **Utilities** pull down and icons include a way to check the validity of a triangulated file, converting triangulated files from previous versions of GEOPAK, converting the DTM data file between ASCII and binary format, converting the DTM from English to Metric, and exporting a TIN to Trimble DTX model or Leica GSI model.

Convert TIN – permits the conversion of a triangulated file from a previous version of GEOPAK to a GEOPAK 98 format.

ASCII to Binary and **Binary to ASCII -** permits conversion of the DTM input file (**.dat**)

Check Triangulation - starts an internal process that verifies the integrity of the triangulated file. A message will appear indicating "Triangulation Valid".

Metric <-> English – converts a file from English to Metric units, or from Metric to English or Imperial units. A custom scale factor can also be used. The DTM can also be translated or rotated. If translation or rotation is desired without scaling, a Custom scale of 1.0 can be used. This process will create a new DTM file.

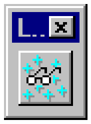


Export DTM – uses a LAT or TIN to create files suitable for GPS controlled construction equipment. This tool supports both Trimble and Leica file format.

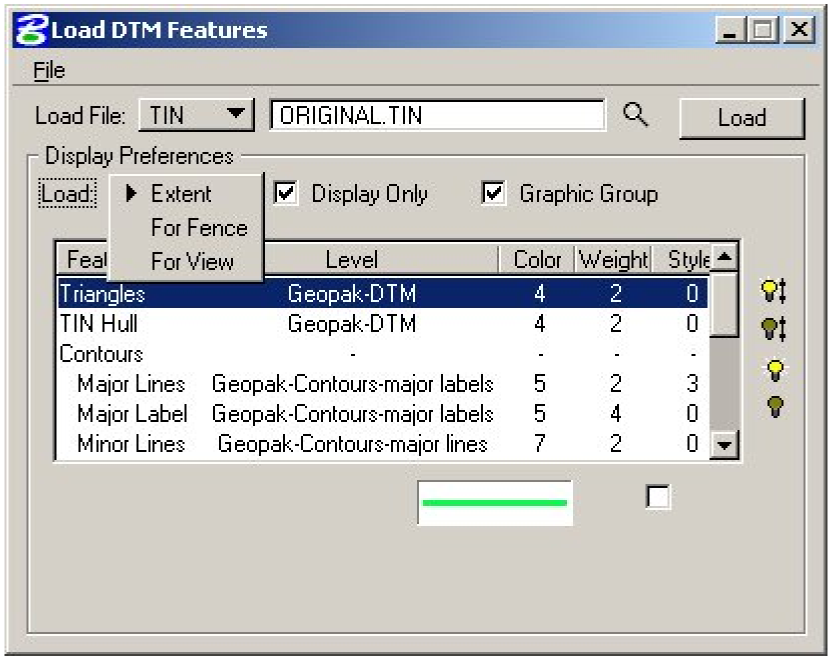
Import LandXML - uses a LandXML file to create a DAT readable by the various DTM tools.

Export LandXML – uses a TIN file to create (or append to) a LandXML file, suitable for import into external programs

4.9 Load

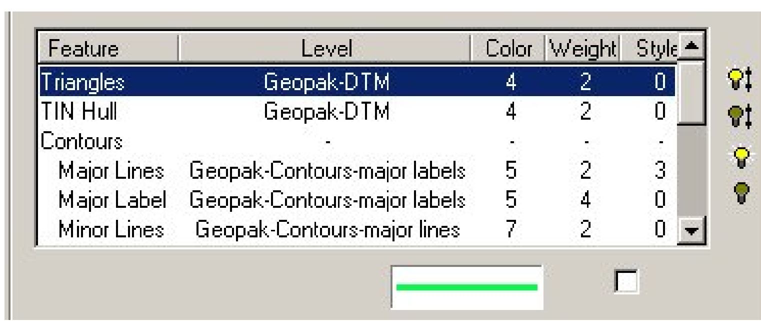


Load is the process by which we can visualize the DTM data, the TIN model, the lattice model, and the contours. By clicking on **Load** >> **DTM Feature**, or by clicking on the icon, the following dialog will appear.



The user can choose to load the DTM data (.dat), the TIN file (.tin), or the lattice file (.lat). Each of these files can be loaded for the model extents, within a fence, or within a window.

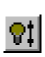
Toggling on **Display Only** will allow the user to view the elements without writing them to the MicroStation file. Conversely, toggling **Display Only** off will store the viewed elements as MicroStation elements. If **Display Only** is on, updating the active screen will clear the display of these elements. When **Display Only** is off, the elements can be placed as a graphic group using the **Graphic Group** toggle.



The user can set what data to visualize, the symbology, and the contour interval (if **Contours** is turned on).

The default MoDOT symbology to visualize DTM items is stored in a preference file. To load the file into dialog box, go to **File** >> **Open** and navigate to **t:\gpk_std\DTM\ MoDOT.lpf.**

 Will turn on all items.

 Will turn off all items.

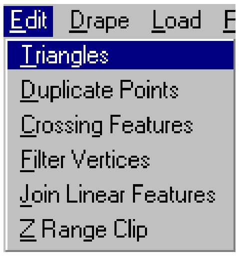
 Will turn on only the selected item.

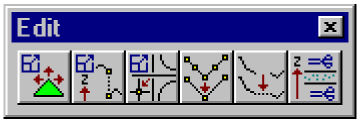
 Will turn off only the selected item.

4.10 Other Pull Down Menus

4.10.1 Edit

The **Edit** pull down provides the ability to edit the digital terrain model.





Triangles - Allows the user to add, delete, or modify triangle vertices, triangle legs, and breaklines.

Duplicate Points – Reports and allows interactive editing of points in a survey data file with the same X and Y coordinates.

Crossing Features – Reports and allows the correction of crossing breaklines.

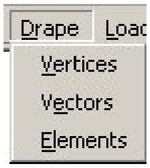
Filter Vertices – Reduces the amount of vertices by deleting the vertices based on a user specified distance.

Join Linear Features – Allows the user join two linear features into one feature.

Z Range Clip – Deletes information from the survey data file (**.dat**) based on given elevation information.

4.10.2 Drape

GEOPAK provides three tools for draping MicroStation elements onto a triangulated model, vertices, vectors and elements.



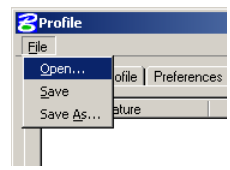
4.10.3 Analysis

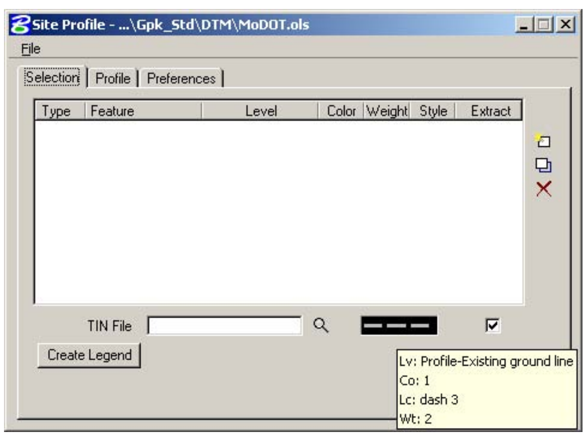
The **Analysis** tools allow the user to view the digital terrain model through many different methods such as a profile, themes, and drainage.

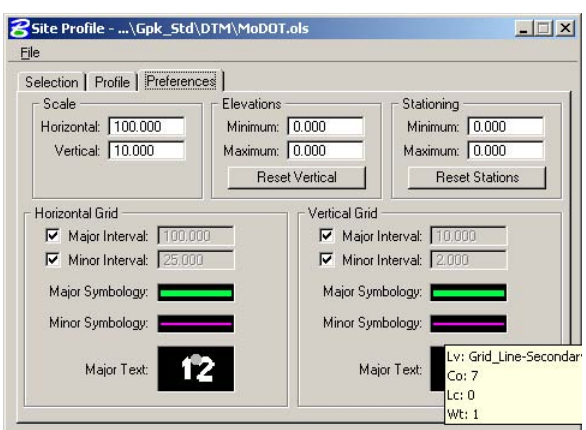
Height – Show the user the x, y, and z coordinates and the slope of a given data point. The contour at that elevation, the triangle the point lies within, and the direction of flow can be displayed.

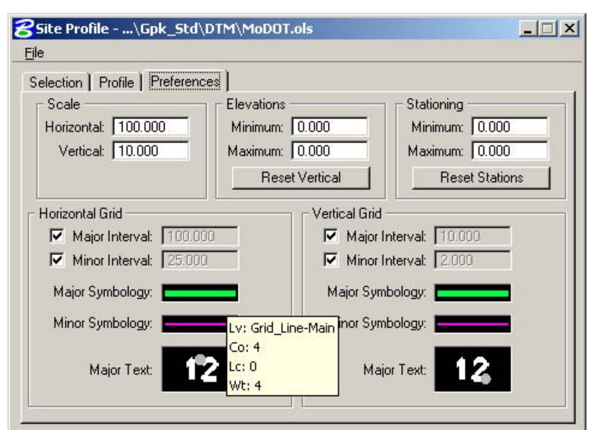
Profile – Will display the profile of the digital terrain model between two points.

To set up the Profile tool preferences according to CADD Standards, the user will need to load the file **MoDOT.ols** set up by CADD support, which is located under **t:\gpk_std\DTM\.** This file will set up the element attributes in the selection and preferences tab.









Volumes – Will calculate the volume between two TIN models, the volume between a TIN model and a plane, or the cut and fill totals between two TIN models.

Elevation Differences – Will display the elevation difference, or the amount of cut and fill between two TIN models, or a TIN model and a plane.

Slope Area – Displays the slope area of a TIN model, or a portion of a TIN model.

Themes – Displays the digital terrain model based on different user definable themes such as, elevation ranges, slope percentage, slope degree, or aspect.

Drainage Tools – Allows a user to display and analyze drainage patterns with in a TIN model. Tools include delineating watersheds, drawing flow arrows, determining upstream and downstream traces, and finding high and low points.

Visibility – Displays lines of sight (which triangles can and cannot be seen), or what is visible between two specified points.

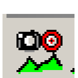
Trace Slope Path –Traces a path along a TIN file, or if site modeler is active, a site model or object.

Trench Volumes – Using pipes from a Drainage project and / or Water Sewer project, this tool uses a TIN file (and optional offset) to compute trench and bedding volumes.

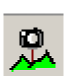
For more information on these items, see the *GEOPAK Help* **Applications > GEOPAK Road > Help**.

Camera – Supports a wide variety of tools and options to view Digital Terrain models within a MicroStation 3D file.

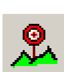
Once a 3D model has been created in Geopak, the ***DTM Camera Tools*** shown to the left can be used to create a drive or fly through of the project.



Before a fly through can be created, the camera and targets must be set using the **Locate Camera and Target Tools**. This is done by setting two data points, the location of the camera and the target view. Once both the camera and targets are set, the next two tools in the pallet can be used to adjust them individually.



Locate Camera Tool

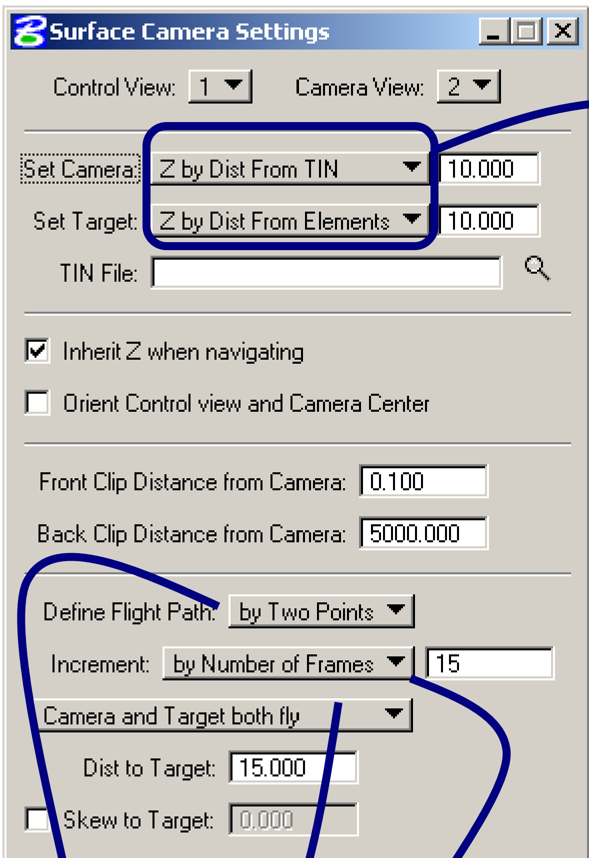


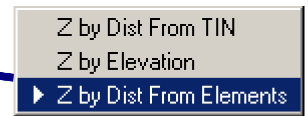
Locate Target Tool

The **Fly Path** Tool  allows the user to start the fly through once all the **Surface Camera Settings**  are defined.

The **Surface Camera Settings** dialog is shown below.

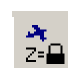
Control View and Camera Views should be set to MicroStation view 1 and view 2 respectively. The Control View is typically a top view, which is used to define the camera and target locations



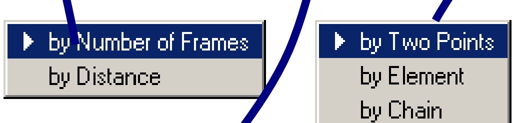


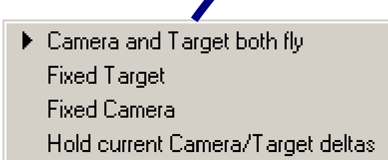
The user can set the camera and target elevation based on a distance from TIN elevation, by a fixed elevation or by a distance from the elements. This distance above the elements determines the perspective of the model.

The **Inherit Z when navigating** and the **Orient Control view and Camera Center** can be toggled on/off as preferred by the user.

The **Inherit Z when navigating** can be turned on/off from the icon on the DTM Camera Tools 

The **Front Clip Distance from Camera** sets the distance (in working units) from the camera to the front clipping plane. If this is set to zero, the front clipping plane is set at the camera origin. The **Back Clip Distance from Camera** controls the distance (in working units) from the camera to the back clipping plane.





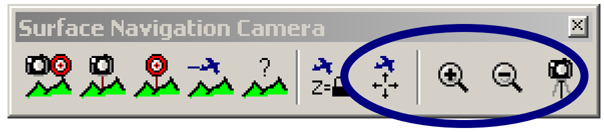
The rest of the settings in the dialog are used for the fly path, which can be defined by two data points, a graphic element or a chain.

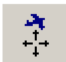
The increment determines the distance between each step of the flight along the flight path.

The last options shown to the left determine whether the camera and target are stationary or moving during the flight.

The Skew to Target toggle can be turned on or off.

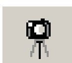
The last four icons on the tool bar are used for camera navigation. The icons are listed below.



 Navigate camera

 Zoom Camera Out

 Zoom Camera In

 Display More Camera Settings

Exercise 4-1

This is a group exercise to present several GEOPAK Digital Terrain Modeling (DTM) tools.

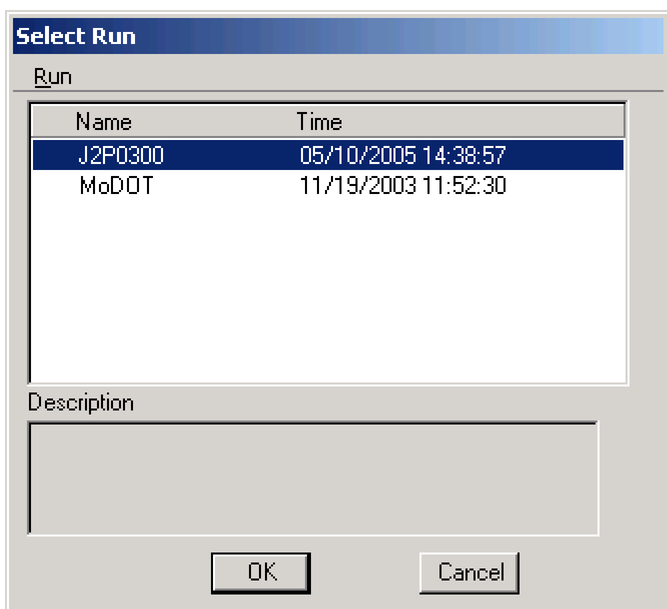
1. Open the Microstation file **t:\br-proj\a_geopak\d2\j2p0300\data\topo_j2p0300.dgn**.

2. Open the project **j2p0300.prj**. Enter the project as user **userc**.

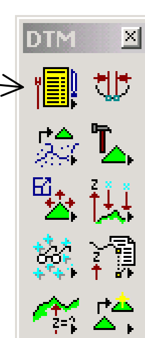
3. Make sure that the Working Alignment is **J2P0300**.

4. Select **Existing Ground** from the upper left corner of the Road Project dialog flow chart.

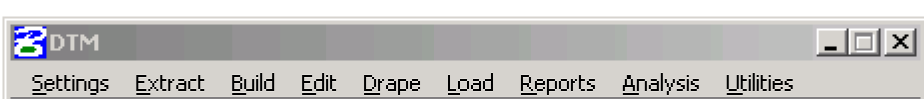
Copy the **MoDOT** run to **J2P0300**, and open the **J2P0300** run. This is the same **Run > Copy… > Run** process used in creating a new working alignment. GEOPAK uses runs to keep track of specific dialog and tool settings. A run allows the user to repeat a task without having to reenter all of the needed information.



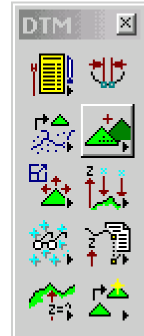
This icon opens the menu bar.



The DTM tools for the following steps may be accessed from either the toolbox shown to the right or the DTM Menu bar depicted below.



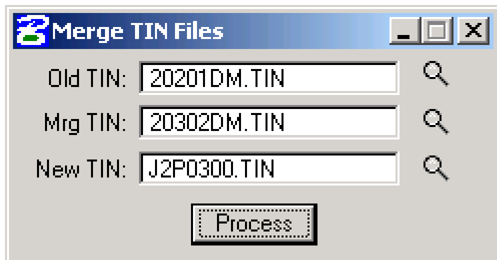
5. Use the **Build Merge TINs** tool (DTM menu path **Build > Merge TINs** or the raised icon shown to the right) to merge the **20201dm.tin** with the **20302dm.tin**.



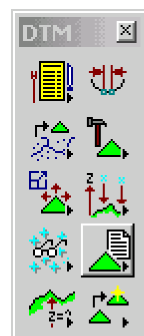
To do this, set **20201dm.tin** as the **Old Tin** and **20302dm.tin** as the **Mrg Tin**. You can either type in the TIN names or use the **Files** button to select the TINs.

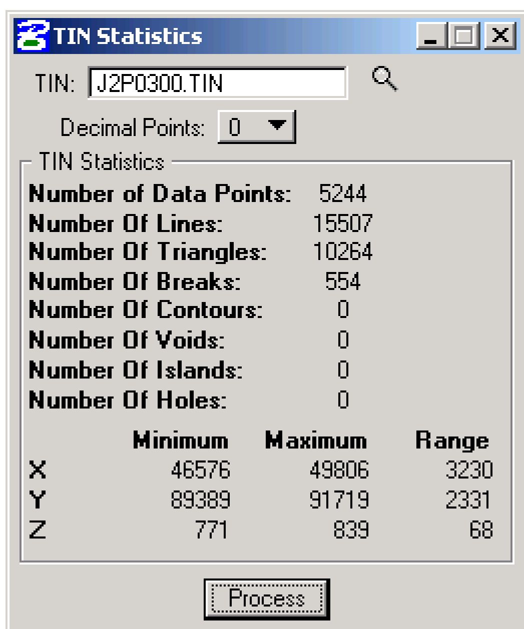
Set the **New Tin** to **J2P0300.TIN**. This needs to be typed since this file needs to be created. This Files button is used only if the already exists.

Click on **Process** to initiate the merge tin process.

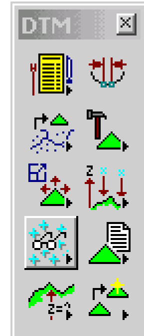


6. Check the **Triangle Statistics** (DTM menu path **Reports > Triangle Statistics TINs** or the raised icon shown to the right) of the tin file **j2p0300.tin**. Use the **Files** button shown below to select the TIN or type its name into the field. Select the **Process** button to calculate and report the TIN statistics.



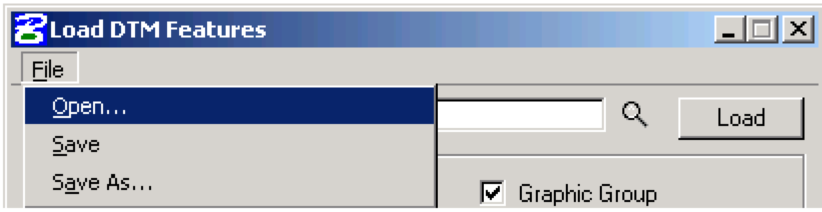


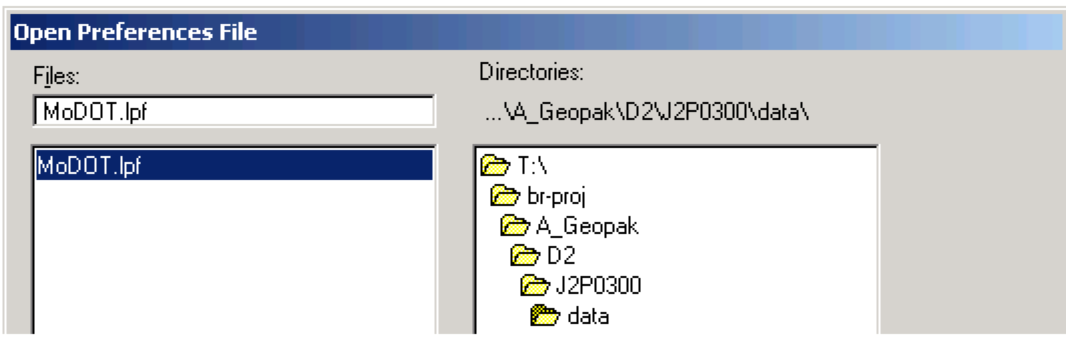
It is a good idea to check the statistics for any new DTM to make sure that its information matches the known project data. The minimum X and Y values can be used to set the custom coordinates for a MicroStation file created to display the DTM.



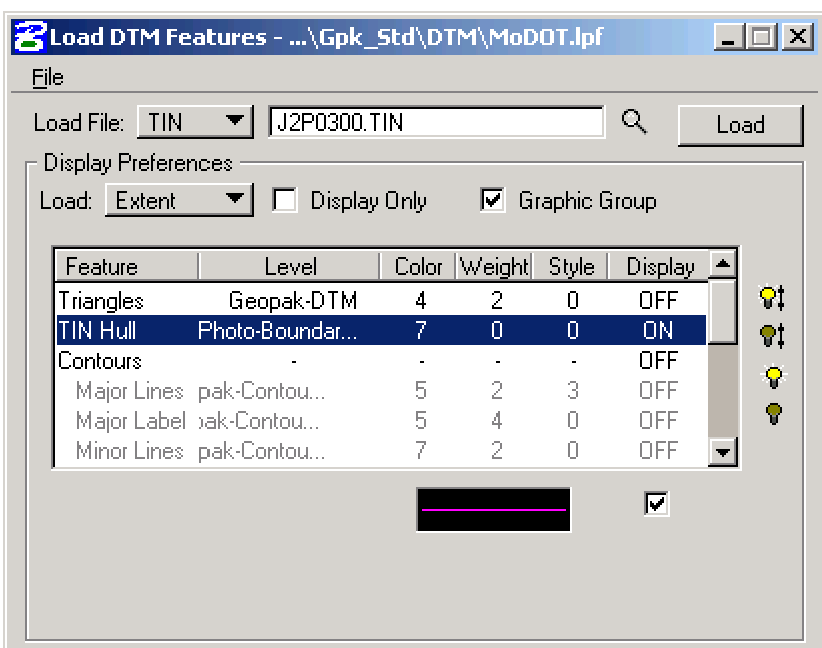
7. Open the **Load DTM Features** dialog (DTM menu path **Load** > **DTM Feature** or the raised icon shown to the figure to the right).

   To load the MoDOT preferences, select **File** > **Open** in the **Load DTM Features** dialog and select the file: MoDOT.lpf in the working directory, as shown below.





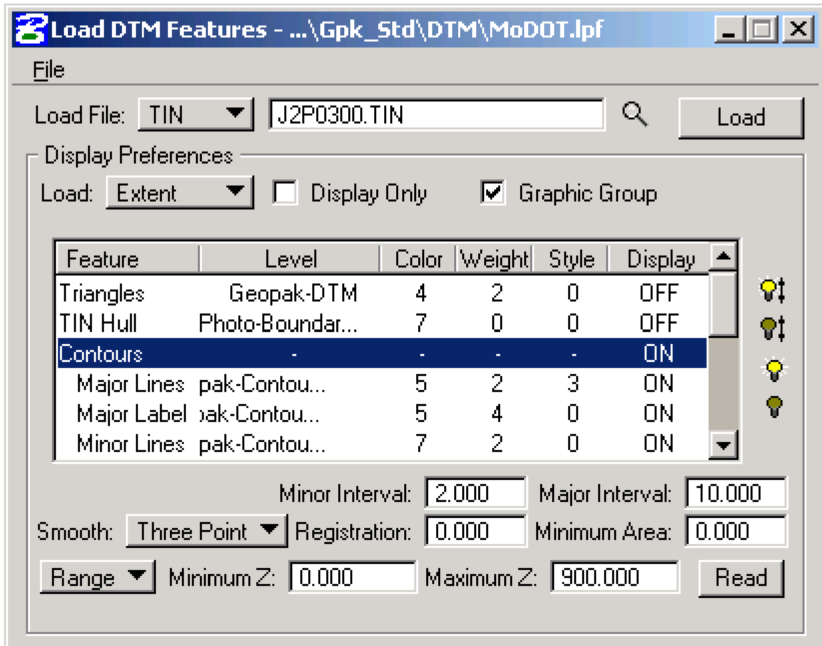
   Set the **Load File** to **TIN** and the file to **J2P0300.TIN**. Load the Tin Hull as a **Graphic Group**, by setting up the dialog as shown below. (See the manual for instructions on how to use the “light bulb” icons to toggle an items Display on and off.)



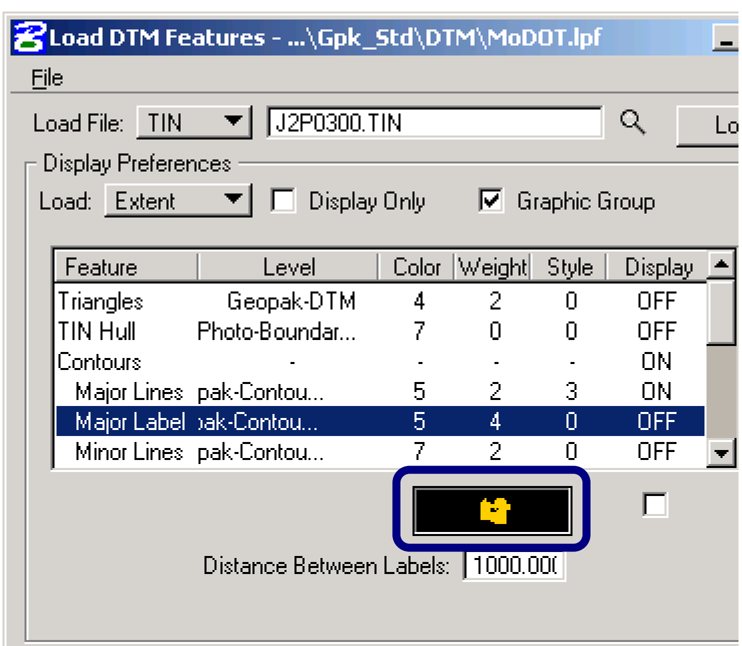
   Fit the MicroStation view so you can see the boundary of the TIN model.

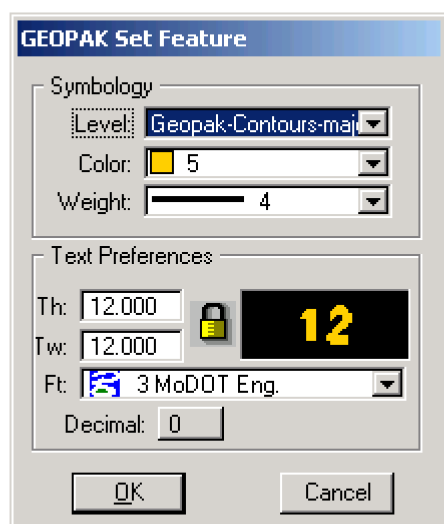
8. Turn **off** the **Tin Hull** and **turn on** the **Contours**, **Major** and **Minor Lines**, and **Major Label** items.

   With the Contours line highlighted, set the following parameters:
   Minor Interval: **2.000**
   Major Interval: **10.000**



   Switch to the **Major Label** line. Set the **text** size to **12** by double-clicking on the preview window outlined below. Set the **Distance Between labels** to **1000**. **Load** the contours as a **Graphic Group**.



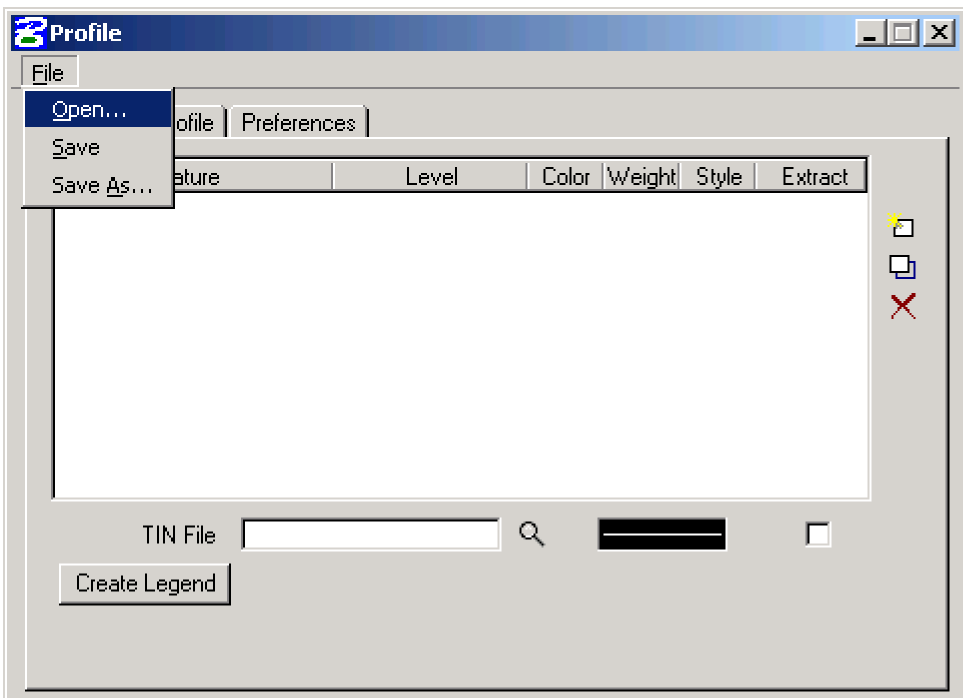


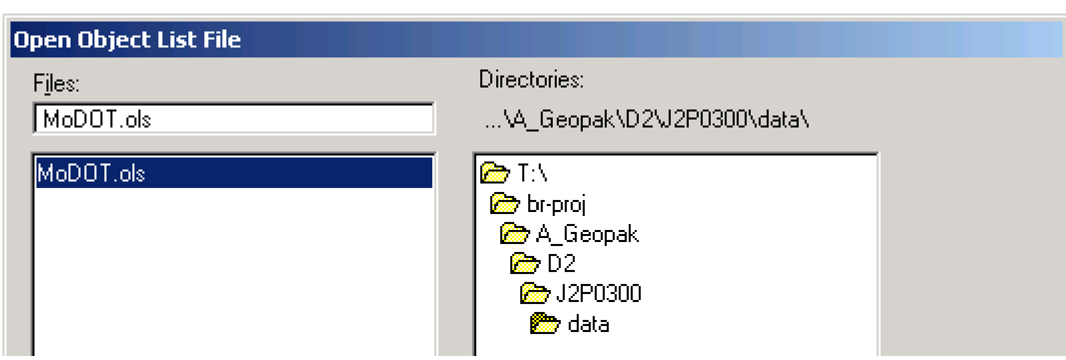
9. Close **Load DTM Features** and **save changes** to the MicroStation drawing.

10. **Turn on Level 22**. It contains a line indicating the location of an upstream valley section.

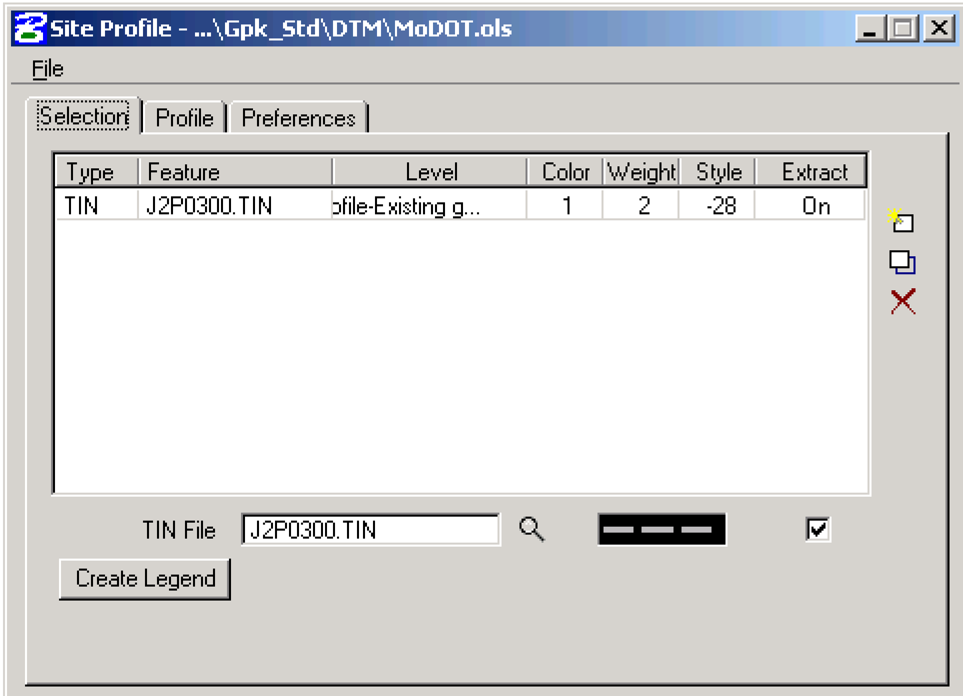
Open the **Site Profile** tool. It can be opened by going to DTM pull down menu item **Analysis > Profile** or clicking on the second icon in the Analysis tool box, which is depicted below and is the tool box in the lower left hand corner of the DTM tools pallet.

The Site Profile dialog is shown below. Go to **File > Open** and select the file **DOT.ols** in the working directory to load the settings in the Object List File.

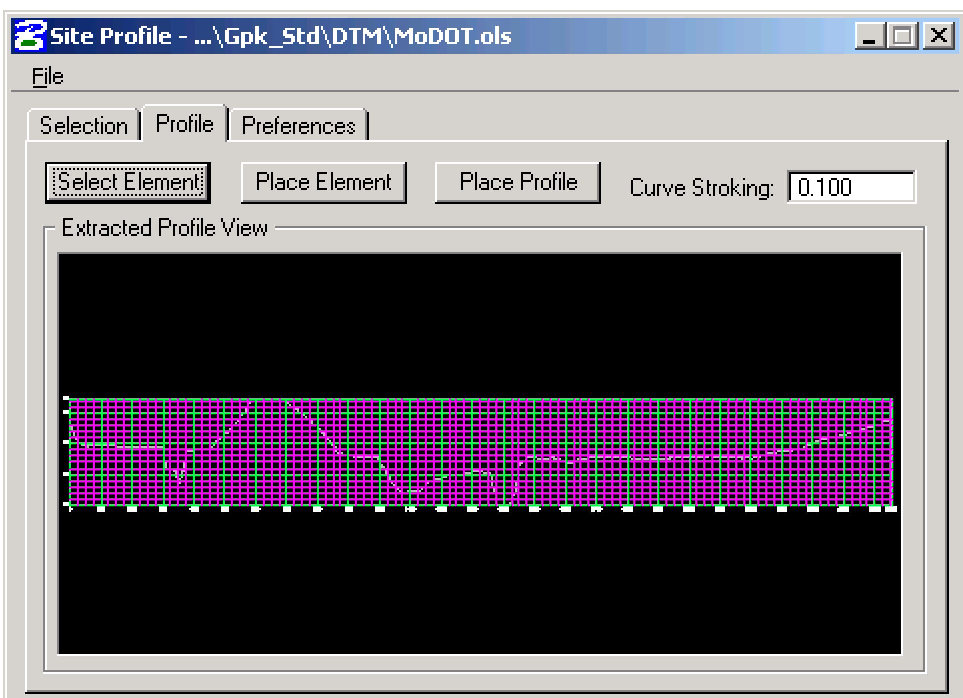




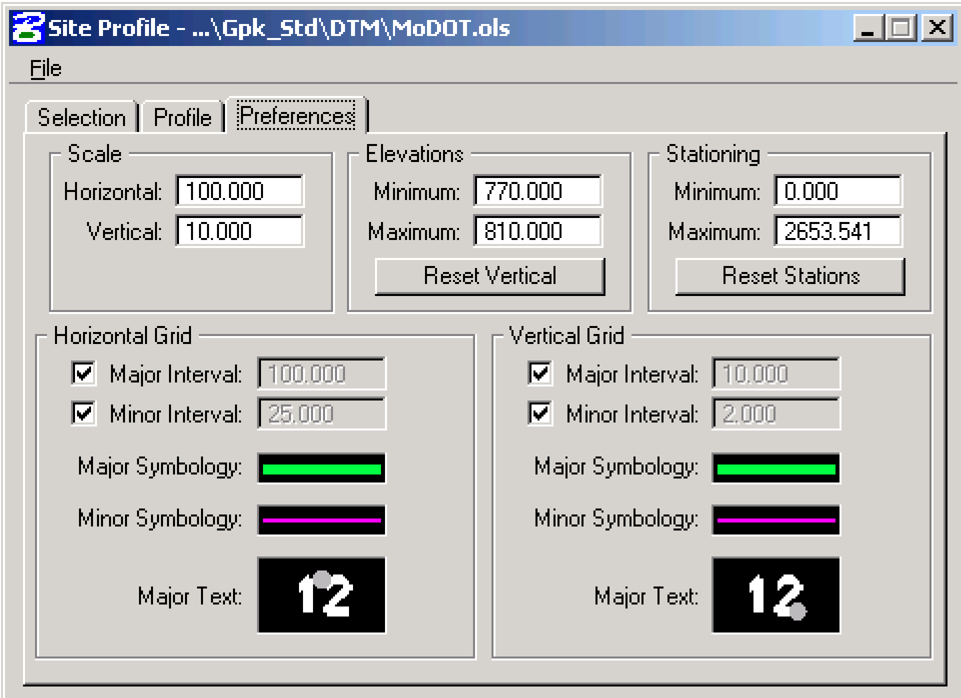
11. Under the **Selection** tab, **add** the **J2P0300.TIN** to the list by clicking on the icon to the right of the **Tin File** field and clicking on the **Add List Item** icon: . Once the TIN has been added to the list, the list area should look like the following:



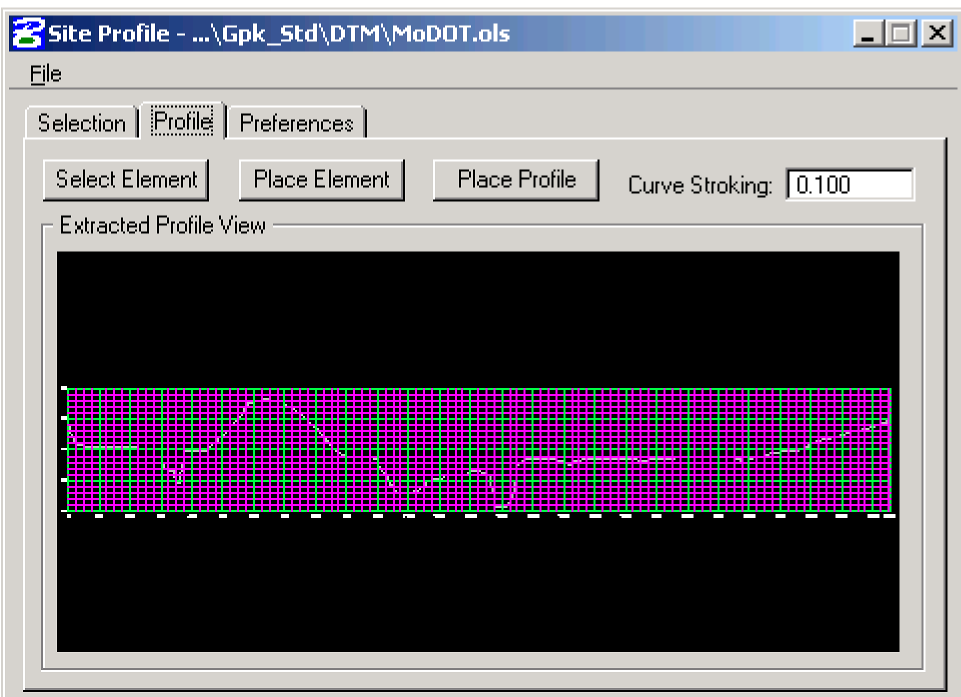
12. Under the **Profile** tab, click on **Select Element**. Data point on the line locating the valley section and accept. This will place the valley section in the dialog, as shown below.



13. Under the **Preferences** tab, modify the preferences for the grid to the settings shown below. Because the OLS file was opened only the **Minimum** and **Maximum Elevations** need to be set so that the vertical grid starts and stops at values rounded to the vertical scale of 1”=10’.



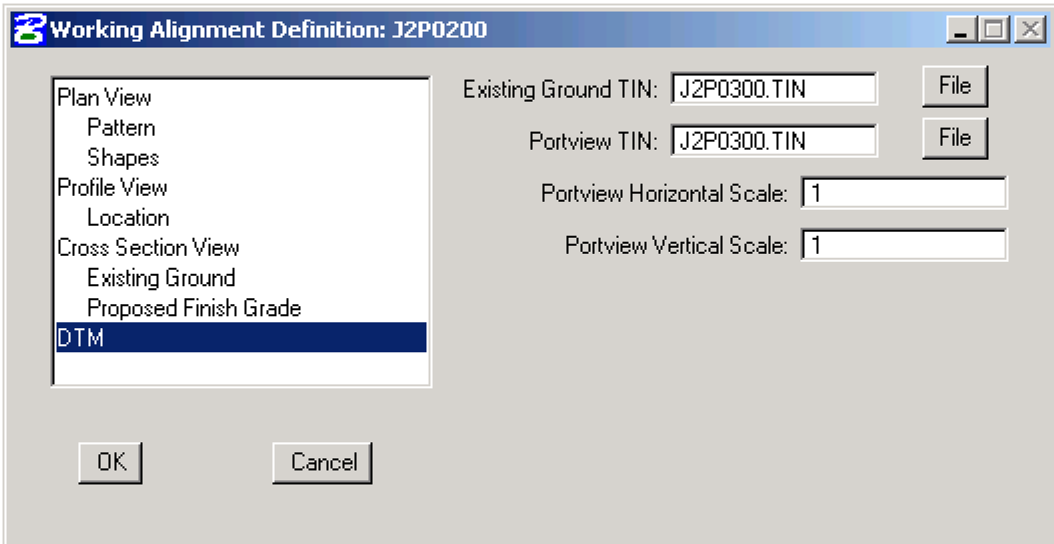
14. Return to the **Profile** tab. The dialog should look similar to the one shown below.



Navigate to a blank area of the MicroStation drawing. Click on **Place Profile** in the Site Profile dialog and place the profile in the MicroStation file.

15. Close all **DTM dialogs** and **save changes** to the MicroStation drawing.

16. Return to the Road Project dialog by selecting the **Project Manager Icon** in the Road toolbox. Click on the working alignment **Define** button. Go to the **DTM** section and set both the **Existing Ground Tin** and **Portview Tin** to **J2P0300.TIN** as shown below.



Click the **OK** button and **Exit Project Manager**.

Chapter 5

Coordinate Geometry

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5.1 Objectives

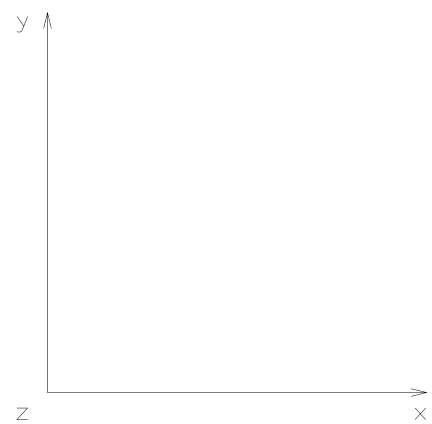
- Learn to set up and access the coordinate geometry database.
- Become proficient in using Geopak Coordinate Geometry.

5.2 Definitions

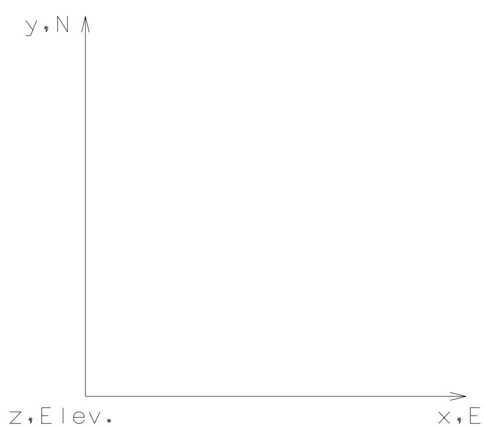
Coordinate Geometry (COGO) is a method of using XYZ coordinates to store geometric elements such as points, lines, curves, spirals, chains, parcels, and profiles. The **Coordinate Geometry** dialog box is an interactive graphical user interface for storing coordinate geometry elements.

5.2.1 Coordinate System

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



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



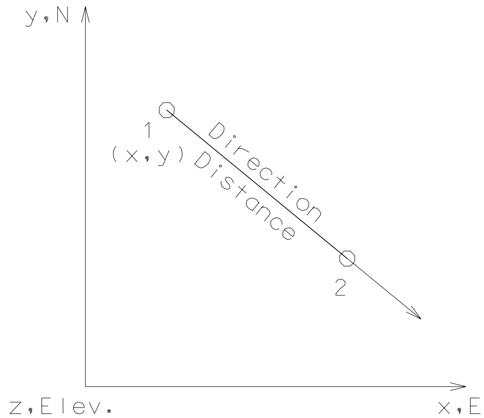
The user must be aware of the coordinate system the data is in, and the coordinate system that GEOPAK is using. When referring to the **XYZ** coordinate system, the coordinates are listed as **(X, Y, Z)**. When referring to the **Northing, Easting, Elevation** coordinate system, the coordinates are listed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

5.2.2 Points

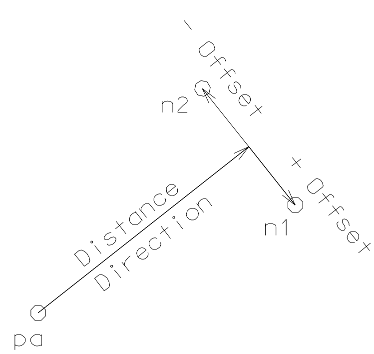
Points are defined by a single set of coordinates. Each **point** will have an X and a Y coordinate. The point may also have a Z coordinate if an elevation is defined.

Point names are alpha-numeric. If alphabetic characters are used, they must come before any numeric characters. The **point** name must contain at least 1 numeric character at the end of the name. Names can be up to 9 characters in length, although limiting the name to 8 characters is recommended.

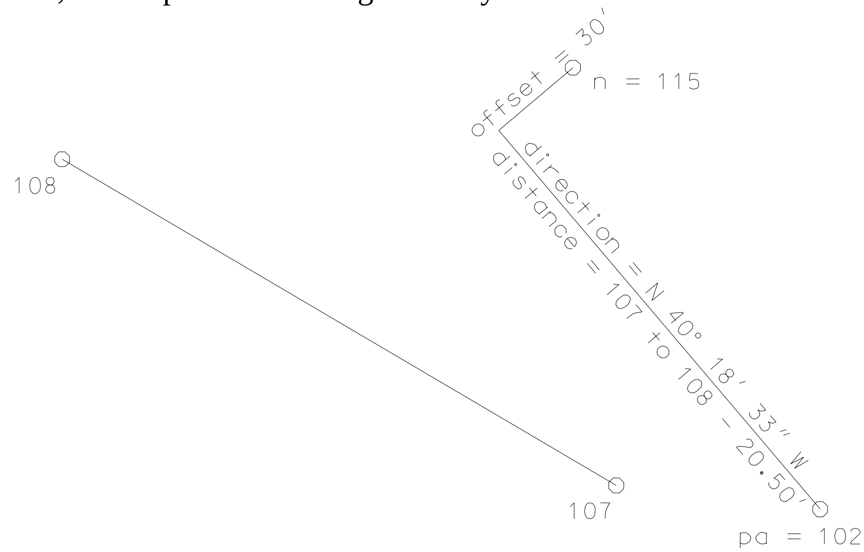
Points can be stored from a set of coordinates, or located from other elements. To define a point from another point, a distance and direction need to be defined.



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



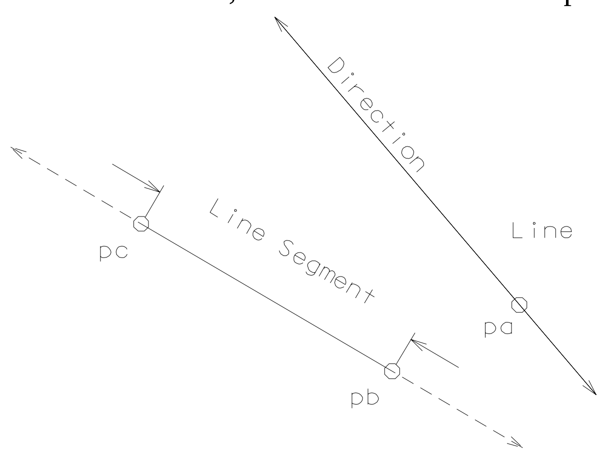
Distances and directions can also be found mathematically. Values can be added, subtracted, multiplied, divided, or computed with a trigonometry function



loc 115 trav 102 dis 107 to 108 m 20.50 n 40 18 33 w off 30

5.2.3 Lines and Line Segments

Lines are defined by a location point and a direction, and are infinite in length. **Line Segments** are a portion of a line that is defined by a beginning and an ending point. **Line Segment** names can be alpha-numeric up to nine characters, but cannot be numeric-alpha.

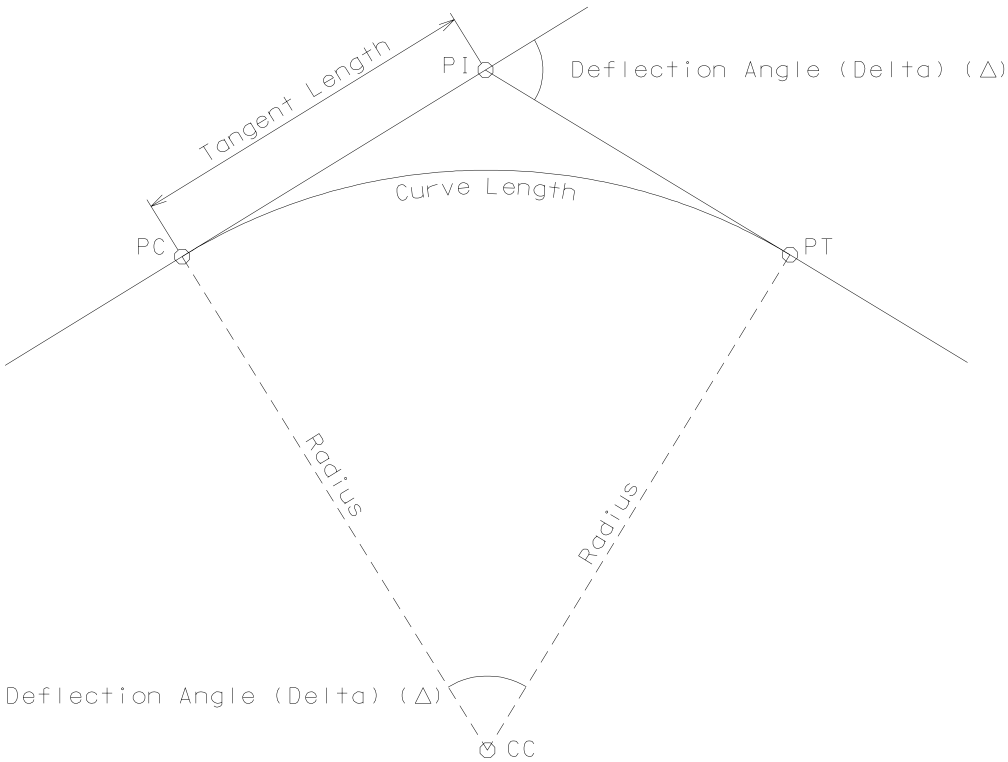


5.2.4 Curves

Curves are a segment of a circular arc. **Curves** can be defined by either the **arc method** (central angle that produces a 100’ arc) or **chord definition** (central angle that produces a 100’ chord). MoDOT uses the arc definition for all new alignments, however the chord definition has been used in the past, and may still be shown on old plans.

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

PC – Point of Curvature; Beginning of the curve.
PT – Point of Tangency; End of the curve.
PI – Point of Intersection; Point where the two tangents meet.
CC – Circle Center; Point at the center of the circle from which the curve is segmented.



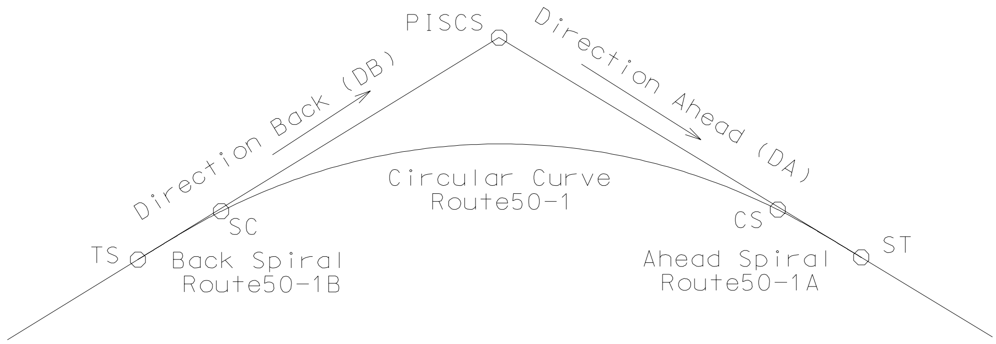
Curve names can be any alpha-numeric characters up to nine characters in length.

5.2.5 Spirals

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

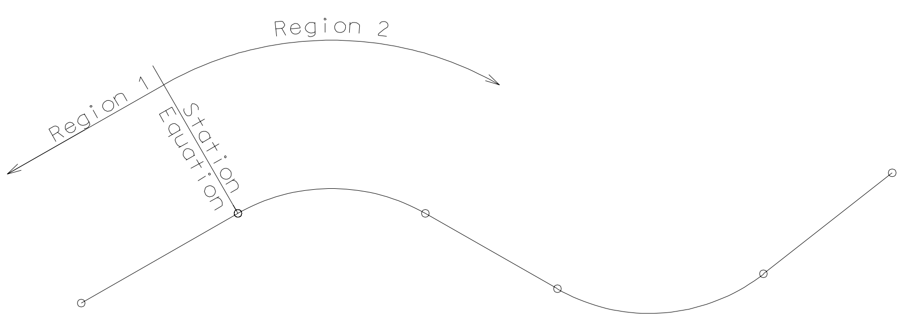
Several points are also stored with a **spiral**. They are as follows:

TS – Tangent to Spiral Point
SC – Spiral to Curve Point
CS – Curve to Spiral Point
ST – Spiral to Tangent Point
PISCS – Overall Point of Intersection for the spiral-curve-spiral combination.



5.2.6 Chains

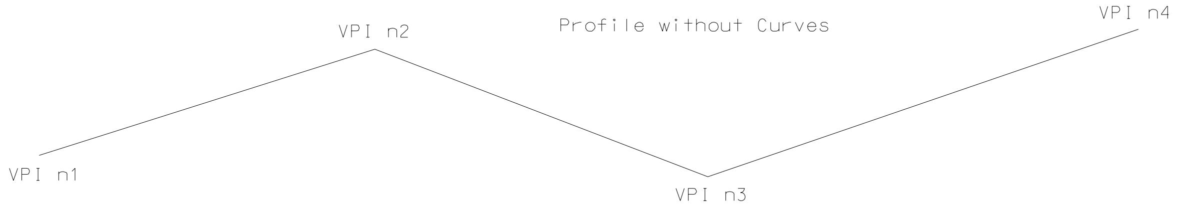
Chains are a combination of other elements. They can consist of points, curves, spirals, or other chains. **Chains** can represent horizontal alignments, or the horizontal location of some element. **Chains** have **stationing** associated with them. Locations along the chain can be determined by the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

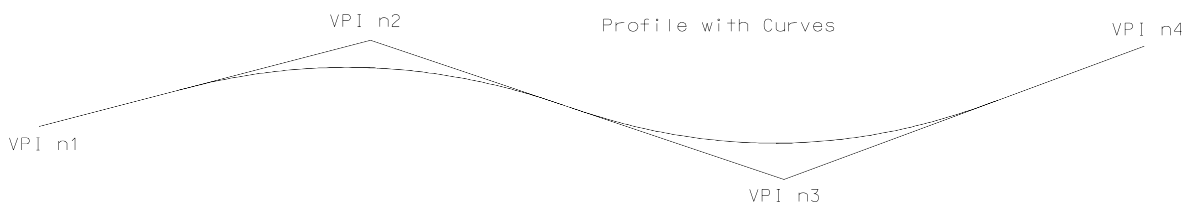


Chain names can be any alpha-numeric characters up to a length of nine characters.

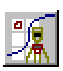
5.2.7 Profiles

Profiles are vertical alignments defined by stations and elevations. They are generally associated with some horizontal chain. **Profiles** can be stored with or without vertical curves. **Profiles** without curves generally represent the existing ground profile, or a ditch profile. **Profiles** with vertical curves are generally used as proposed alignment profiles.

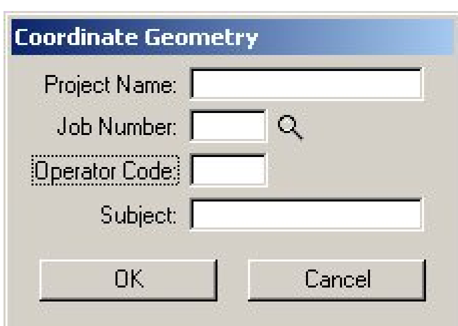




5.3 Accessing



From **Project Manager** choose **Coordinate Geometry**, or choose the **Coordinate Geometry** icon.



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

Project Name – shows name displayed on reports (optional entry, 60 alphanumeric characters max). If **Project Manager** is used, this field will be filled in automatically.

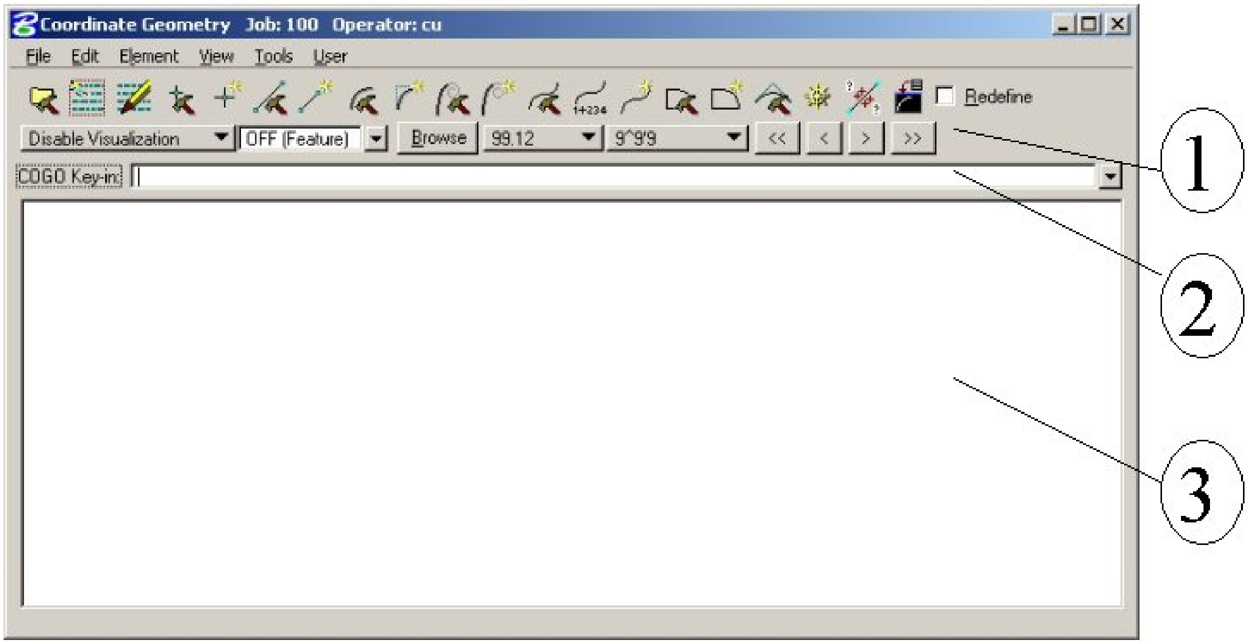
Job Number - identifies coordinate geometry database (3 alphanumeric characters, max) (required). If **Project Manager** is used, this field will be filled in automatically.

Operator Code – identifies a unique 2-character operator code. Allows multiple users access to database. (Required, user's initials suggested). If **Project Manager** is used, this field will be filled in automatically.

Subject - description of work (48 alphanumeric characters, max) (optional)

Once these parameters have been defined, the coordinate geometry dialog box will appear.

5.4 Coordinate Geometry Dialog Box



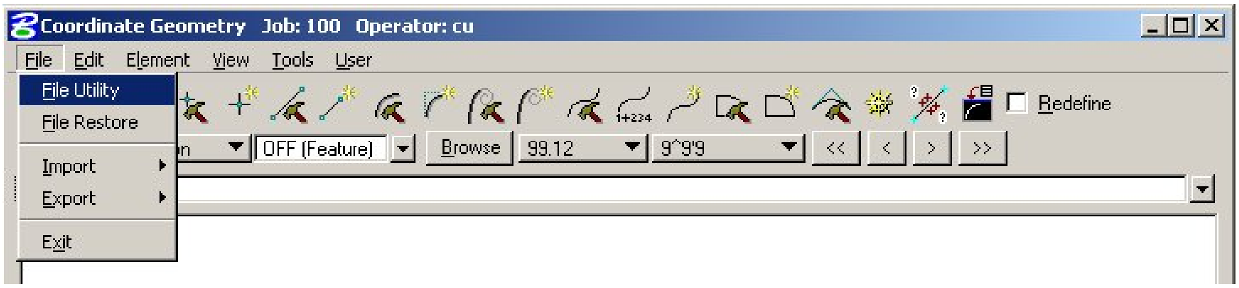
The coordinate geometry dialog box is made up of three separate display areas:

1) **Tool Bar** consisting of pull down menus and icons. The icons displayed are customizable.

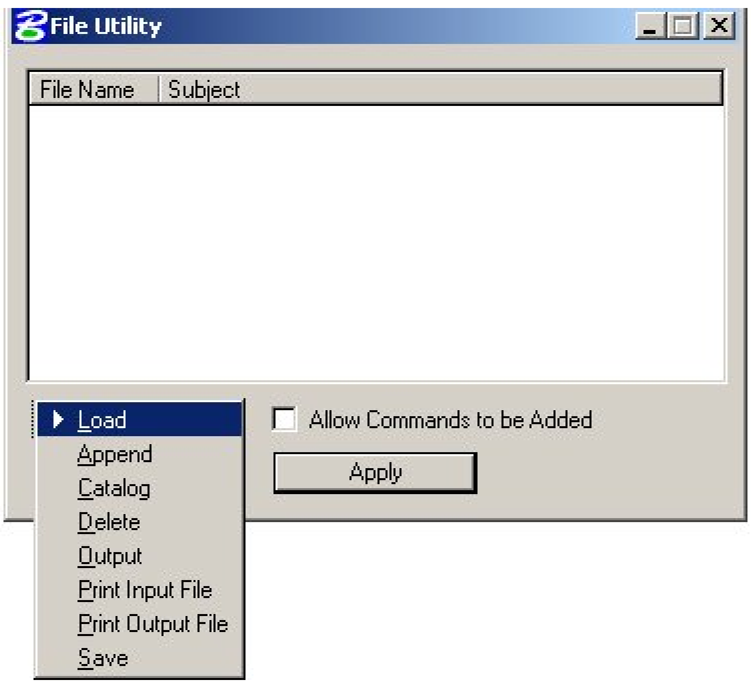
2) **Command Key-in** allows commands to be typed in. The drop down button allows for a history of commands to be seen.

3) **Output Window** shows the results generated by the commands.

5.4.1 File Commands



File Utility – this tool is for manipulating *input files*. When this tool is selected, the dialog with a list of available input files below appears. File utilities include **Load, Append, Catalog, Delete, Output, Print, and Save.**



Load - *Highlight* a file then click the **Apply** button. The input lines from the highlighted file are now displayed in the output buffer and are ready for modify, delete, edit or read.

Append - A new input file is created by copying the contents of an existing input file to the end of the current input file; you must use the **Save** command to store this new file.

Catalog - when selected, a menu appears listing all saved input files in the project directory. This is for reference only no action is taken.

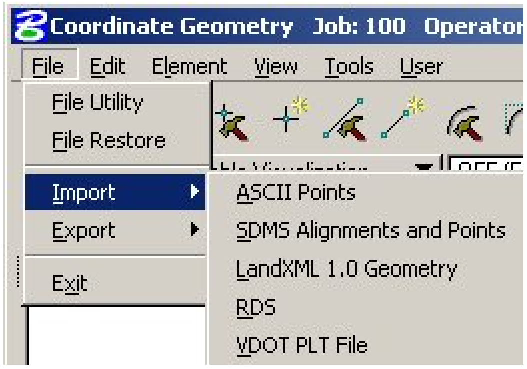
Delete - when selected, a menu appears listing all saved input files. *Highlight* a file then click the **OK** button to remove this file from your project directory.

Output - writes a Geopak output file from your current output buffer session to a newly created file for reviewing and printing. (**Fname999.ooc**)

Print Input File - sends your input file to the printer.

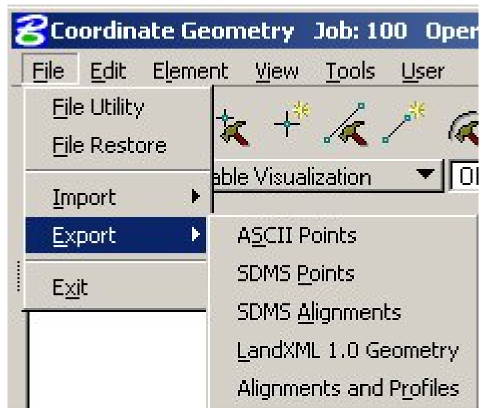
Print Output File - sends your out file to the printer.

Save - will save the current input buffer to a file. (**Fname999.ioc**)



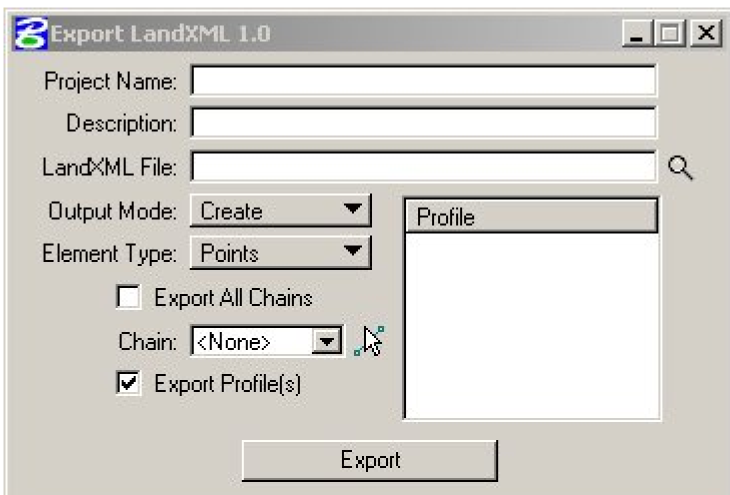
File Restore – converts an ASCII file of Geopak commands to a Geopak COGO input file.

Import - will import horizontal and vertical alignments and points from RDS, SDMS, LandXML 1.0 Geometry, and Virginia Department of Transportation file format into the Geopak .gpk file.



Export - will export Geopak, points, chains and profiles into into SDMS format and LandXML 1.0 Geometry.

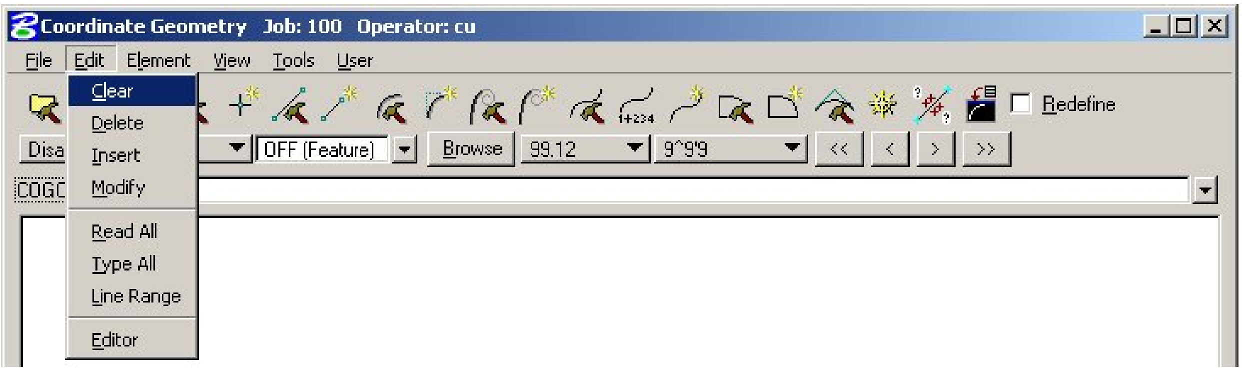
Since most surveying software now reads LandXML format, it is recommended to extract geometry into this format for providing it to contractors.



The Export option in GEOPAK for profile is only activated (visible on the dialog) when you are also exporting chains. You cannot export just a profile by itself as LandXML does not permit this.

Exit - closes the COGO dialog box and ends the coordinate geometry session. A prompt to save the session appears. **Yes** saves the input buffer, **No** exits without saving, **Cancel** returns to the COGO session. Whether you pick **Yes** or **No** everything you did is still saved in the **.gpk** file.

5.4.2 Edit Commands



Clear - empties the memory of the current input and output buffers without saving and initializes the line numbers to begin a new sequence of commands.

Delete - deletes input commands in the input buffer by line number (or range of line numbers) and re-sequences the line numbers for the remaining commands.

Insert - allows the user to add a command line to the current input buffer *before* a specified line number; the other command lines will shift down and line numbering will automatically be re-sequenced

Modify - allows the user to change a word in a command line. The modified command line will not be computed until the operator uses the **Read** command.

Read All - the lines in the output buffer are processed. This may be done for the entire file (**All**) or by specifying a range of line numbers (**Line Range**).

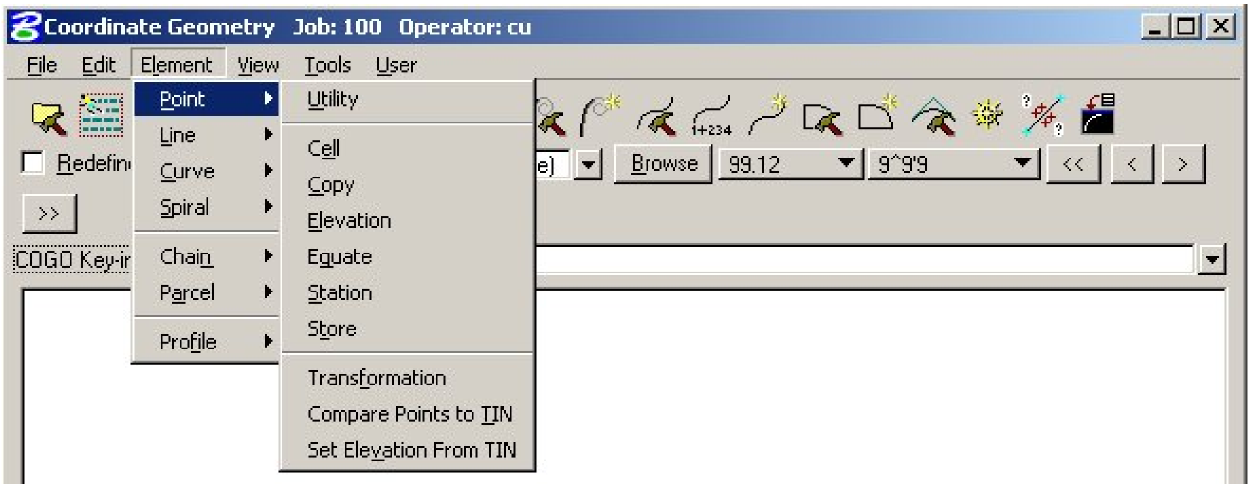
Type All - displays the content of the current input file, (**All**) or a portion of the file by specifying a range of line numbers (**Line Range**).

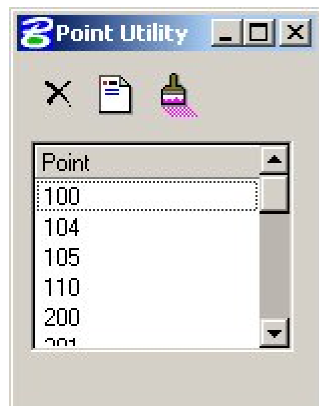
Line Range - displays a portion of the file by specifying a range of line numbers.

Editor - opens the **GEOPAK COGO Command Editor,** which allows the user to edit an input file before executing.

5.4.3 Element Commands

5.4.3.1 ELEMENT>>POINT





Utility - The Point Utility tool displays a list of all stored points, and has options for deleting, printing, or visualizing points.

Delete – deletes one point or multiple points currently stored in the .gpk file. User must highlight the points to be deleted in the utility tool display list, then click on the delete icon.

Print - prints point data currently stored in the .gpk file including coordinates and other associated data.

Visualize– visualizes currently stored points in the .gpk file according to the visualization settings in the coordinate geometry dialog. If visualization is turned off, points will not be visualized.

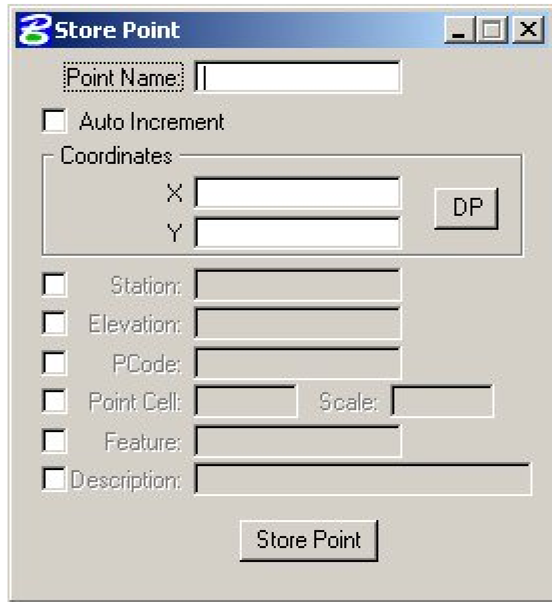
Cell - assigns a cell name to a previously stored point

Copy – copies points or a point range to a new point number or range within the same Geopak database

Elevation - assigns an elevation to a previously stored point

Equate - stores a new point with the same values as a previously defined point

Station - allows you to specify a station for an existing point.



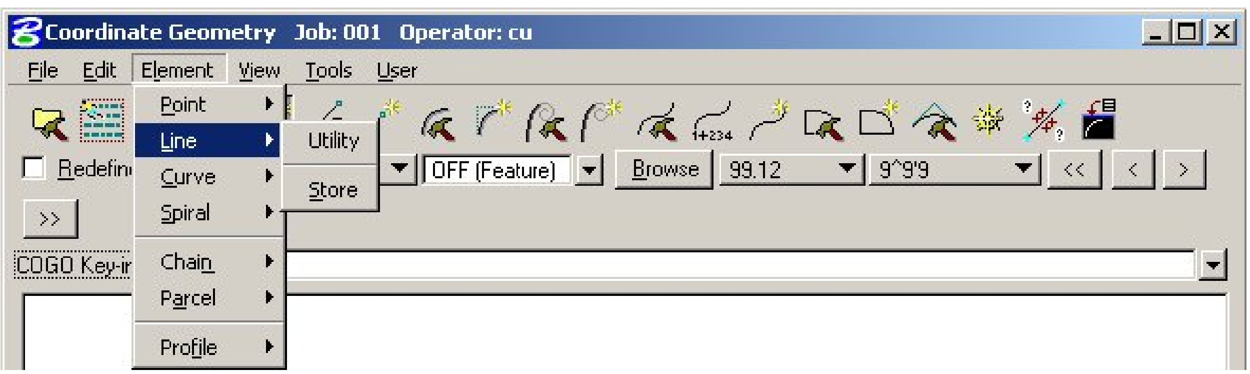
Store - stores a point located by key-in or by digitizing a point on the screen. A station, elevation, point code, cell, feature, or description can be added to the point.

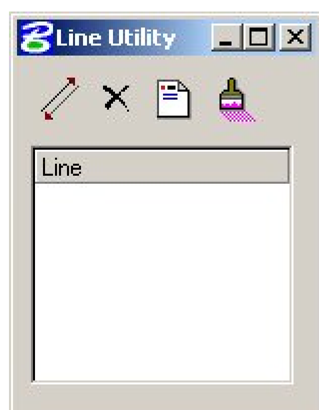
Transformation - transform one set of points into a new coordinate system.

Compare Points to TIN – computes the elevations of a given set of points based on a given DTM, and outputs the elevations to a text file.

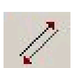
Set Elevation From Tin – computes the elevations of a given set of points based on a given DTM, and stores the elevations to the points.

5.4.3.2 ELEMENT>>LINE





Utility - displays all stored lines, and has options for transposing, deleting, printing, or visualizing lines.



Transpose – Changes the direction of the selected lines.

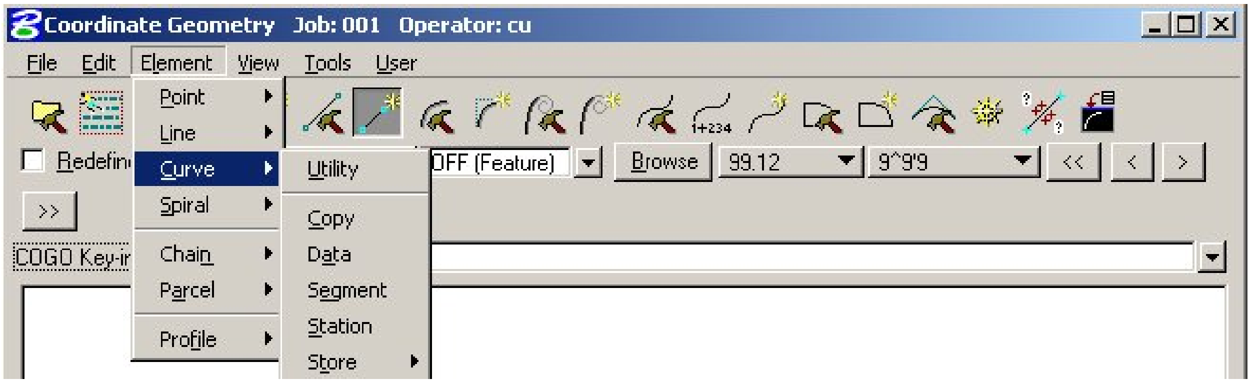
Delete – Removes the selected lines from the GPK.

Print – Writes information about the selected lines to the COGO output window.

Visualize - Plots lines based on current COGO visualization settings.

Store - stores a line based on one point and a direction or two points. The line name can be alpha-numeric (but not numeric-alpha) to a maximum of nine characters.

5.4.3.3 ELEMENT>>CURVE



Utility - displays all stored lines in .gpk file, and has options for transposing, deleting, printing, or visualizing lines.

Copy - copy a specified curve to another curve name

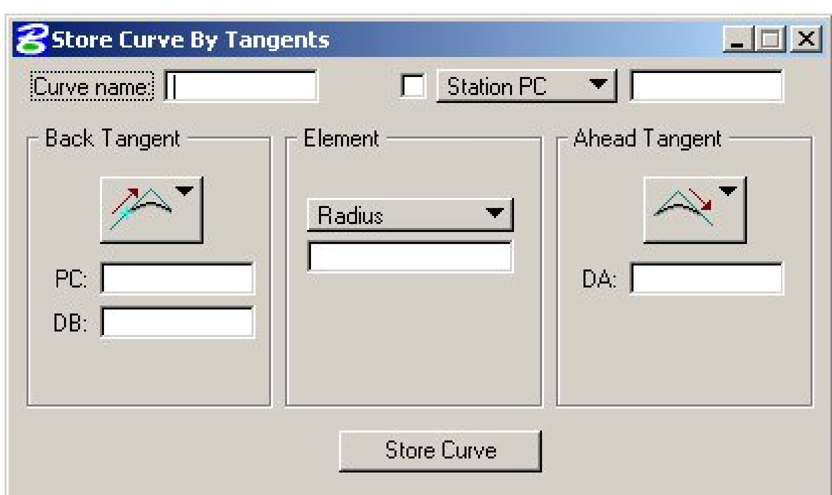
Data - calculates the geometric parameters of a curve, displaying values for Delta, Degree, Tangent, Length and Radius

Segment – defines new curves by dividing a stored curve into segments.

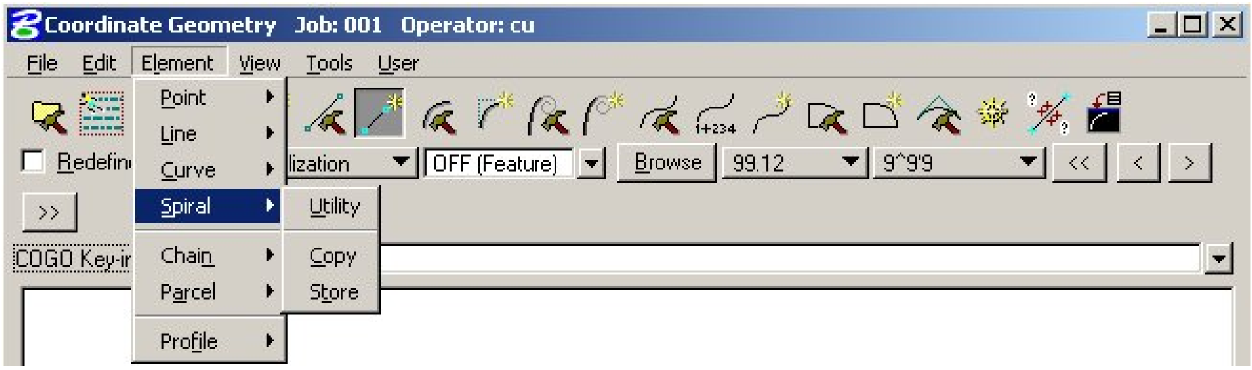
Station - allows the user to identify a curve and the position on the curve (PC, PI, or PT) that a station value may be assigned.

Store – provides the following three options for defining and storing curves: **By Tangents, By End Points (from PC and PT previously stored)** and **Concentric** as shown to the right.

Storing a curve **By Tangents** is the most commonly used tool to store curves. Its dialog is shown below.



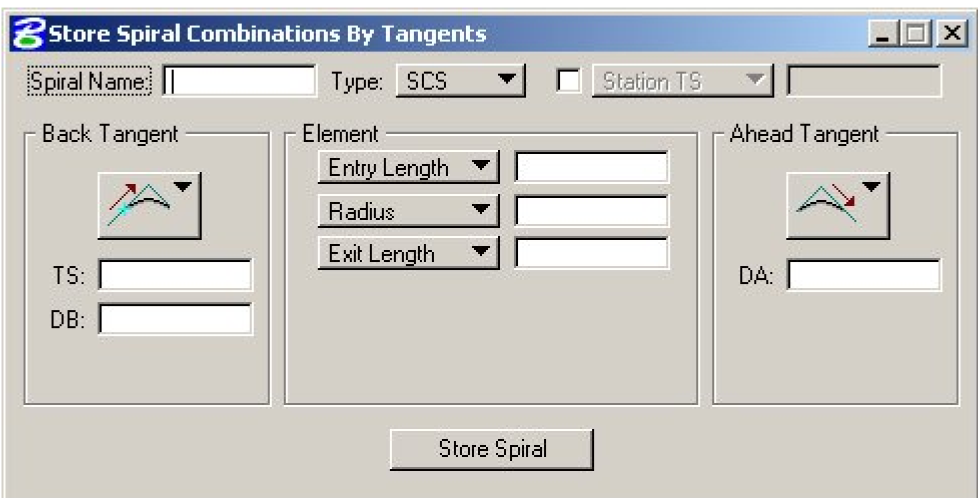
5.4.3.4 ELEMENT>>SPIRAL



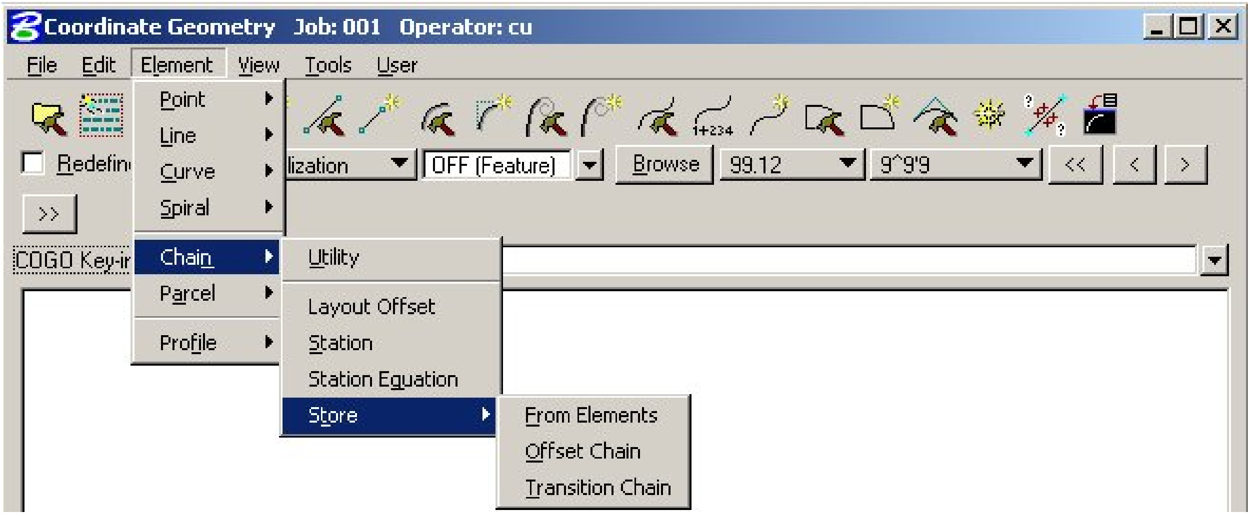
Utility - displays all stored spirals in the GPK file, and has options for deleting, printing, and visualizing spirals.

Copy - copy a specified spiral to another spiral name

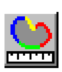
Store – provides various options for defining and storing spiral combinations. The dialog for an Spiral-Curve-Spiral (SCS) combination is shown below.



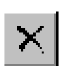
5.4.3.5 ELEMENT>>CHAIN



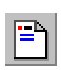
Utility - displays all stored chains in the .gpk file, and has options for computing area, deleting, printing, describing, or visualizing chains.



Area – calculates the area of a closed chain previously stored in the GPK file.



Delete – deletes chains stored in the .gpk file.

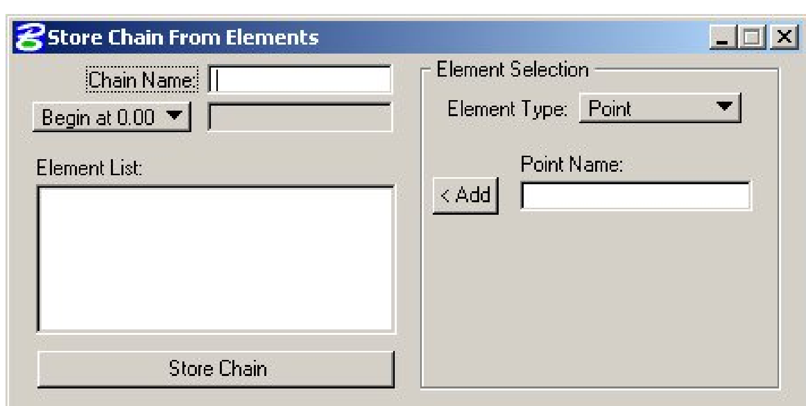


Print – displays the name of each chain element.

Describe – displays the alignment data of each element in the selected chain.

Visualize - plots chains based on current COGO visualization settings.

Layout Offset – computes the station and offset of a point or a chain based on a given chain.

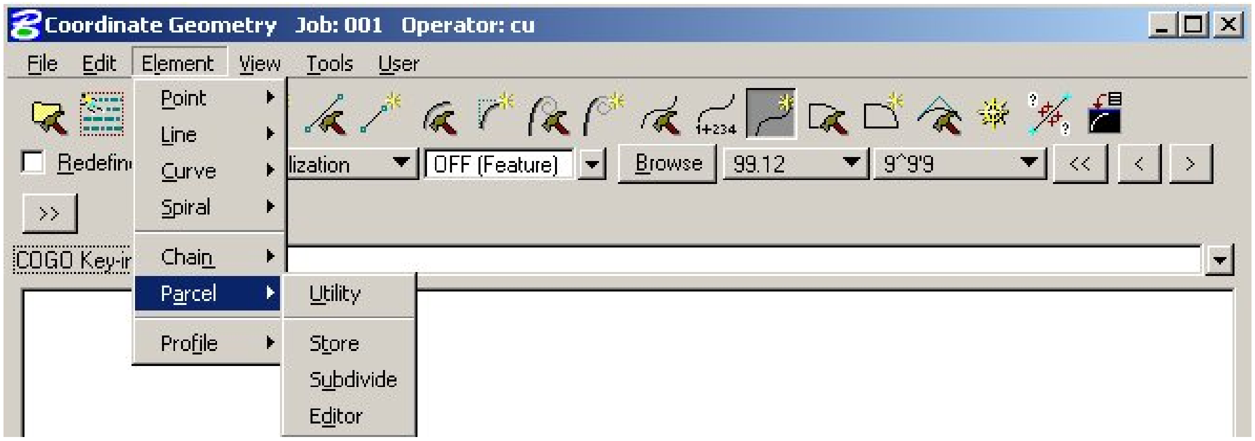


Station - provides a method for stationing or re-stationing a chain.

Station Equation - provides a method for applying a station equation to a chain

Store - provides three options for storing a chain in the database, **From Elements**, **From Offset Chain**, and **Transition Chain**.

5.4.3.6 ELEMENT>>PARCEL



Utility - displays all stored parcels in .gpk file, and has options for describing, deleting, printing, or visualizing parcels.

Store - allows a user to store a parcel by adding points, curves and spirals.

Subdivide – divides a parcel into individual lots.

Editor – edits a parcel

Manual Entry - Parcel Commands

Store Taking - allows you to store the portion of a parcel taken by entering point and curve names in either a clockwise or counterclockwise direction.

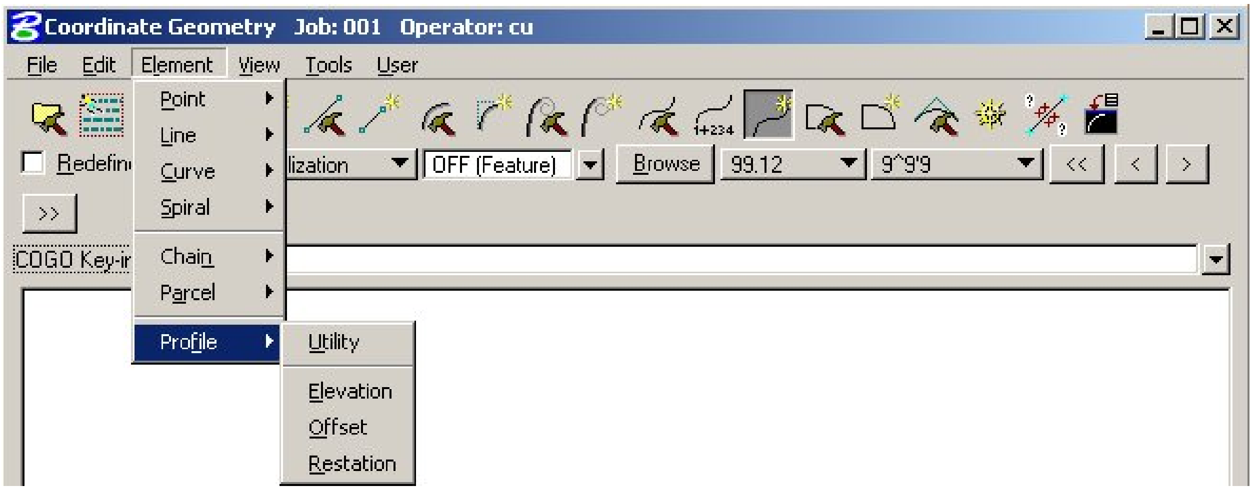
Store Easement - allows you to store an easement by entering point and curve names in either a clockwise or counterclockwise direction.

Own Parcel - stores the name of the owner associated with a previously stored parcel.

Make Legal - creates a legal description and writes it to a user named text file.

For more detailed parcel information, see GEOPAK Help.

5.4.3.7 ELEMENTS>>PROFILES



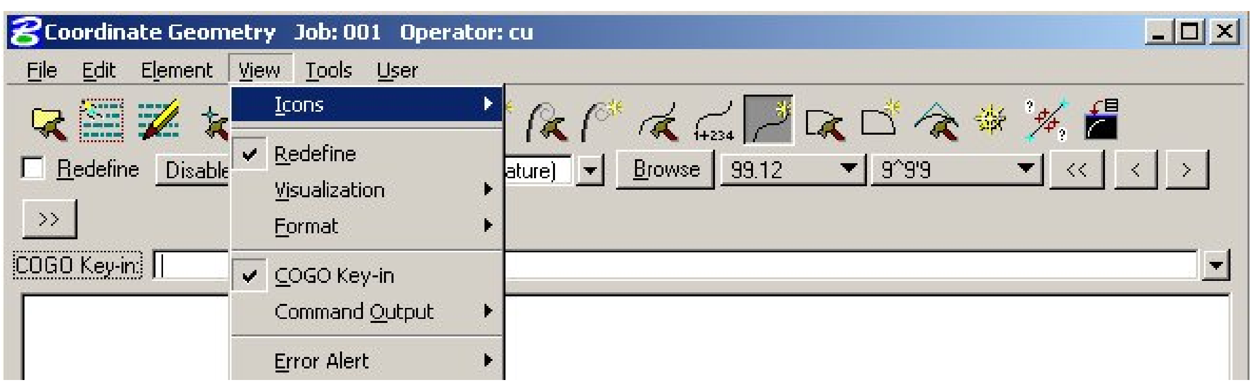
Utility - displays all stored profiles in .gpk file, and has options for deleting or printing profiles.

Elevation - provides three options for reporting elevations along a selected profile, **Station**, **Even Station, Incremental Stations**

Offset – stores a new profile at a given vertical offset.

Restation - creates a **Target Profile** based on a **Source Profile** and **Chain**, but uses the **Begin Station** specified in the dialog.

5.4.4 View Commands



Icons – allows the user to customize which icons appear in the tool bar.

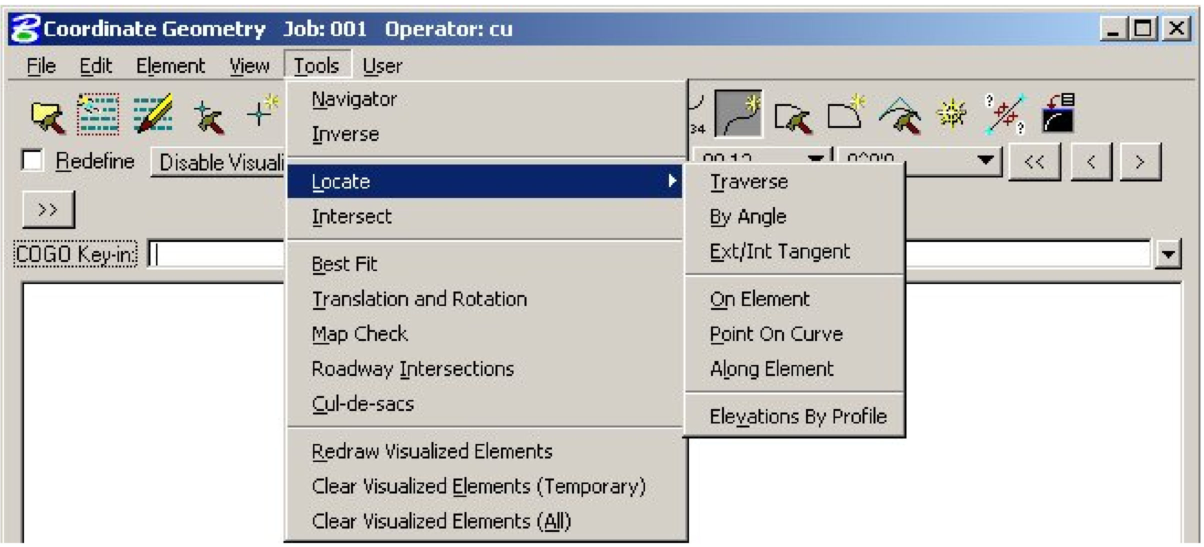
Redefine – shows the **Redefine** box on the tool bar.

Visualization – shows the visualization items on the tool bar.**Format** – shows the format items (i.e. number of decimals, station format, etc.) on the tool bar.
COGO Key-in – shows the COGO Key-in box for entering commands in the dialog.

Command Output - show the Command Output Window in the dialog box, and controls options for the Command Output Window.

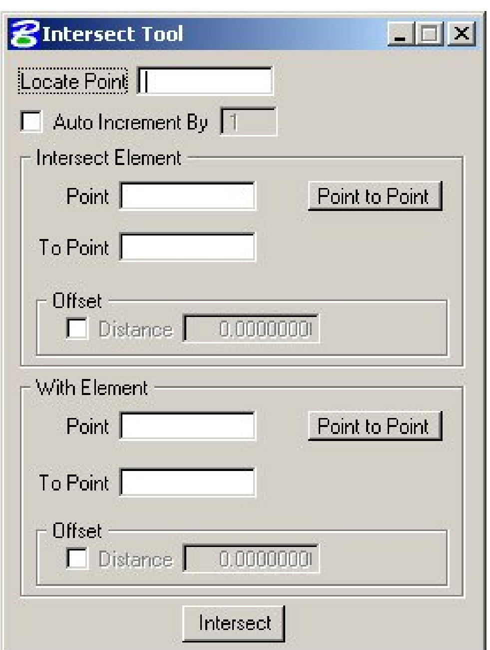
Error Alert – allows the user to turn on a *beep* and/or bring up the COGO dialog when an error occurs.

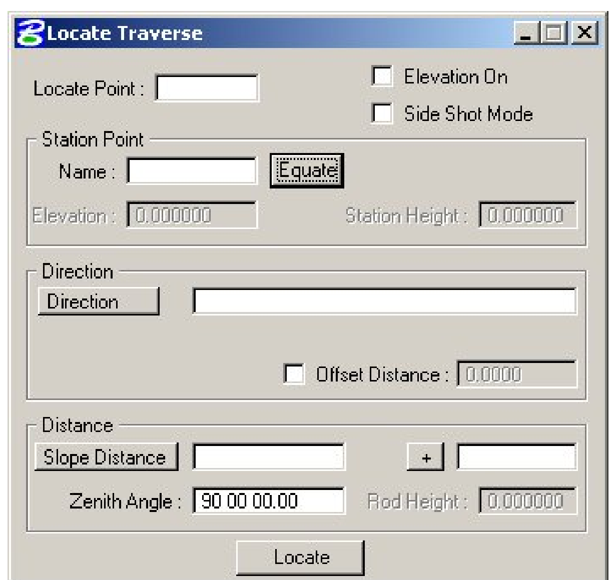
5.4.5 Tools Commands



Intersect – stores a point at the intersection of the defined elements

Locate – locates a point from another point by several methods such as distance and direction, or station and offset. (To locate by distance and bearing, use the Tools >> Locate >> Traverse)





Superelevation – calculates the superelevation for a given chain. (This will be covered in more detail in Chapter 11)

Inverse – calculates the distance and direction between points.

Navigator – starts the COGO Navigator. (This will be covered in more detail in Section 5.5)

Best Fit – calculates a best-fit chain through a set of points.

Translation and Rotation – moves, rotates, and scales a data set.

Map Check – edits a parcel.

Roadway Intersection – calculates the data for the intersection of two roadways.

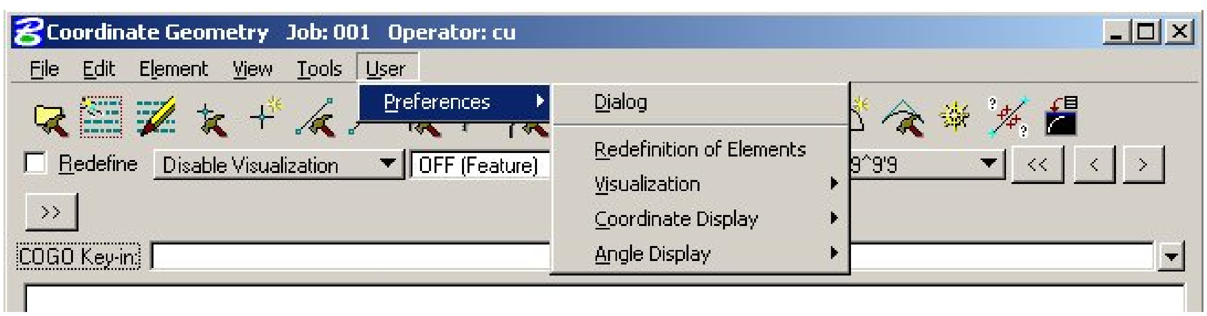
Cul-de-sacs – calculates the data for a cul-de-sac.

Redraw Visualized Elements – re-syncs the coordinate geometry data with the data displayed in the Microstation file.

Clear Visualized Elements (Temporary) – clears the temporary visualized elements from the view.

Clear Visualized Elements (All) – clears the visualized elements from the Microstation file.

5.4.6 User Preferences



Dialog - allows access to COGO Preferences dialog box.

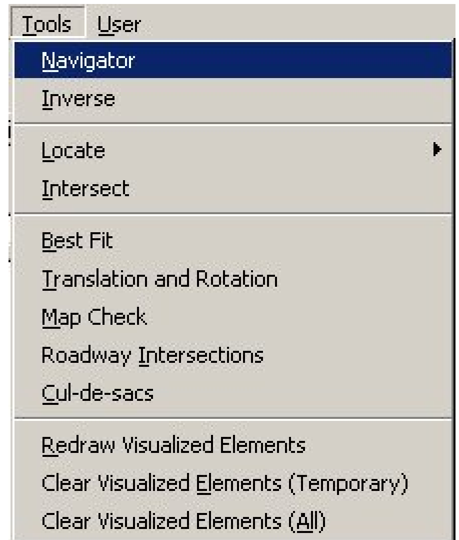
Redefinition of Elements – toggles the **Redefine** option on/off. If **Redefine** is on, COGO data can be redefined/overwritten. (It is recommended to work with **Redefine** off so the user does not overwrite another user's data.)

Visualization – allows the elements to be displayed in the Microstation file permanently or temporarily.

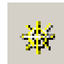
Coordinate Display – toggles between displaying NE or XY coordinates.

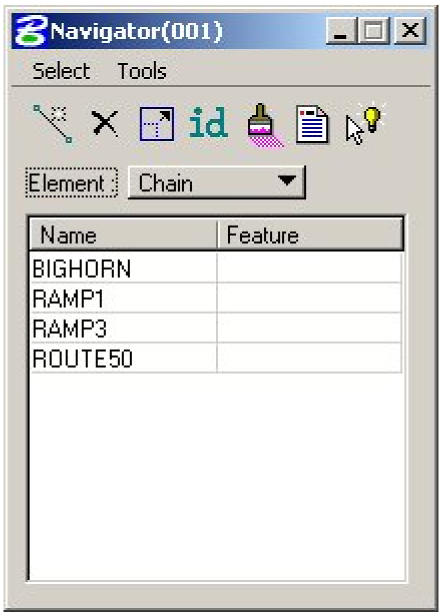
Angle Display – toggles between displaying Bearing or Azimuth.

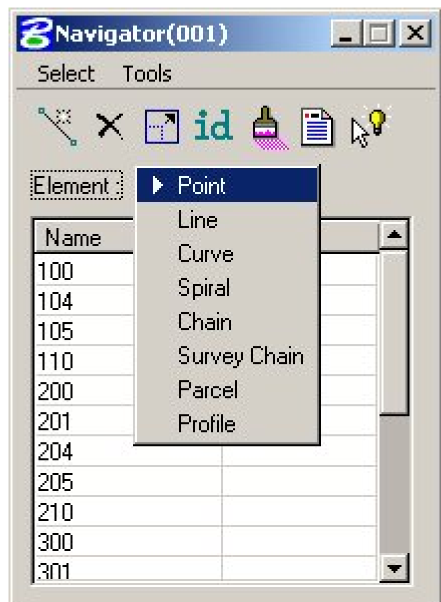
5.5 COGO Navigator



COGO Navigator is a tool to easily view and edit COGO data. **Navigator** can be accessed by the pull down menu **COGO >> Tools >> Navigator** or by the **Navigator** icon. The following dialog box will appear.

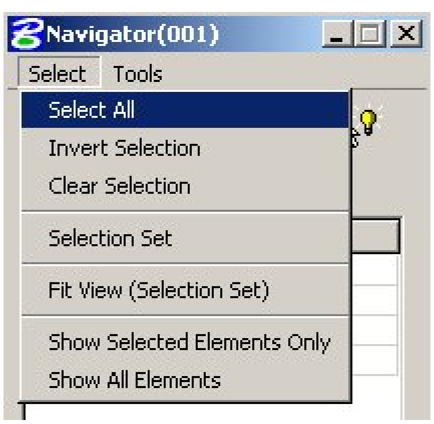






From the **Navigator**, points, lines, curves, spirals, chains, survey chains, parcels, and profiles can be added, deleted, modified, identified, visualized, printed, or selected.

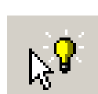
5.5.1 Select



Select All – selects all data items of a certain type. (I.e. all points)

Invert Selection – selects all items not previously selected, and unselects all items previously selected.

Clear Selection – unselects all items.



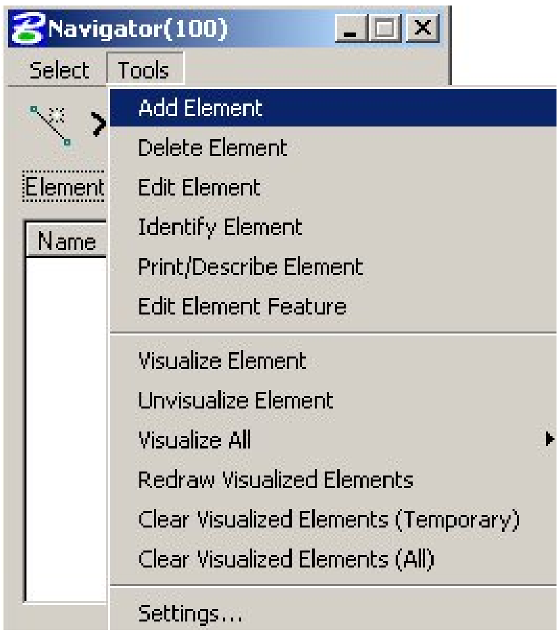
Selection Set - allows the user to create a selection set that meets particular criteria. This is the same as using the **Selection Set** icon.

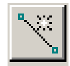
Fit View (Selection Set) – fits the items selected to the active Microstation window.

Show Selected Elements Only – only the items in the selection set will be displayed in the MicroStation window.

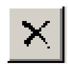
Show All Elements – all items in the database will be displayed in the MicroStation window.

5.5.2 Tools

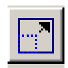




Add Element – allows the selected type of element to be stored.



Delete Element – deletes the selected type of element.



Edit Element – allows the selected element to be edited.

Identify Element – allows the user to select an element by selecting it graphically.

Print/Describe Element – displays the selected element's coordinate or alignment data.

Edit Element Feature – Changes the feature code of the element.

Visualize Element – displays the selected elements according to their feature codes.

Unvisualize Element – un-displays the selected elements.

Visualize All – displays all of the elements of a certain type, or all elements.

Redraw Visualized Elements - re-syncs the coordinate geometry data with the data displayed in the Microstation file.

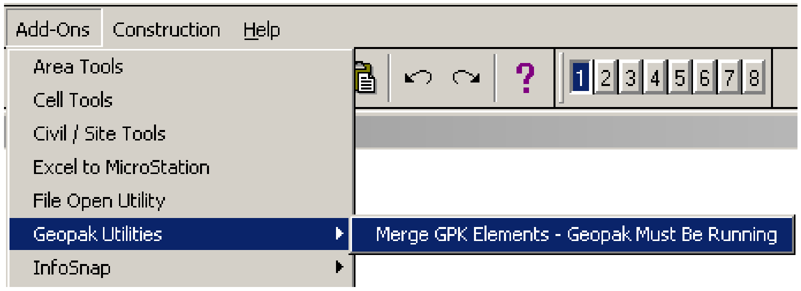
Clear Visualized Elements (Temporary) – clears the temporary visualized elements from the view.

Clear Visualized Elements (All) – clears the visualized elements from the Microstation file.

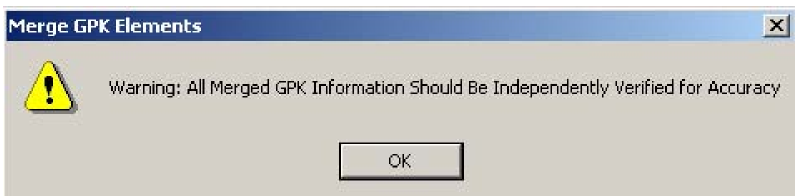
Settings – allows the user to define certain actions and behaviors of the Navigator.

5.6 Merging GPK Elements

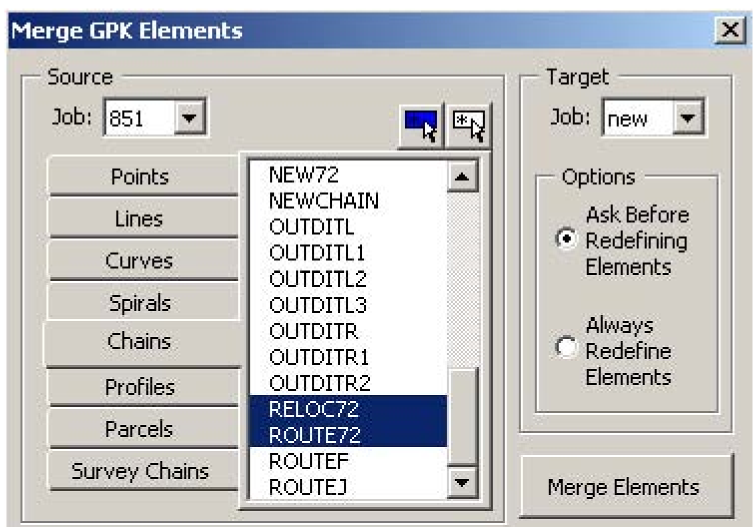
A Visual Basic Application (VBA) is available to allow users to merge elements from one GPK to another. This VBA is located under the MicroStation Add-Ons pull down menu. **Add-Ons>>Geopak Utilities>>Merge GPK Elements – Geopak must be running**.



When opening the tool, the user will get the following dialog box. Select OK to dismiss.

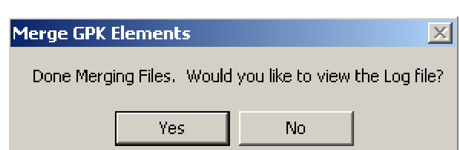


The tool requires a source and a target GPK. Both databases must exist before running the tool. The source GPK is defined as the database from which the elements are extracted, and the target one is where the elements will be transferred.



The user can select multiple type geometry at one time. To select an element, first select the type of geometry and then high light from the available list. The tool offers two options for handling existing geometry in the target GPK with the same name. One is to always "**Ask Before Redefining Elements**", and the second one is to "**Always Redefine Elements**". If any redefinition of elements must be done, the Redefine toggle must be checked on in the Coordinate Geometry dialog box.

Once the tool is set up, select **Merge Elements**. Once the tool is done merging elements, the user will get the message to the right. To view the log file select **Yes**.



5.7 Importing CEAL Data

A CEAL interface file can be imported using the following command:

LOAD CEAL FILE *filename*

where ***filename*** is the name of the CEAL interface file. This command will create a Geopak input file that can be saved or read. Points, curves, spirals, chains, and alignment profiles can be transferred to Geopak from CEAL. Once the above command has been executed, to store the data into the .gpk file the input file must be read by going to **Edit>>Read All**.

5.8 Bridge Deck Elevation Commands

COGO solves the deck elevation requirements for the design of highway bridges. The elevations computed by GEOPAK are top of slab elevations within the limits of the bridge. The program computes deck elevations on a per span basis along the edge of the deck, gutterlines, centerline bearings, beams parallel to any line defined by two points, curves or lines concentric to the baseline, or non-parallel lines defined by unequal spacing along the piers. The software is also capable of computing deck elevations between parallel or non-parallel piers. Note these commands are not located on pull down menus and must be keyed in.

Most of the commands in this chapter are provided with graphic illustrations and are indexed in the following order:

BRIDGE name	name of the bridge for output
PROFILE name	a profile already stored in GPK.
TIE value	defines the location of the profile grade line
SE commands	width and slopes across the bridge
ALI name	a chain already stored in GPK.
PIER command	defines the direction of the piers (optional)
SPAN command	defines the layout of the span
CB command	refers to Centerline Bearing Elevations (optional)
FC command	refers to the edge of the deck elevations (optional)
GU command	refers to the gutterline elevations (optional)
BEAM commands	set the framing plan for the current span
End Span command	initiates the calculation
Edit Text command	displays the results of the calculation

The following convention will be used in presenting the bridge deck commands: Words in all upper case letters indicate command names. Lower case words indicate alphanumeric values provided by the user. Since many keywords can be abbreviated, the minimum required is underlined. As always, it is recommended that COGO element names be limited to nine characters. For a full presentation of the COGO conventions go to **Applications >> GEOPAK Road >> Help >> Coordinate Geometry** and select the topic **General Reference / General Conventions**.

5.8.1 Bridge Name

BRIDGE name

The **Bridge name** command stores the name of the bridge. The name of the bridge and the name of the span together form the name of the Deck Elevations Table for the current span.

5.8.2 Profile Name

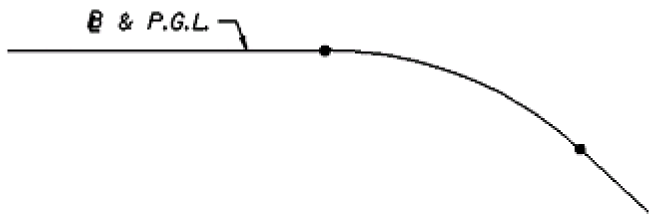
PROFILE name

The **Profile name** command refers to a previously defined profile utilized to define the deck elevations of the bridge. If the profile name is not stored, a message will be printed. Station equations along this profile, if any, must match the station equations along the chain (ALI name).

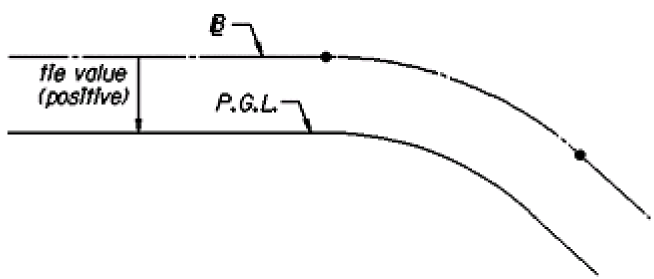
5.8.3 Tie Value

TIE value

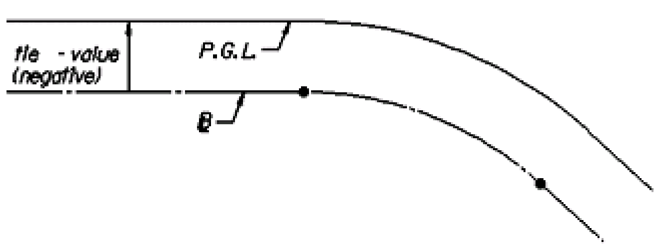
The **Tie Value** command defines the horizontal location of the Profile Grade Line (PGL) by a radial distance (or value) measured from the baseline or centerline of construction of the bridge. When the PGL is located to the left of the baseline the tie value is negative.



When the profile grade line is coincident with the baseline, the Tie value is zero as depicted above.



When the profile grade line is to the right of the baseline, the Tie value is positive as depicted above.

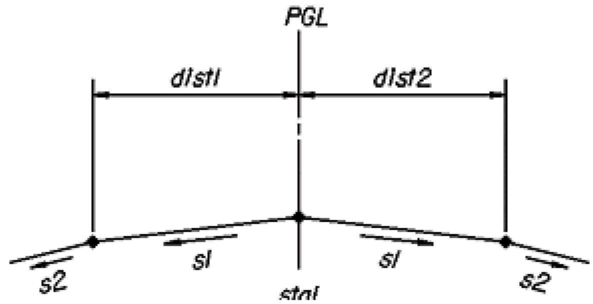


When the profile grade line is to the left of the baseline, the Tie value is negative as depicted above.

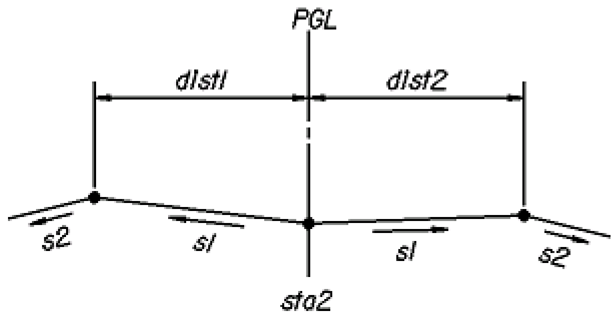
5.8.4 SE Command

SE station (R region) LT slope1 dist1 slope2 RT slope1 dist1 slope2

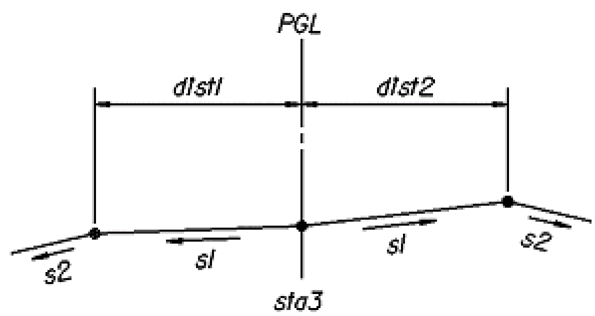
The **SE command** set the slopes in percentage across the bridge from the PGL, left and right. The slope1 in percentage applies across the distance dist1, and slope2 applies to any point beyond the distance dist1 (left and right). Slopes are negative when going down away from the PGL. Three examples are given below.



SE sta1 LT s1 dist1 s2 RT s1 dist1 s2



SE sta2 LT s1 dist1 s2 RT s1 dist1 s2



SE sta3 LT s1 dist1 s2 RT s1 dist1 s2

5.8.5 ALI Name

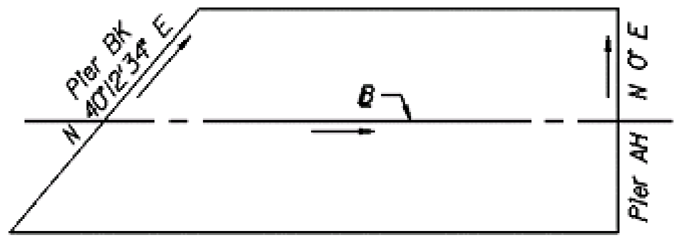
ALI name

The **ALI name** command refers to a chain already stored in the GPK. It defines the stationing of the bridge. Station equations along this alignment or chain, if any, should match the station equations along the profile.

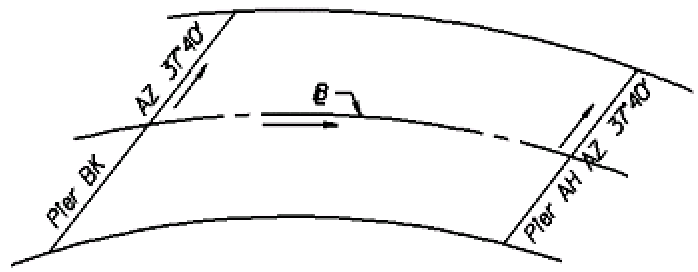
5.8.6 Pier Command

PIER BK direction AH direction

The **Pier command** sets the direction from right to left of the pier centerline. When the Pier command is not used, the piers are assumed perpendicular or radial to the baseline.



Pier BK N 40 12 34 E AH N 0 E

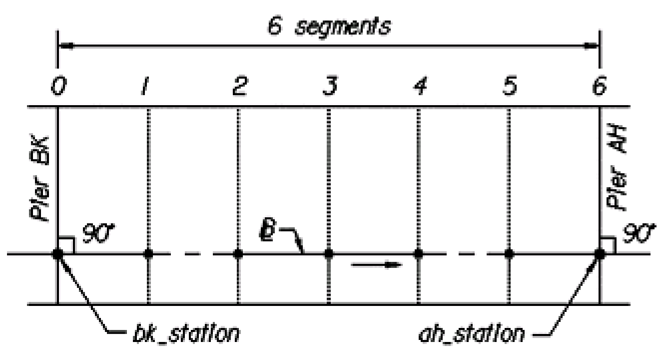


Pier BK AZ 37 40 AH AZ 37 40

5.8.7 Span Command

The **Span** commands define the beginning station (bk_sta) and the end station (ah_sta) of the current span along with the location of the required elevations.

Format A:



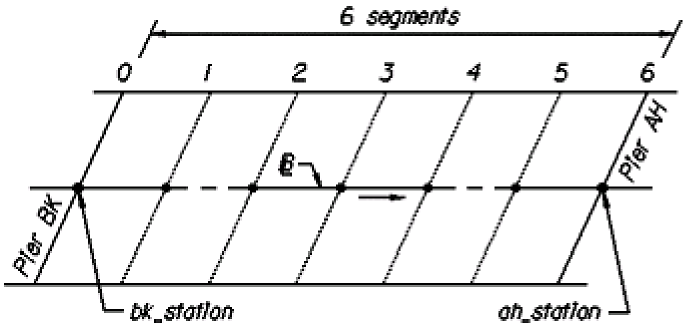
SPAN (name) bk_sta ah_sta segments (+)

Defines the current span defined from pier on bk_sta to pier on ah_sta, where:

name = the name of the span,
bk_sta = the station value for the centerline of the back pier,
ah_sta = the station value for the centerline of the ahead pier, and
segments = the number of equal length segments along the span.

Elevations are calculated perpendicular or radial to the baseline at each segment. The optional (+) calculates elevations on the pier ahead.

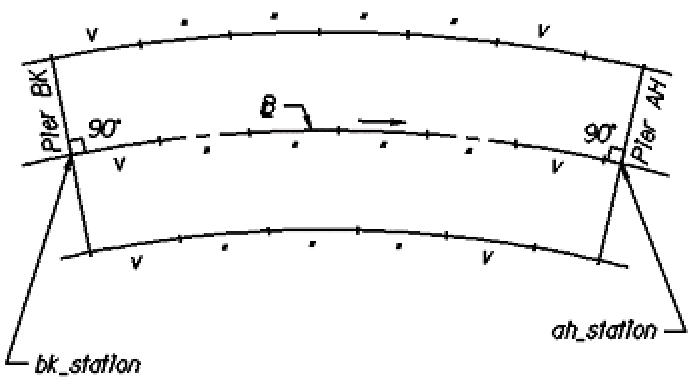
Format B:



<u>SPAN (name)</u> <u>bk_sta ah_sta segments</u> (<u>+</u>) <u>P</u>

Current span defined from pier on bk_sta to pier on ah_sta, with the terms used as defined above. Elevations are calculated at each segment and parallel (**P**) to the pier on bk_sta. The optional (**+**) calculates elevations on pier ahead.

5.8.7.1 FORMAT C



<u>SPAN (name)</u> <u>bk_sta ah_sta IN v</u> (<u>+</u>)

Current span defined from pier on bk_sta to pier on ah_sta, where:

v = interval length and the rest of the terms are used as define above.

Elevations are calculated at equal intervals (IN v) measured from the pier on bk_sta. The optional (+) calculates elevations on pier ahead.

5.8.8 CB Command

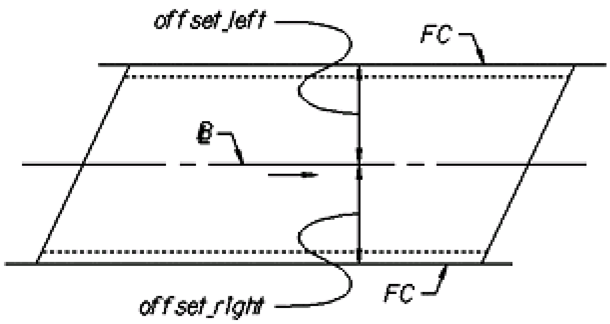
<u>CB value</u>

The **CB** commands calculate deck elevations at the Centerline Bearing of the current span. When **value** is positive, the elevations are computed along a line parallel to and right of the pier on the back station; when **value** is negative the elevations are computed along a line parallel to and left of the pier on the ahead station. Centerline bearing elevations are specified with asterisks (*) in the table of elevations for the current span.

5.8.9 FC Command

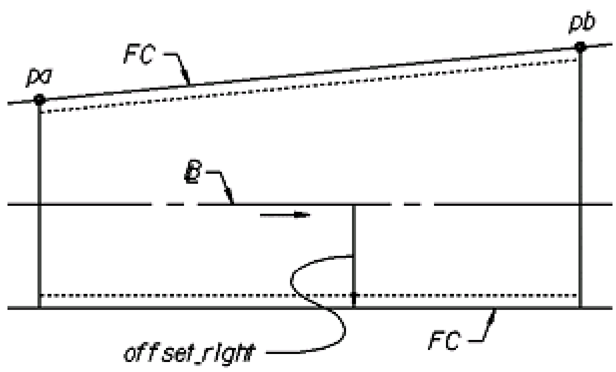
The **FC commands** calculate deck elevations along the Face of Coping or edge of the deck. This edge is defined by a line concentric to the baseline at the offset distance **offset_left** or **offset_right**, or along a line designated by two points.

Format A:



FC offset_left offset_right
Deck elevations along a line concentric to the baseline at offset distances, left and right.

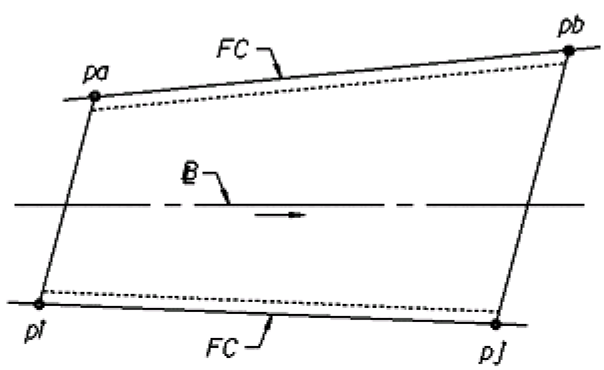
Format B:



<u>FC pa, pb offset_right</u>

Deck elevations along a line to the left of the baseline, from **pa** to **pb**, and along a line to the right and concentric to the baseline at offset distance.

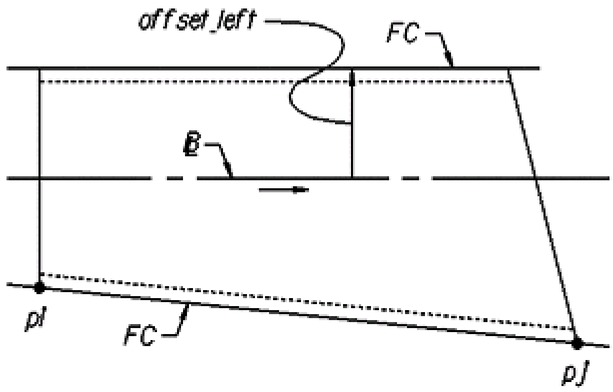
Format C:



<u>FC pa, pb pi, pj</u>

Deck elevations along a line to the left of the baseline, from **pa** to **pb**, and to the right of the baseline from **pi** to **pj**.

Format D:



FC offset_left pi, pj

Deck elevations along a line to the left and concentric to the baseline at offset distance **offset_left**, and along a line to the right of the baseline from point **pi** to point **pj**.

5.8.10 GU Command

The **GU commands** calculate deck elevations along the gutterline of the current span. The gutter is defined by a line concentric to the baseline at the offset distance **offset_left** or **offset_right**, or along a line designated by two points **pa**, **pb** (to the left of the baseline) or **pi**, **pj** (to the right of the baseline). It uses the same four formats as the FC Command

5.8.11 Beam Command

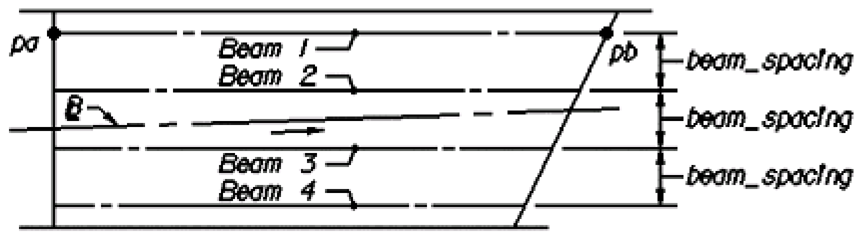
The **Beam** commands calculate deck elevations along beams defined by offset distances concentric to the baseline (Format A); parallel to a line pa, pb (Format B); by points (Format C) or along unparallel lines defined by unequal spacing along the piers (Format D).

Format A:

BEAM OFF offset1 offset2 offset3 . . . offsetn

Negative offsets are to the left of the baseline and positive offsets are to the right.

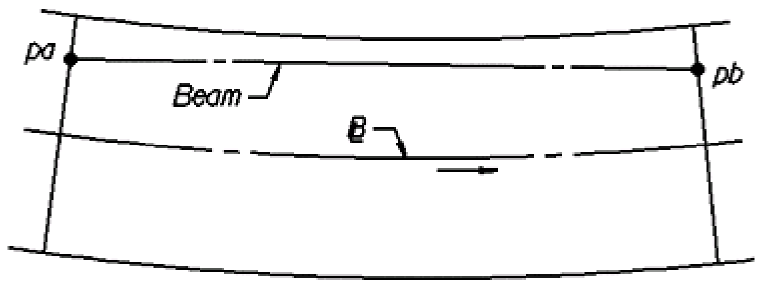
Format B:



BEAM PAR pa, pb beam_spacing number_of_beams

The beams are laid out parallel to the line from **pa** to **pb**, which defines the location of the left most beam as shown above. The value **Beam_spacing** designates the spacing between the beams with the value **number_of_beams** indicates the number of beams.

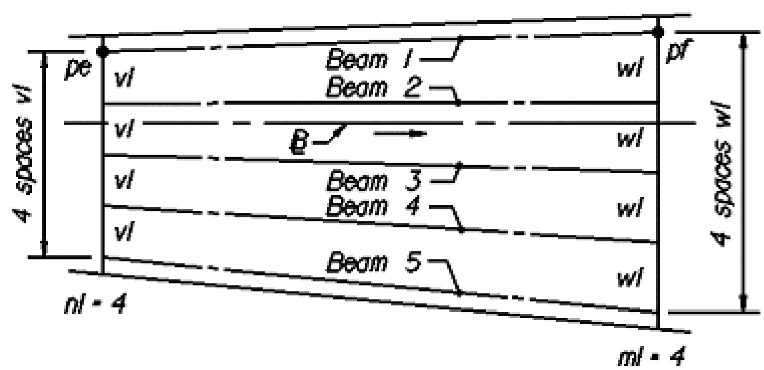
Format C:



BEAM BY POI pa, pb

Locates a single beam running from **pa** to **pb**.

Format D:



BEAM pe, pf FROM n1 SPS v1 n2 SPS v2 . . . TO m1 SPS w1 m2 SPS w2 . . .

The line from the previously defined point **pe** to the previously defined point **pf** locates the left most beam with the other beams located along the back (**FROM**) pier at **n1** spaces of length **v1**, **n2** spaces of length **v2**…and located along the ahead (**TO**) pier at **m1** spaces of length **w1**, **m2** spaces of length **w2**….

5.8.12 End Span Command

END SPAN

The **End Span** command initiates the calculation of elevations for the current span and stores, on disk, a table of elevations with a name composed of the name of the bridge, a hyphen, and the name of the span (bridge-span). An ASCII file is also stored for digital terrain modeling purposes. This ASCII file has a name composed of the name of the span, a dot, and the extension xyz. If no name has been stored for the current span, COGO, assigns numbers to the span starting with number 1. The XYZ file can be used to store COGO points at each of the locations where a deck elevation was calculated. This procedure is presented in **Section 5.9 Store ASCII XZ DAT file to COGO**.

5.8.13 Edit Text Command

EDIT TEXT bridge-span.TXT

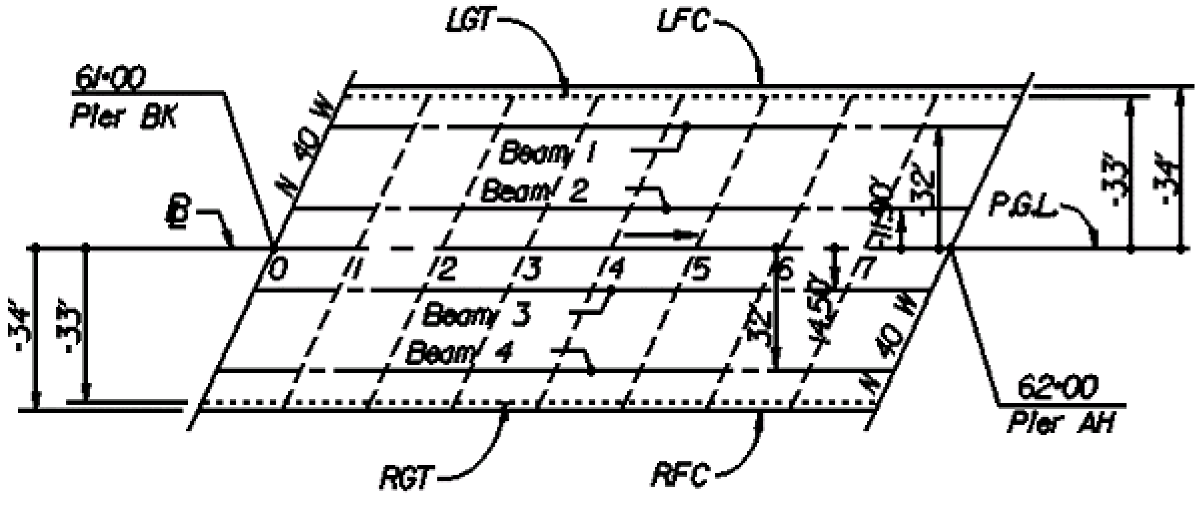
The Edit Text command displays the table of deck elevations stored on disc as bridge-name, hyphen, span-name. When the table exceeds 8 columns, COGO breaks the table into groups of 8 columns. The file can also be viewed with any text-editing program.

5.8.14 Point Elevation Command

POI/EL list

The Point elevation commands calculate deck elevations for any points on the deck, which has been stored in the coordinate geometry database file, where **list** is the list of points. This command is active only when the Alignment, Profile, Tie, and Cross-slopes (SE commands) have been previously designated.

5.8.15 Example



SPAN K1-A

The input commands for the above figure are:

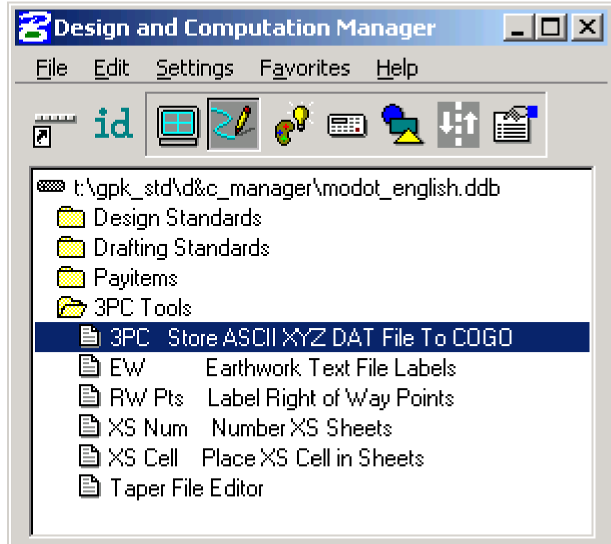
```
*1      BRIDGE K1
*2      PROFILE ABC
*3      TIE 0
*4      SE 60+00 LT -2 24 -3 RT -2 24 -3
*5      SE 63+00 LT -2 36 -3 RT -2 36 -3
*6      SE 65+00 LT 4 24 4 RT -4 24 -4
*7      ALIG IN
*8      GU -33 33
*9      FC -34 34
*10     PIER BK N 40 W AH N 40 W
*11     SPAN A 61+00 62+00 8 P
*12     BEAM OFF -32 -11.90 14.50 32
*13     END SPAN
*14     END
```

The resulting output is:

```
Bridge deck elevation
Span K1-A  61+00.00 to 62+00.00
LFC   11.4187  11.1029  11.3712  11.3712  11.3554  11.3396  11.3237  11.3079
LGT   11.4490  11.4331  11.4015  11.4015  11.3856  11.3698  11.3540  11.3381
BM 1  11.4792  11.4634  11.4475  11.4317  11.4159  11.4000  11.3842  11.3684
BM 2  11.9250  11.9042  11.8834  11.8625  11.8417  11.8209  11.8000  11.7792
BM 3  11.8811  11.8603  11.8394  11.8186  11.7978  11.7769  11.7561  11.7353
BM 4  11.4941  11.4783  11.4625  11.4466  11.4308  11.4150  11.3991  11.3833
RGT   11.4644  11.4485  11.4327  11.4169  11.4010  11.3852  11.3694  11.3535
RFC   11.4346  11.4188  11.4029  11.3871  11.3713  11.3554  11.3396  11.3238
PGL   12.1667  12.1458  12.1250  12.1042  12.0833  12.0625  12.0417  12.0208
```

5.9 Store ASCII XZ DAT file to COGO 3PC

The XYZ data file created when calculating the deck elevations as described in Section 5.8.12 End Span Command above can be used to store COGO points at the locations where an elevation was calculated. A 3PC application has been written to accomplish this task. It can be launched from the 3PC section of the Design and Computation Manager.

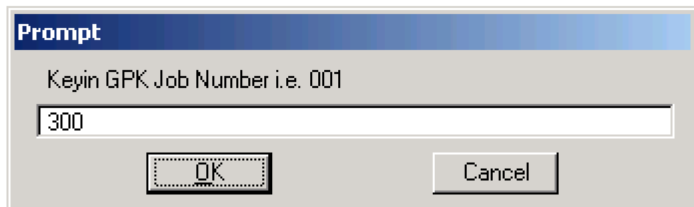


5.9.1 Launching the Tool

To launch the application, go to the **D&C Manager path 3PC Tools\Store ASCII XYZ DAT File to COGO**, which is highlighted in the following figure.

5.9.2 GPK Job Number Prompt

Double-clicking on the Store ASCII XYZ DAT File to COGO entry brings up the following Prompt. **Enter the GPK Job Number** (for example enter "300" for job300.gpk) and click **OK**.

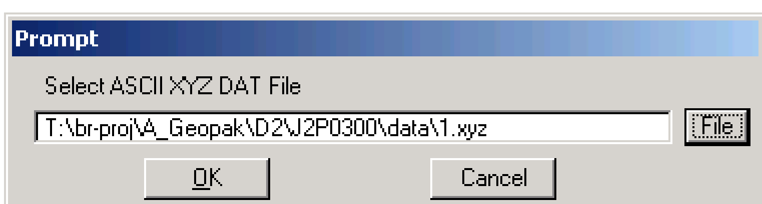


5.9.3 Select Redefine Option for COGO

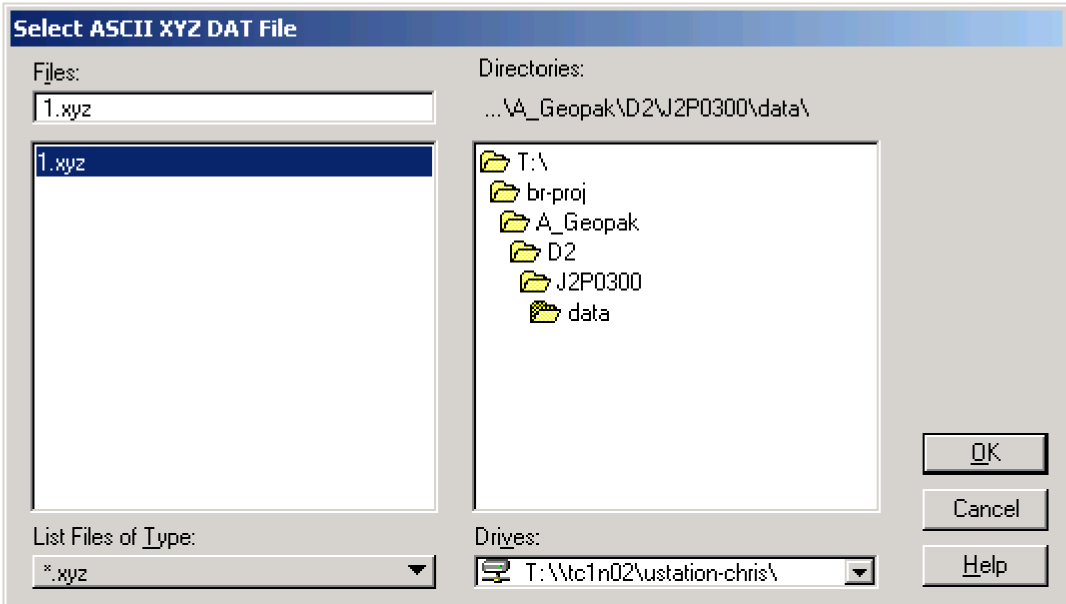
The next step is to determine if you want **Redefine to be On or Off** when the points are stored. Off is used for the example. If you set it to on, make sure you choose a safe beginning point namer. Click **OK** to accept your choice.

5.9.4 Select ASCII XYZ DAT File

The name of the file containing the XYZ data is requested next, as shown below.



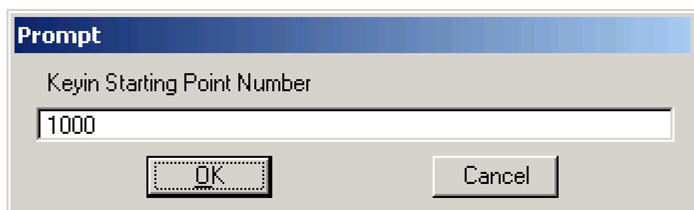
It can be typed in or the **File** button can be used to navigate to the file and select it using the following dialog.



Click **OK** to proceed to the next prompt.

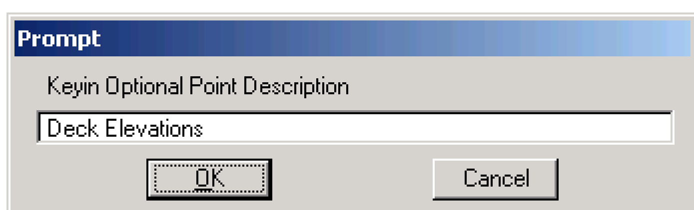
5.9.5 Keyin Starting Point Number

This prompt asks for the name to be assigned to the first point number to be stored. Since the names for the successive points are incremented by 1 be sure to use a starting name that will allow for a sufficient range of unused point names. 1000 is used below. Click **OK** to proceed.



5.9.6 Keyin Optional Point Descriptions

A description can be assigned to the points using this prompt. Enter the description you wish to use and click OK or leave in blank if you do not wish to use a description. This completes the process and the points are added to the GPK. At any point in the process you may click the Cancel button to end it at this point. Any values entered to that point are remember the next time you launch the application.



5.10 Additional Information

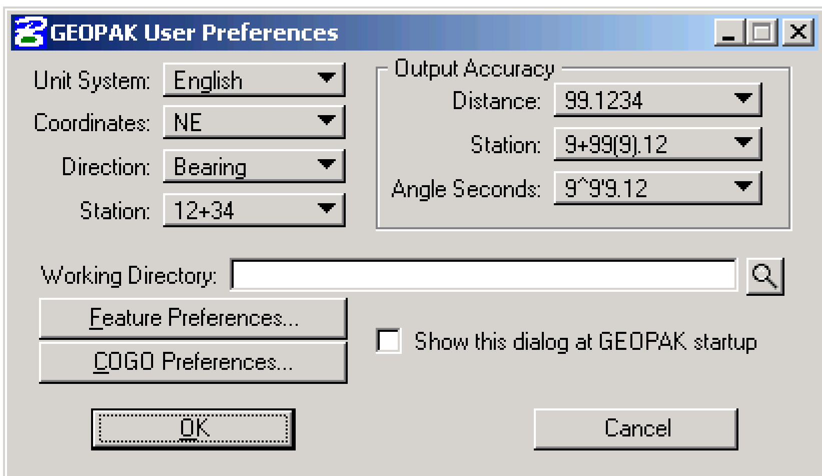
Additional COGO commands and information can be found in the GEOPAK Help.

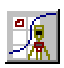
Exercise 5-1

This is an individual exercise to practice using COGO. All of the steps are given to you. Make sure you understand each step, because later you will need to determine which tools are needed to store COGO elements

1. Open the MicroStation file **t:\br-proj\Exercise_Rte_24\Route_24.dgn**.

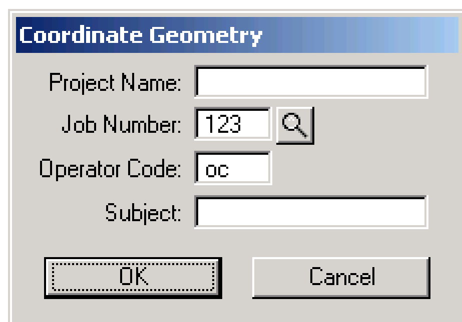
2. Go to **Applications>>Geopak Road>>User Preferences** and delete the working directory and set the **Coordinates** to Northing and Easting (**NE**).

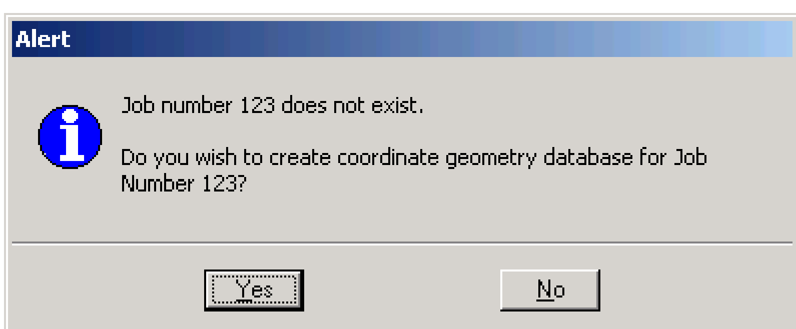


3. Open the **Coordinate Geometry** dialog. 

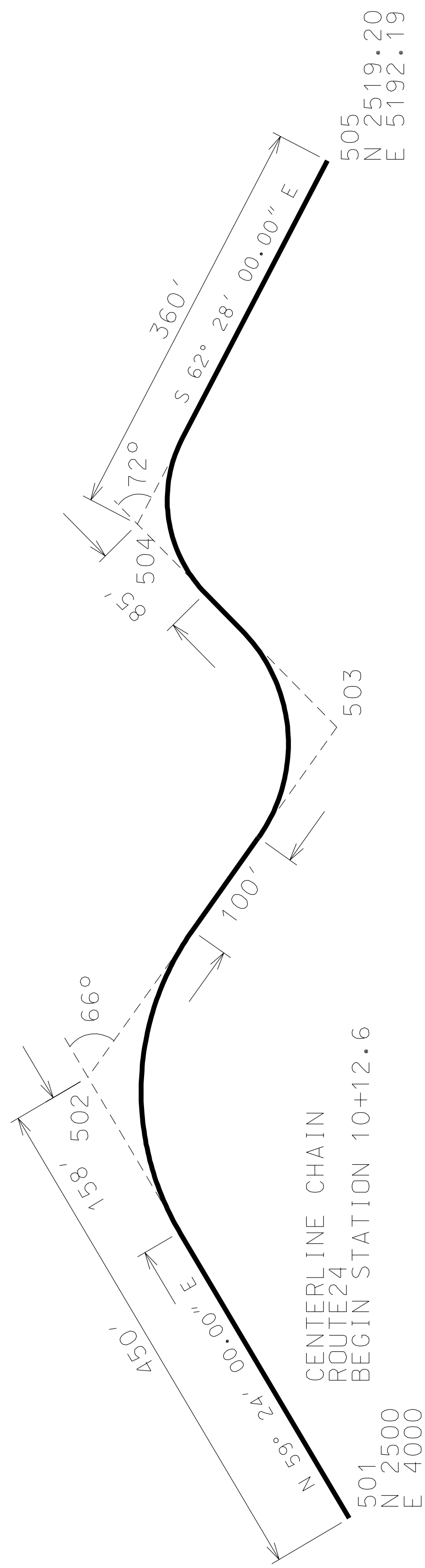
Use the settings shown to the right:
Create **Job Number: 123**
Set the **Operator Code** to your initials.

Say Yes to create the coordinate geometry database when the following Alert dialog box appears:

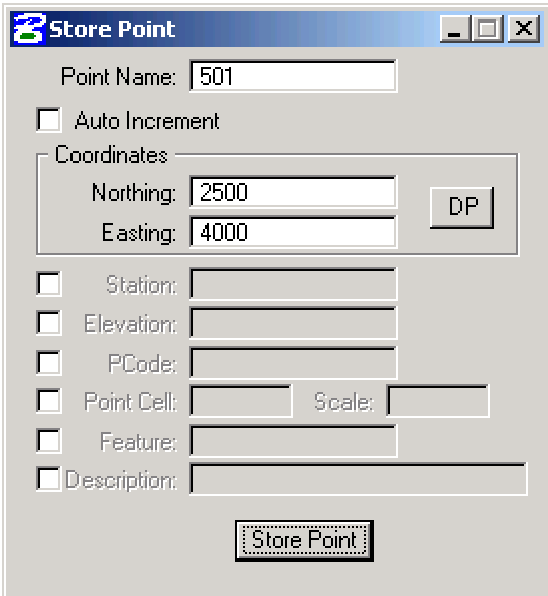


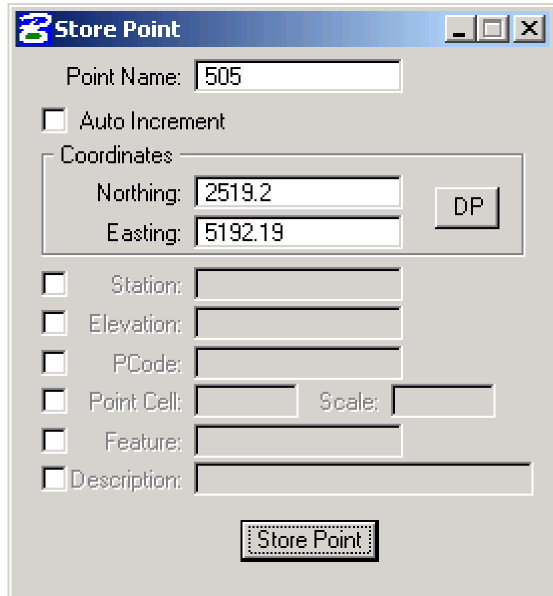


Create the following alignment as shown on the following pages.



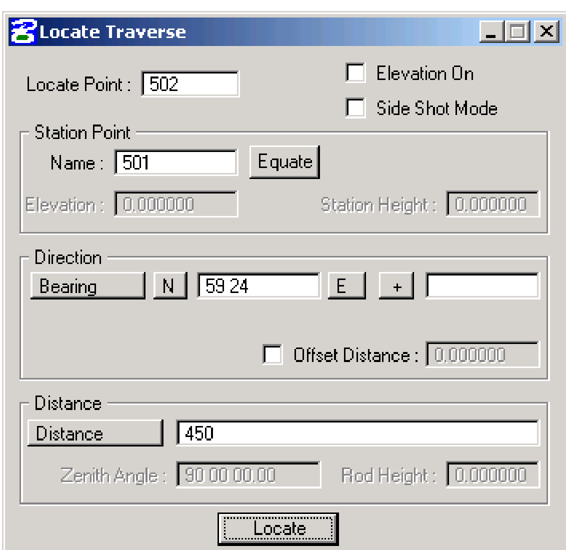
4. Store points 501 and 505 with the coordinates shown (**Element > Point > Store**).

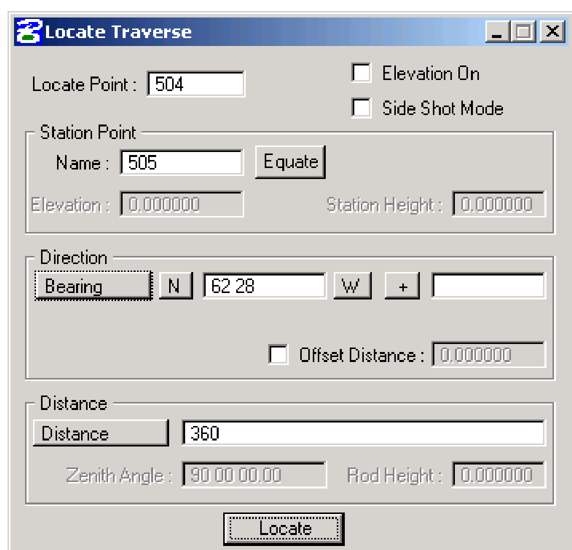




Key-in Commands:
Store Point 501 2500 4000
Store Point 505 2519.2 5192.19

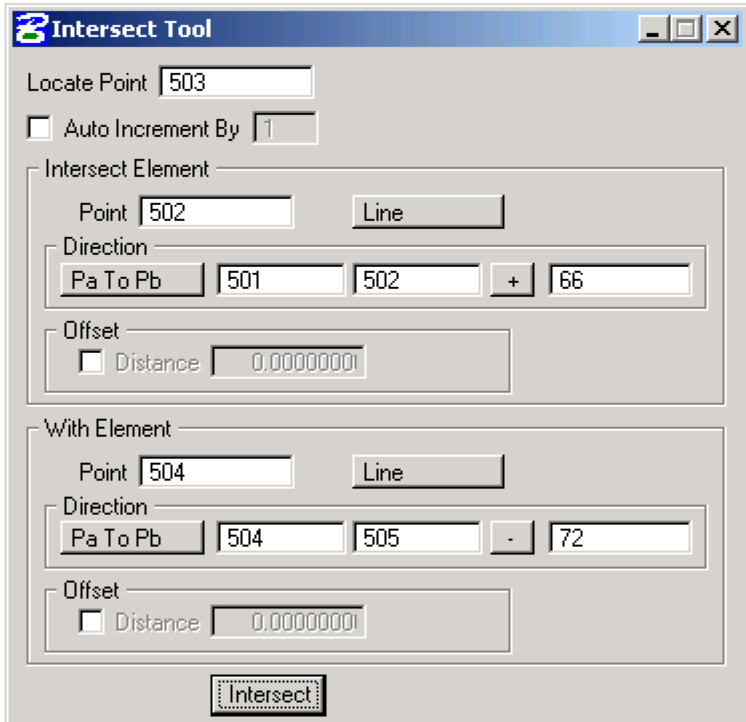
5. Locate points 502 and 504 (**Tools > Locate > Traverse**).





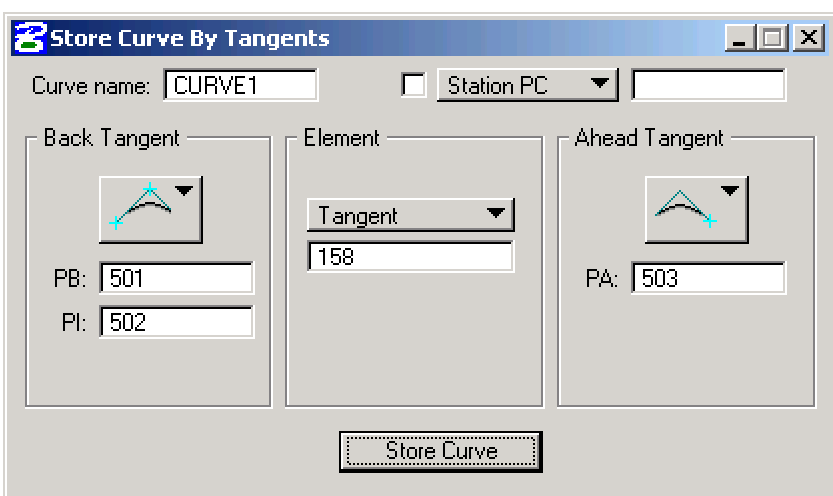
Key-in Commands:
LOCATE 502 TRAVERSE 501 DIS 450 N 59 24 E
LOCATE 504 TRAVERSE 505 DIS 360 N 62 28 W

6. Locate point 503 by using the **Intersect** tool (**Tools** > **Intersect**).



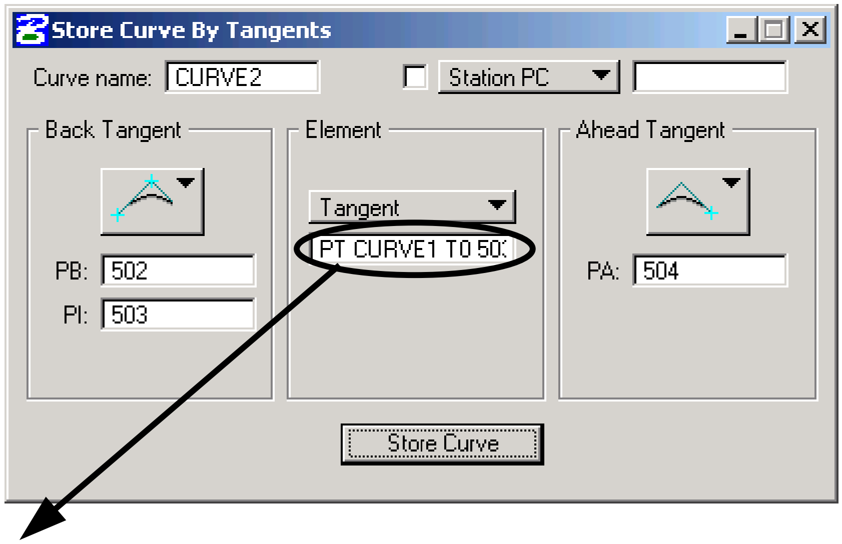
Key-in Command:
LOCATE 503 INTERSECT LINE 502 501 TO 502 P 66 LINE 504 504 TO 505 M 72

7. Store CURVE1, CURVE2, and CURVE3 (**Element** > **Curve** > **Store** > **By Tangents**).



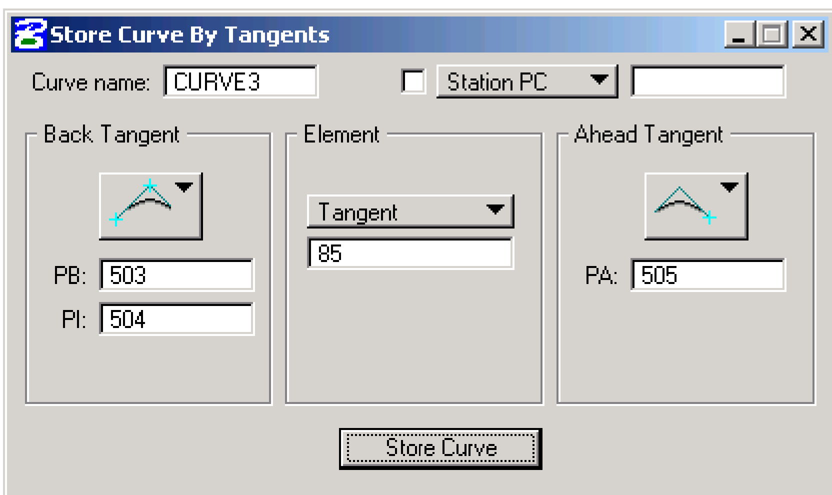
Key-in Command:
Store Curve CURVE1 PB 501 PI 502 Tangent 158 PA 503

7. (Continued)



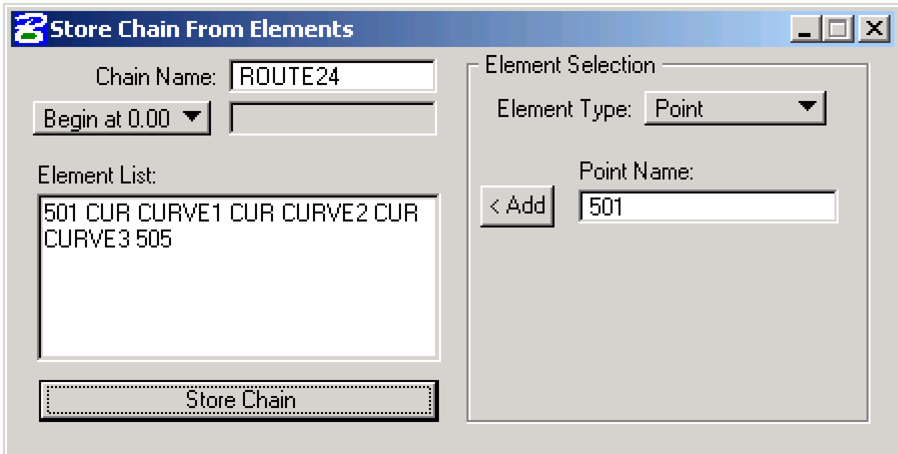
PT CURVE1 To 503 M 100

Key-in Command:
Store Curve CURVE2 PB 502 PI 503 Tangent PT CURVE1 To 503 M 100 PA 504



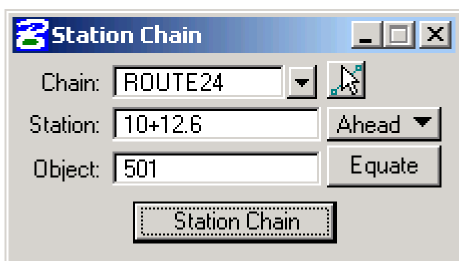
Key-in Command:
Store Curve CURVE3 PB 503 PI 504 Tangent 85 PA 505

8. Store the alignment chain Route24 (**Element** > **Chain** > **Store** > **From Elements**).



Key-in Command:
Store Chain ROUTE24 501 CUR CURVE1 CUR CURVE2 CUR CURVE3 505

9. Station the centerline at the beginning with station 10+12.6 (**Element** > **Chain** > **Station**).



Key-in Command:
Station Chain ROUTE24 BEG 10+12.6 501 AH

10. Describe the chain (**Element** > **Chain** > **Utility** or **Tools** > **Navigator**) and save the output file (**File** > **Utility**). Review the output file in **UltraEdit** or another text editor.

11. Use **COGO Navigator** (**Tools** > **Navigator**) to view the data.

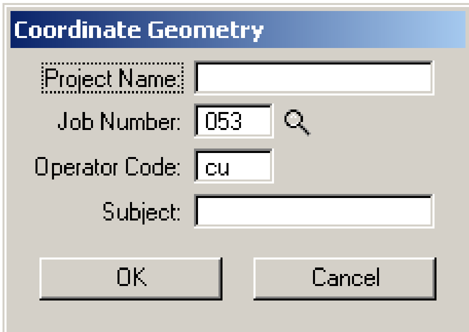
12. Exit Coordinate Geometry.

Exercise 5-2

This is an individual exercise to practice storing a horizontal alignment. It is to be done outside of a GEOPAK project.

1. Open the MicroStation file **t:\br-proj\Exercise_5-2\Route_50.dgn**.

2. Enter Coordinate Geometry creating a new GPK called **053**, as shown in the following dialog.



3. Use **Coordinate Geometry** to create the alignments as shown on the following pages.

   Note that all of the **coordinates are in XY** format.

   Do not worry about the graphics (stationing, curve data, etc.) being plotted. These items will be discussed in later chapters.

4. Upon completion of storing the alignments in coordinate geometry, close **coordinate geometry**.

Route50

Beginning Point: X = 1698102.3440 Y = 999551.4260

Ending Point: X = 1702419.9216 Y = 1000116.5660

Intersect the PI point using the direction back and direction ahead of curve.

Direction Back of Curve = S 82° 41’ 55” E

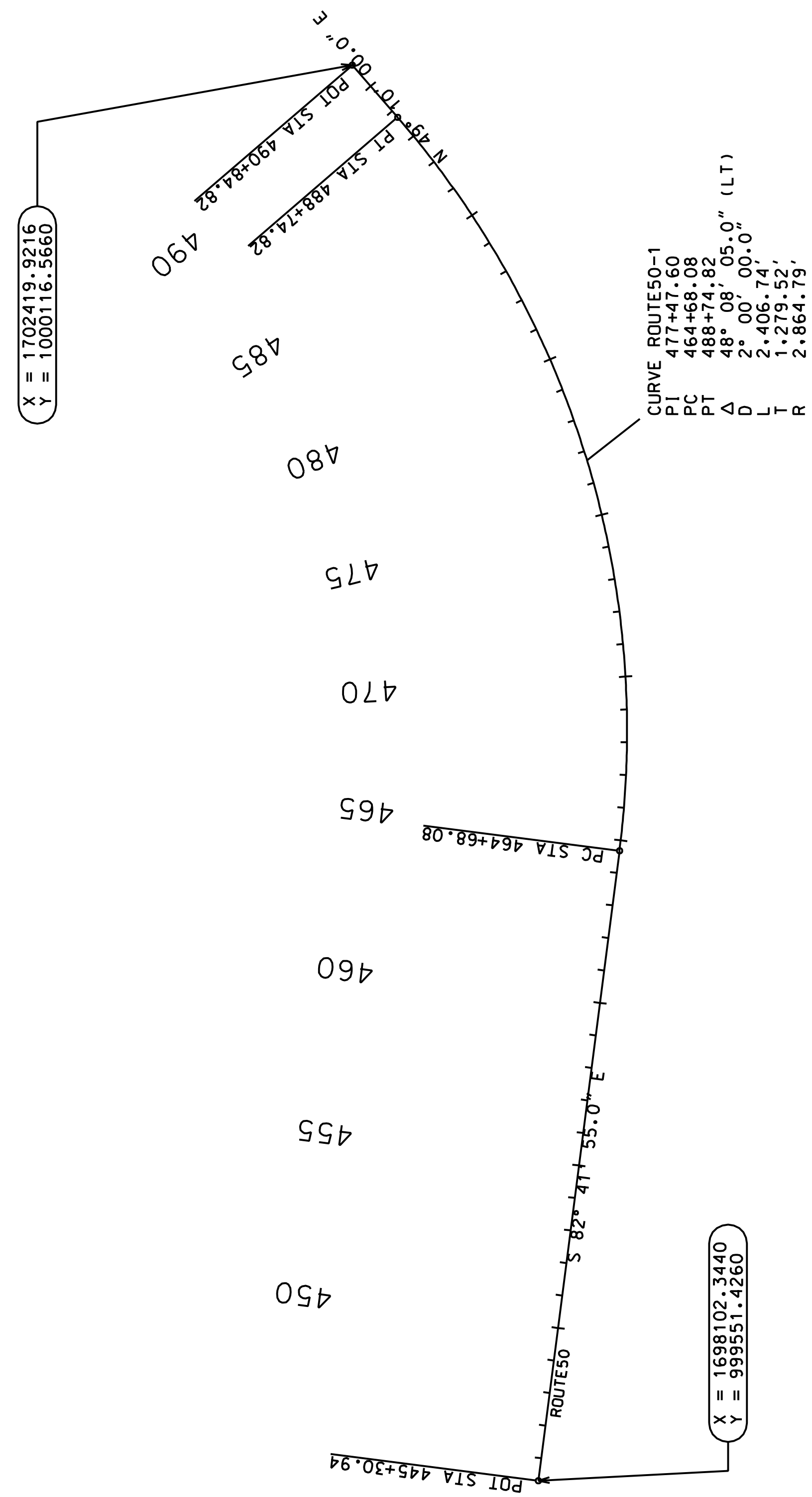
Degree of Curve = 2° 00’ 00”

Direction Ahead of Curve = N 49° 10’ 00” E

Station the chain beginning at 445+30.94

Name the alignment **Route50**.

Route 50


X = 1702419.9216
Y = 1000116.5660
POT STA 490+84.82
PT STA 488+74.82
N 49° 10' 00.0" E
490
485
480
475
470
465
460
455
450
CURVE ROUTE50-1
PI 477+47.60
PC 464+68.08
PT 488+74.82
Δ 48° 08' 05.0" (LT)
D 2° 00' 00.0"
L 2,406.74'
T 1,279.52'
R 2,864.79'
PC STA 464+68.08
S 82° 41' 55.0" E
ROUTE50
X = 1698102.3440
Y = 999551.4260
POT STA 445+30.94

Big Horn

Beginning Point: X = 1700104.5480
Y = 1000188.1340

Ending Point: X = 1700092.3040
Y = 998143.9168

PI of the first curve is exactly 248.8954’ from the beginning point on a bearing of S 1° 04’ 27.8” W

Direction Back of first curve = S 1° 04’ 27.8” W

Degree of Curve for first curve = 5° 00’ 00”

Direction Ahead of first curve = S 6° 32’ 27.3” E

The direction back of second curve matches the direction ahead of the first curve, which is S 6° 32’ 27.3” E

Degree of Curve for second curve = 5° 00’ 00”

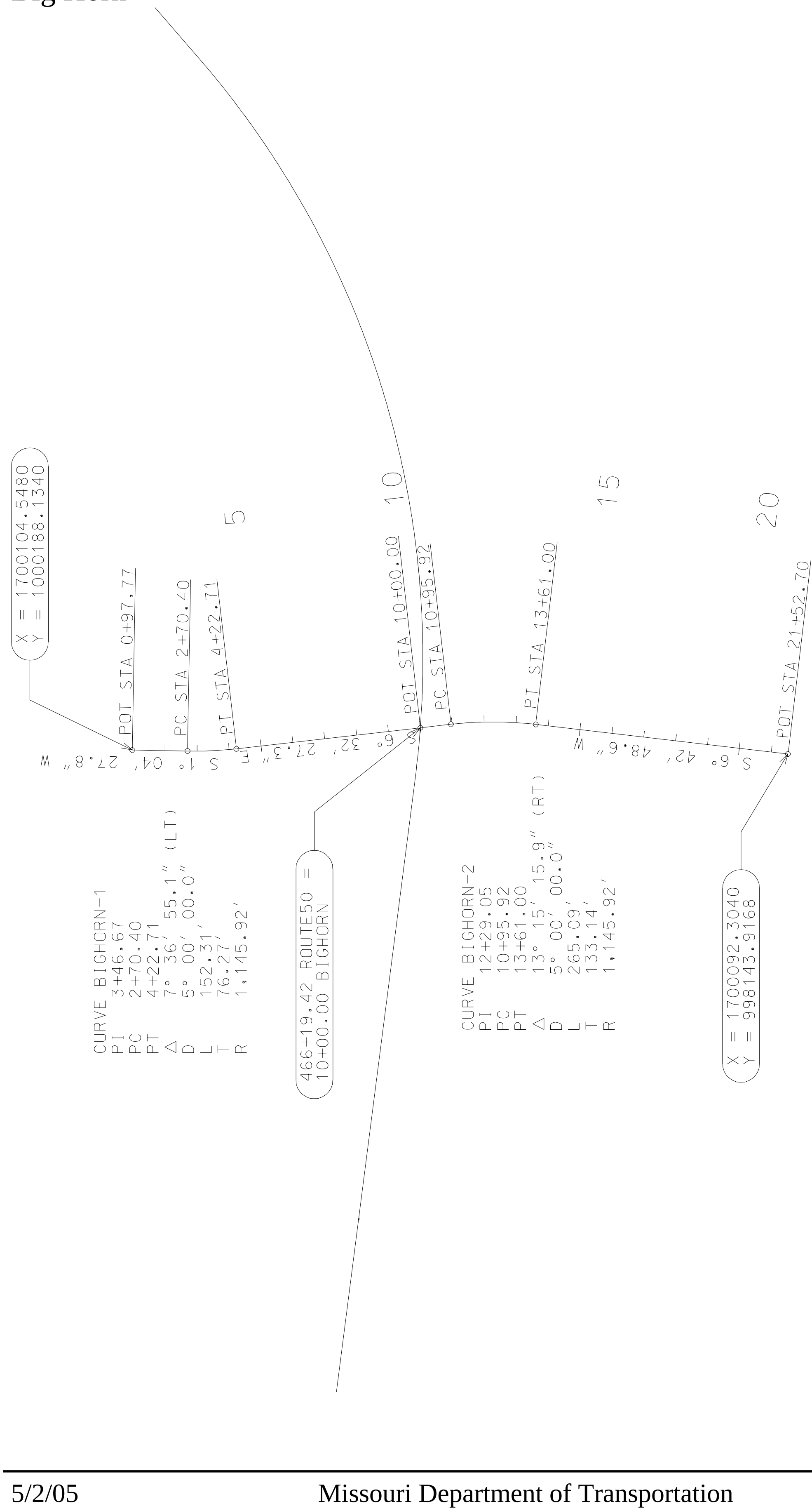
Direction Ahead of second curve = S 6° 42’ 48.6” W

Intersect the alignment chain Route50 with a line segment between the PT of the first curve, and the PC of the second curve. **Note**: The Route 50 station value shown is approximate.

Store the alignment as BigHorn (be sure to include the Route50 intersection point)

Station the alignment with station 10+00 at the intersection point with the Route50 chain.

Big Horn



X = 1700104.5480
Y = 1000188.1340
POT STA 0+97.77
PC STA 2+70.40
PT STA 4+22.71
5
POT STA 10+00.00
10
PC STA 10+95.92
PT STA 13+61.00
15
20
POT STA 21+52.70
S 1° 04' 27.8" W
6° 32' 27.3" E
S 6° 42' 48.6" W
CURVE BIGHORN-1
PI 3+46.67
PC 2+70.40
PT 4+22.71
Δ 7° 36' 55.1" (LT)
D 5° 00' 00.0"
L 152.31'
T 76.27'
R 1,145.92'
466+19.42 ROUTE50 =
10+00.00 BIGHORN
CURVE BIGHORN-2
PI 12+29.05
PC 10+95.92
PT 13+61.00
Δ 13° 15' 15.9" (RT)
D 5° 00' 00.0"
L 265.09'
T 133.14'
R 1,145.92'
X = 1700092.3040
Y = 998143.9168

Ramp 1

Beginning Point is at station 452+56.52; offset 66’ LT of Route 50

The PC of the curve is the Beginning Point

Direction Back of the curve is S 82° 41’ 55” E

Degree of Curvature = 4° 00’ 00”

Direction Ahead of the curve is N 83° 27’ 28.56” E

Alignment ends at Big Horn, at **about** Station 6+55.32

Station the alignment beginning at 0+00

Name the alignment Ramp1

Ramp 3

Beginning Point is at station 479+48.31; offset 66’ LT of Route 50

Ending Point is at end of Ramp1; however, use different point numbers for the ending point of each ramp. **Hint**: Element > Point> Equate.

PC of the first curve is the alignment beginning point.

Direction Back for the first curve is S 67° 41’ 47.7” W

Degree of Curvature for first curve = 6° 00’ 00”

Direction Ahead for the first curve is N 69° 50’ 21.3” W

Point Back of the second curve is the PI of the first curve

PI of second curve is at the intersection of a line through the PI of the first curve with a bearing of N 69° 50’ 21.3” W and a line through ending point of Ramp1 with a bearing of N 83° 27’ 28.56” E. **Hint**: Do not use the same point number as the ending point for both ramps.

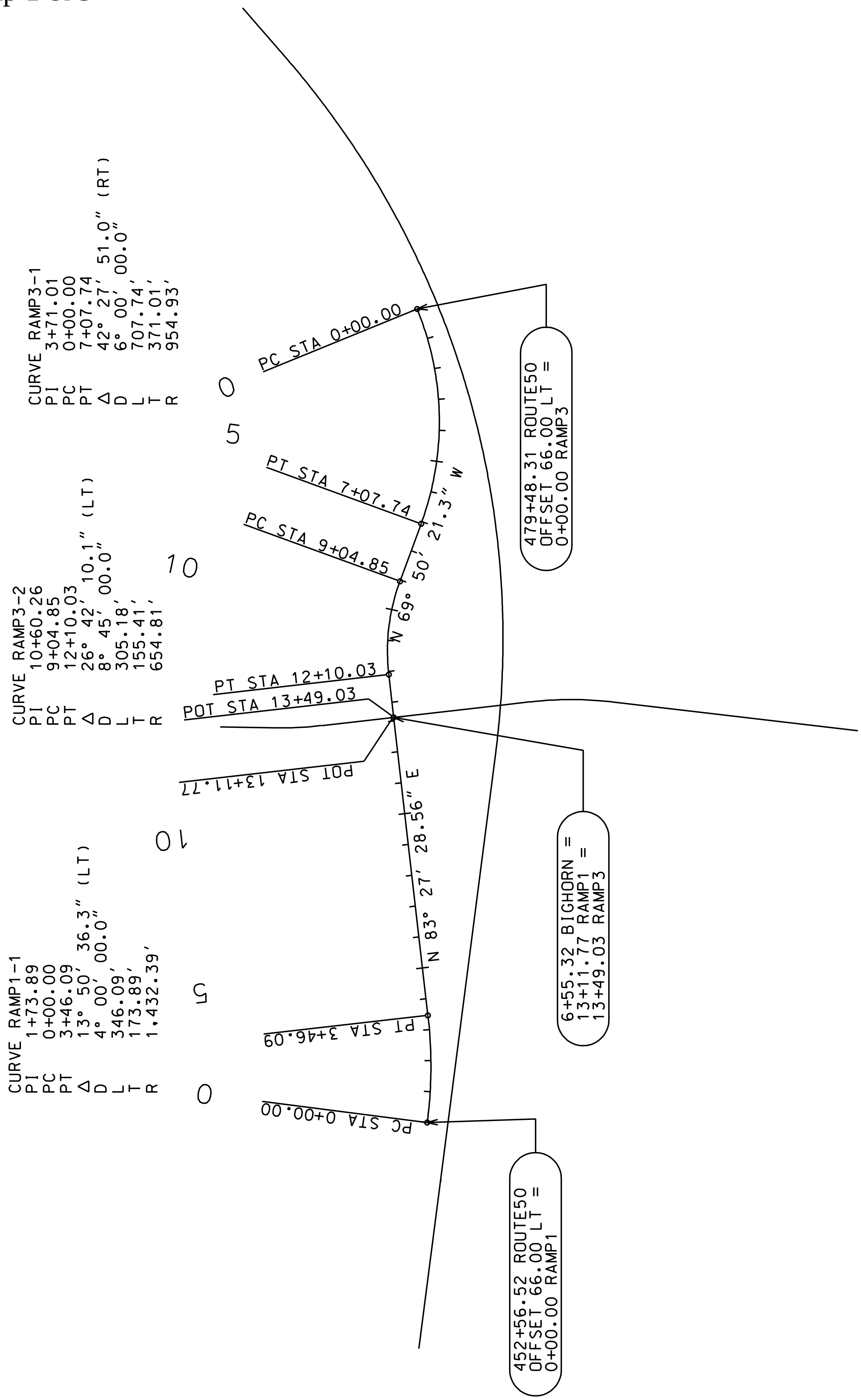
Degree of Curvature for the second curve = 8° 45’ 00”

Point Ahead of the second curve is the alignment end point

Station the alignment beginning at station 0+00

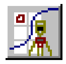
Name the alignment Ramp3

Ramp 1 & 3


CURVE RAMP3-1
PI 3+71.01
PC 0+00.00
PT 7+07.74
Δ 42° 27' 51.0" (RT)
D 6° 00' 00.0"
L 707.74'
T 371.01'
R 954.93'
CURVE RAMP3-2
PI 10+60.26
PC 9+04.85
PT 12+10.03
Δ 26° 42' 10.1" (LT)
D 8° 45' 00.0"
L 305.18'
T 155.41'
R 654.81'
CURVE RAMP1-1
PI 1+73.89
PC 0+00.00
PT 3+46.09
Δ 13° 50' 36.3" (LT)
D 4° 00' 00.0"
L 346.09'
T 173.89'
R 1,432.39'
PC STA 0+00.00
PT STA 7+07.74
PC STA 9+04.85
PT STA 12+10.03
POT STA 13+49.03
POT STA 13+11.77
PT STA 3+46.09
PC STA 0+00.00
N 69° 50' 21.3" W
N 83° 27' 28.56" E
0
5
10
10
5
0
479+48.31 ROUTE50
OFFSET 66.00 LT =
0+00.00 RAMP3
6+55.32 BIGHORN =
13+11.77 RAMP1 =
13+49.03 RAMP3
452+56.52 ROUTE50
OFFSET 66.00 LT =
0+00.00 RAMP1

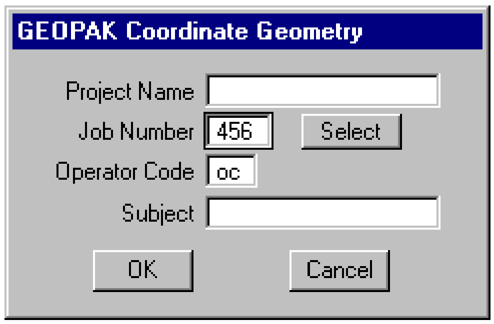
Exercise 5-3 This is an optional individual exercise.

1. Open the Microstation file **t:\br-proj\Exercise_B1\B1.dgn**

2. Open the **Coordinate Geometry** dialog. 

   Create **Job Number**: **456**

   Set the **Operator Code** to your initials.

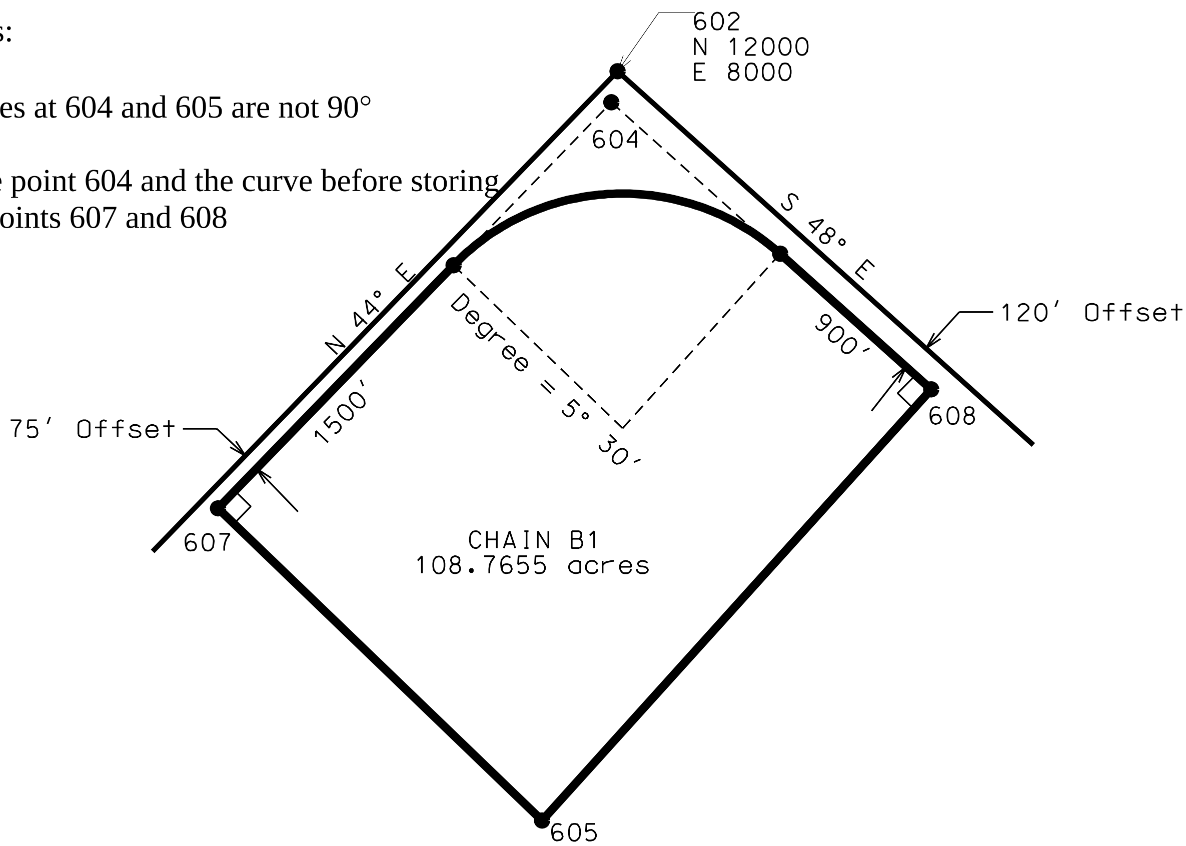


3. Use the **Coordinate Geometry** tools to create chain B1 as shown below. Verify the area of the chain.

Hints:

Angles at 604 and 605 are not 90°

Store point 604 and the curve before storing points 607 and 608



Exercise 5-4

This is a group exercise to demonstrate how survey points stored in a GPK file can be use to store a chain and profile.

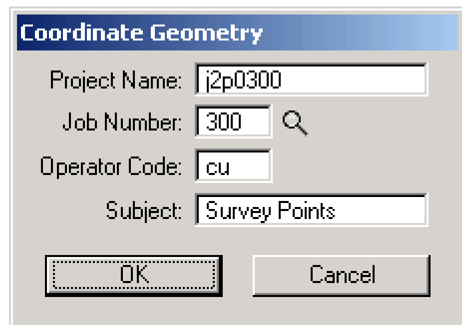
1. Open the MicroStation file **t:\br-proj\a_geopak\d2\j2p0300\data\plan_j2p0300.dgn**.

   If it is not already attached, attach **t:\br-proj\a_geopak\d2\j2p0300\data\topo_j2p0300.dgn** as a reference file.

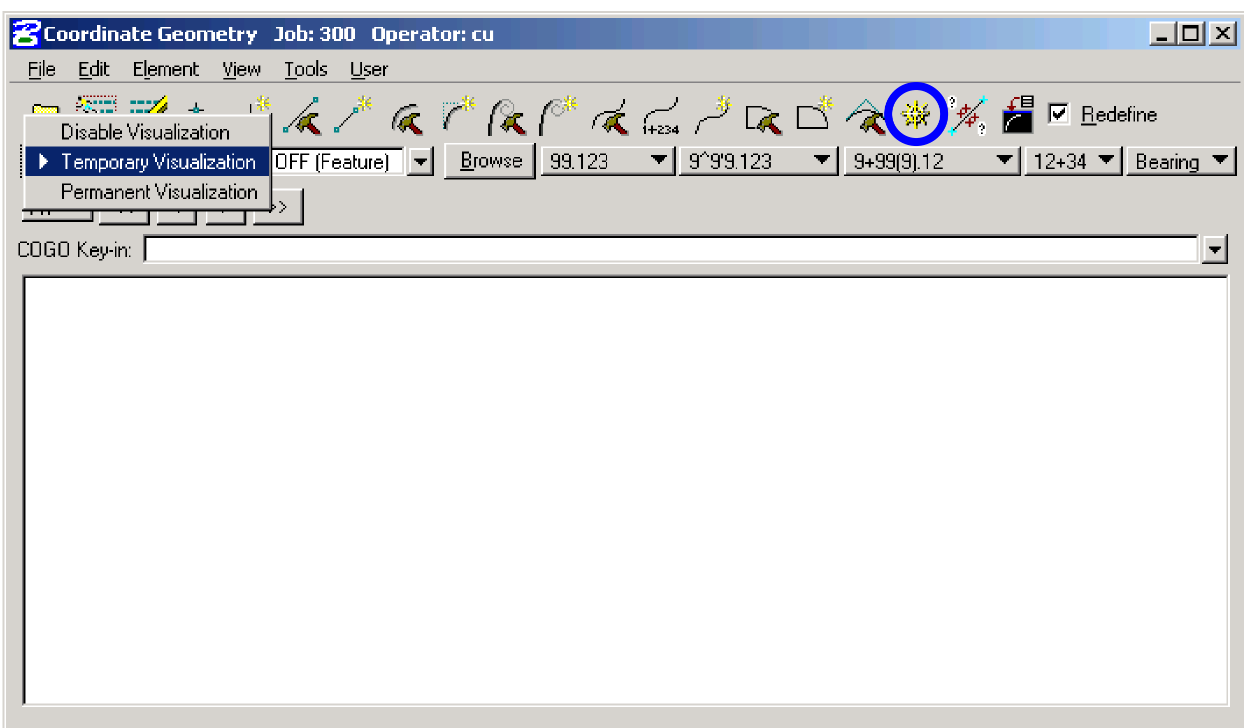
2. Enter **Coordinate Geometry**.

   If the dialog box to the right appears, enter the following settings as shown to the right:

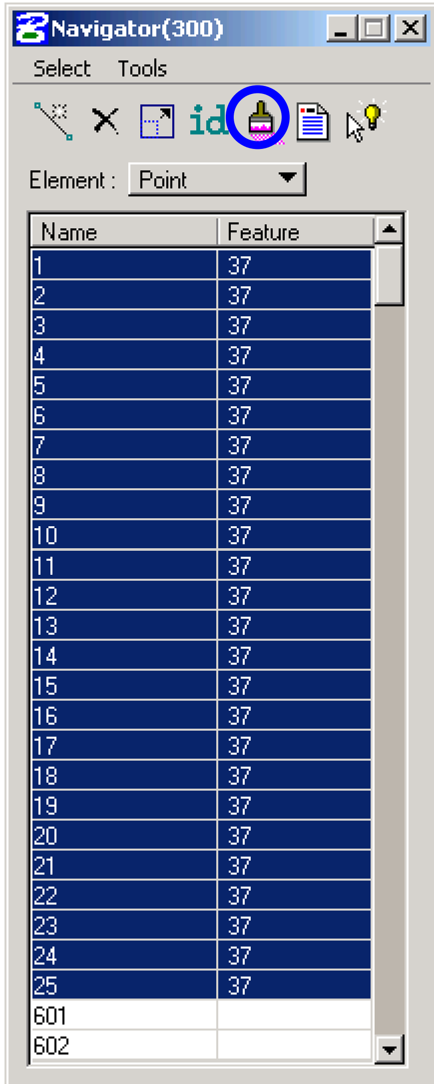
   Project Name: **J2P0300**
   Job Number: **300**
   Operator Code: **cu**
   Subject: **Survey Points**



3. Set the Visualization to Temporary Visualization and open the COGO navigator by clicking on the icon circled following dialog.



4. With the Element set to Point, highlight points 1-25 as shown below. Visualize the points by clicking on the Visualize Element icon (the paint brush), which is circled in the figure.



These points are the field survey and contain XY&Z information for the streambed. Typically these points are used to store a 3D survey chain. Many parts of GEOPAK Road cannot work with a three dimensional chain, a 2D chain and profile need to be created from the points.

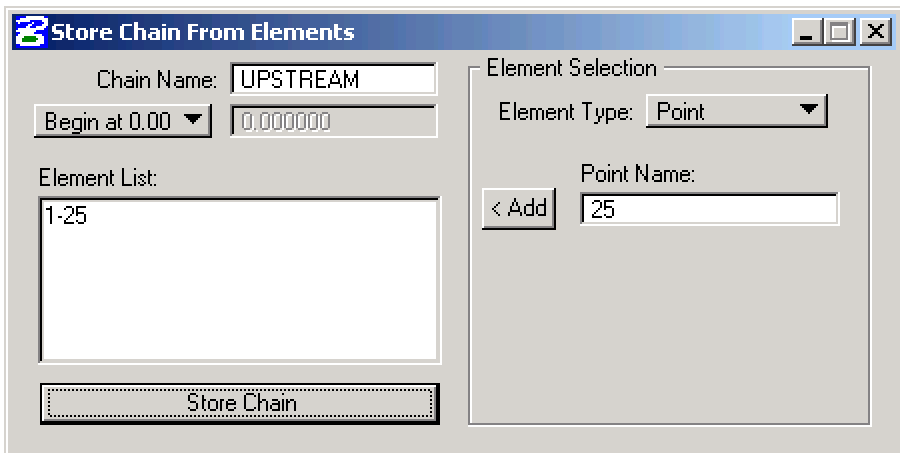
In most instances the District Designer will have already done this. The following steps show how the points can be used the 2D chain and profile. The process is to store a point-to-point chain using the points, which assigns station values to the points based in the station value assigned to the beginning of the chain.

Once the chain is stored, a key-in command can be used to create the profile from the 3D points with the station value assigned to them

5. The chain can be created from a list of points by going to the COGO pull down menu **Element** > **Chain** > **Store** > **From Elements**: The chain can be stored in either direction, depending upon the order in which the points are listed. If the chain and profile are desired to run in the same direction as the increasing numerical order of the points the element list for the twenty-five points in the example is "**1-25**". However, if the chain and profile are to run in the opposite direction of the numerical order of the points, the element list needs to be reversed so it is "25-1". If this reverse order is used, COGO assigns the beginning station value to point 25 and increase the stationing as the chain proceeds to points 24, 223, etc.

   Since we are going to use upstream stationing, fill our the Store Chain From Elements using the following values as shown in the following dialog as well:

   Chain Name: **UPSTREAM**
   Stationing: **Begin at 0.00**
   Element List: **1-25**



   Once the dialog is complete, click on **Store Chain** to store the chain.

6. The profile must be created using a key-in command. It is of the form:

   <u>S PRO name list</u>,

   where:
   S is short for STORE command,
   PRO is short for PROFILE,
   name is the name of the profile to be stored, and
   list is the list of previously stored points.

   The list of points may be listed as individual points, a point range, or a combination of the two.

   Type in the following command intn the COGO Key-in field and hit ENTER to execute the command:

   S PRO UPSTREAM 1-25

7. Use the COGO navigator to describe the chain and profile just stored.

Chapter 6

Graphical COGO

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6.1 Objectives

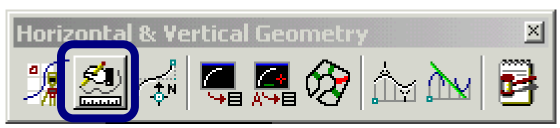
Create and store coordinate geometry elements using the Graphical Coordinate Geometry tools.

6.2 Definitions

Graphical Coordinate Geometry (Graphical COGO) is a set of tools that allows the user to store or modify coordinate geometry elements (points, lines, curves, spirals, chains, and parcels) by key-in or a mouse click. (**Note**: Use a "left click" to data point or accept and a "right click" to reject.) The elements are stored directly into the coordinate geometry database (.gpk) while being created or modified graphically on the screen.

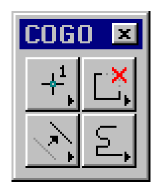
6.3 Accessing

The Graphical Coordinate Geometry tools can be accessed from the Road tool frame or from the MicroStation Application pull down menu. Click on the second icon in the Horizontal & Vertical Geometry tools shown below to access the tool from the Road tool frame.



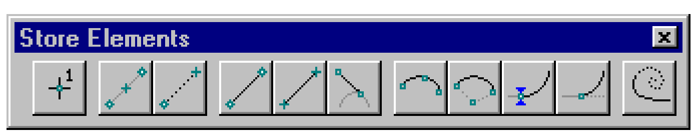
Or select **Applications > GEOPAK Road > Geometry > Graphical Coordinate Geometry** to access the tool. If the user attempts to activate Graphical COGO without an active session of coordinate geometry, a warning dialog will appear advising the user that a coordinate geometry session must be started.

6.4 Tool Frame

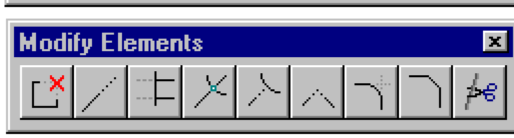


When Graphical COGO is started, the tool frame shown in the figure to the right appears. It contains the following four toolboxes. When a tool in one of the toolboxes is selected, a dialog box will appear for the user to key-in any required information.

6.4.1 Store Elements



6.4.2 Modify Elements

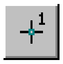


6.4.3 Manipulate Elements

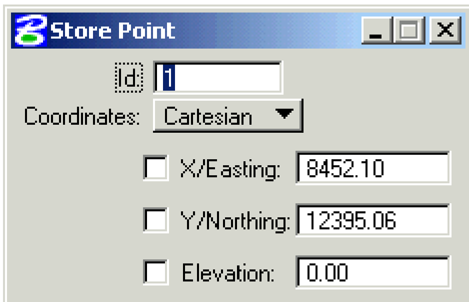
6.4.4 Groups

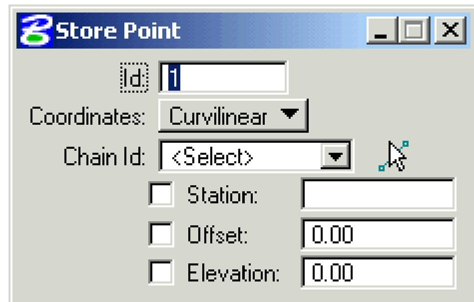
6.5 Store Elements Tools

The Store Elements toolbox is used to store points, lines, curves, and spirals. The following tools are contained in the Store Elements toolbox.

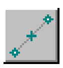


6.5.1 Store Point

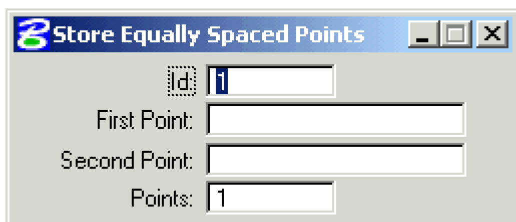




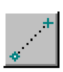
The user can store a point by either Cartesian coordinates (XYZ), or curvilinear coordinates (station and offset). The XY and/or Z coordinates or the station, offset, and/or elevation can be locked or a data point can be used to place the point.



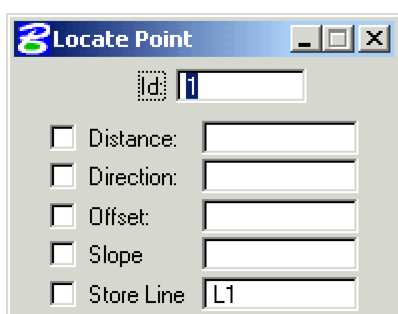
6.5.2 Store Equally Spaced Points



Stores a given number of points spaced equally between two specified points. The points may be either previously stored to COGO points or may be stored automatically by data pointing at the location of the desired point.

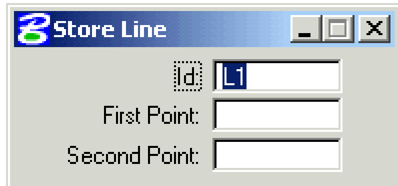


6.5.3 Locate Point



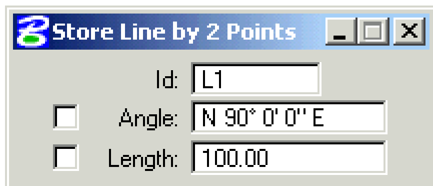
Stores a point by distance and direction. The distance, direction, offset, and slope can be locked. A line segment can also be stored.

6.5.4 Store Line



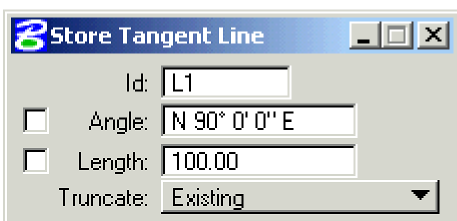
Stores a line segment between two previously stored points.

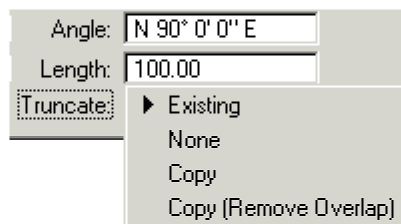
6.5.5 Store Line by 2 Points



Stores a line segment and its endpoints. The distance and direction of the line segment can be specified.

6.5.6 Store Tangent Line





Stores a line segment that is tangent to a curve. The two endpoints of the line segment are also stored. The angle and the length of the tangent line can be specified. Four **Truncate** options affect what happens to the original COGO element. They are:

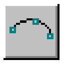
Existing: The original COGO element is truncated or extended to the end of the new COGO element.

None: The original COGO element is unchanged and is not truncated.

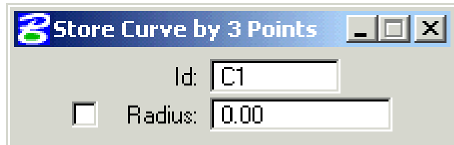
Copy: The original COGO element is copied and the copy is truncated or extended so that the original element is left unchanged

Copy (Remove Overlap): If the end of the new COGO element is not on the original element, a copy is made of the original element. The copy is extended to the new element and any overlap with the original element is removed.

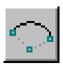
Note: Redefine must be activated for the original element to be modified.



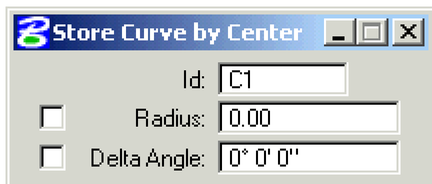
6.5.7 Store Curve by 3 Points



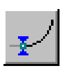
Stores a circular curve by data pointing to locate the beginning (PC) and ending points (PT) of the curve. The radius of the curve may be specified (by entering and locking its value in the **Radius:** field) or set dynamically by a data point locating a point on the curve (prompt requests a Through Point). If the radius is specified the final data point determines which of the possible solutions is stored.



6.5.8 Store Curve by Center

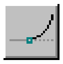


Stores a curve by specifying the center and the beginning location of the curve. The **Radius** may be specified or set dynamically by a data point locating the start of the curve. The **Delta Angle** may be specified or set dynamically by locating the ending point.

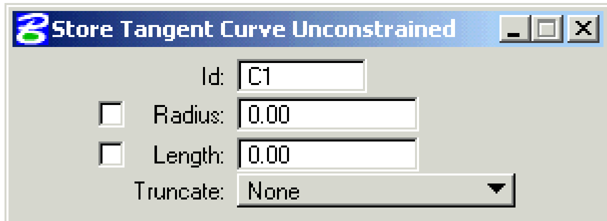


6.5.9 Store Tangent Curve Constrained

Stores a curve tangent to a previously stored COGO element selected with a data point. The curve **Radius** may be specified or set dynamically by a data point locating the center of the curve. Once the radius is set, the length of the curve may set manually by specifying either the **Delta** angle, the **Direction** ahead, or the **Length** of the curve with the final data point determining which of the possible solutions is stored. If the length of the curve is not specified, a data point sets it dynamically.

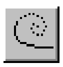


6.5.10 Store Tangent Curve Unconstrained

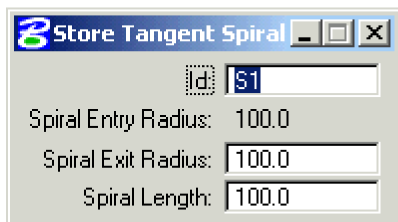


Stores a curve tangent to a previously stored COGO element selected by the first data point. The second data point dynamically specifies the through point. The **Radius** and/or the **Length** of the curve may be specified or set dynamically by a data point. The **Truncate** options are the same as those described for Store Tangent Line.

Note: Redefine must be activated for the original element to be modified.



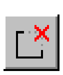
6.5.11 Stores Tangent Spiral



Stores a spiral tangent to a previously stored COGO element. To use the tool, manually enter the **Spiral Exit Radius** and **Spiral Length**. Once these are set, identify the COGO element. The **Spiral Entry Radius** is calculated from the identified element and displayed. Move the cursor to see the possible solutions and data point when the desired one is displayed.

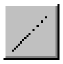
6.6 Modify Element Tools

The Modify Elements toolbox is used to modify previously stored cogo elements. The **Redefine** toggle must be turned on to modify existing elements. **Note: When using the tools it is very important to pay attention to the prompts in the lower left hand corner of the MicroStation window**. This is because may of the tools require the user to identify the element to be modified and than accept or reject the selection before moving on to the next step. This functionality is provided because unlike the MicroStation, Graphical COGO does not have an undo function. The following tools are contained in the Modify Elements toolbox.

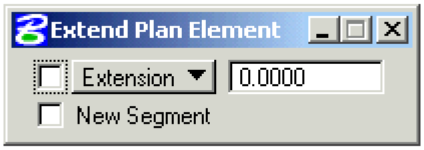


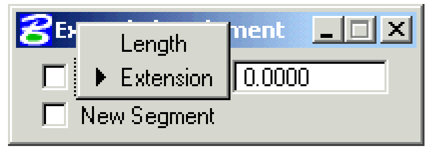
6.6.1 Partial Delete

Deletes part of a COGO element creating two separate COGO elements. Additional points will be stored if needed. It works like the MicroStation Partial Delete tool. The first data point indicates the start of the deletion. With this defined the movement of the cursor shows the dynamic deletion with the second data point indicating the end of the deletion.

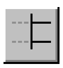


6.6.2 Extend Plan Element



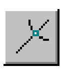


Extends or shortens any COGO element. The tool work similar to the MicroStation Extend tool with the addition that the total **Length** of the modified element or only the amount of the **Extension** may be specified manual. A **positive** extension value lengthens the element and a **negative** value shortens it. If the **New Segment** is toggled on and the new length is longer than the original element, the original element is left unchanged and a new COGO line segment is created to bridge the gap. New Segment has no effect if the original element is shortened.

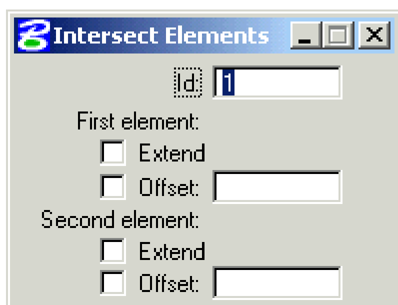


6.6.3 Trim Elements

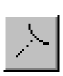
Trims or extends COGO elements to another COGO element. Its function is similar to the MicroStation Trim Element tool. First select and accept the COGO element to be used as the cutting element (2 separate mouse data points). With the cutting element selected, identify the COGO element to be trimmed or extended by a data point on the end of the element to trimmed or extended. COGO will display the tentative solution. Data point on the screen to accept or press the mouse resent button to reject. If desired, additional elements can be modified based on the cutting line by identifying the end of the next COGO element to be modified.



6.6.4 Intersect Elements

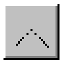


Stores a new COGO point at the intersection of two COGO elements. The original elements are not modified. If the elements do not actually cross, **Extend** must de activated (toggled on) for the element(s) that needs to projected. An **Offset** may be specified for either of the elements by activating the option and entering the offset amount (positive for an offset to the right and negative for an offset to the left). The steps to using the tool are to identify the first element and accept it; identify the second element and accept it; and accept the proposed solution. Clicking the mouse-reset will stop the process.



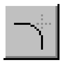
6.6.5 Extend Element to Intersection

Lengthen or shorten a COGO element to another COGO element. Works functionally the same as its MicroStation counterpart with the addition of the accept/reject option.

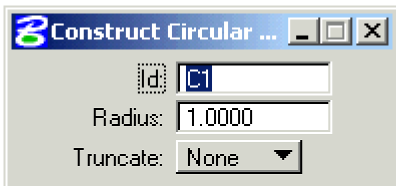


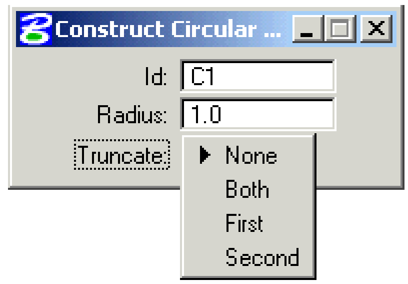
6.6.6 Extend Elements to Intersection

Lengthens or shortens two elements to intersect each other. Works functionally the same as its MicroStation counterpart with the addition of the accept/reject option.

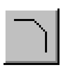


6.6.7 Construct Circular Fillet

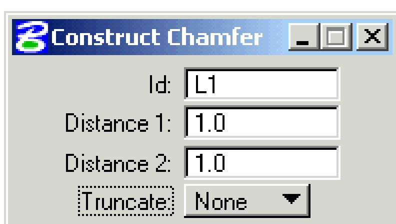


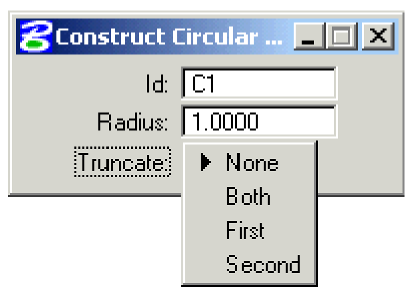


Stores a circular curve between two COGO elements. To use the tool, specify the name of the curve to be created and its radius or accept the next available name. There are four **Truncate** options determine whether or not the original elements are modified: **None**—neither element is modified, **Both**—both original elements are lengthened or shortened as need, **First**—only the first element is modified, and **Second**—only the element selected second is modified. After identifying and accepting the first element and identifying the second element, at tentative solution will be displayed if there is one. Moving the cursor will through the four possible quadrants will vary the solution. With the desired solution displayed data point to accept the solution.

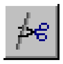


6.6.8 Construct Chamfer

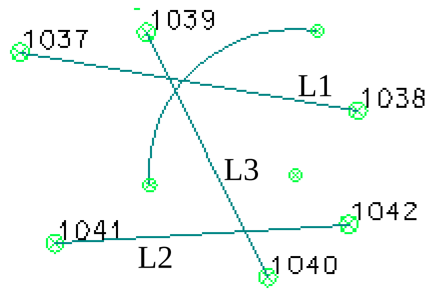




Stores a line and its endpoints between two nonparallel elements. To use the tool, specify the name of the line to be created or accept the next available name. **Distance 1** is the distance along the first selected COGO element from the intersection point of the two original elements to the start of the chamfer. **Distance 2** is the along the second COGO element from intersection point to the end of the chamfer. After identifying & accepting the first element and identifying the second element, the movement of the cursor will display the different possible solutions. Data point when the desired solution is displayed to accept that solution. The four **Truncate** options are the same as those for constructing a circular fillet.



6.6.9 Cut Element



The tool cuts a COGO element into segments. **Keep original element** causes the original element(s) to remain unchanged and only copies of the element are modified if this option is activated. There are four operation modes for the tool. The figure to the right is used to describe the first two modes.

One Cut Many: If a MicroStation selection set is not used, the first element identified is the element to be cut and the second element is the cutting element. However, if more than one element is to be cut, a MicroStation selection set must be used. For this option, place the elements to be cut into a selection set, activate the Cut Element tool, identify the cutting element, and accept/reject the proposed solution. As an example: L1, L2 and the curve can be cut at the same time by placing them into a MicroStation selection set and selecting L3 as the cutting element.

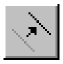
Many Cut One: If a MicroStation selection set is not used, the first element identified is the cutting element and the second element is the element to be cut. However, if one element is to be cut by many, a MicroStation selection set must be used. For this option, place the cutting elements in a selection set, activate the Cut Element tool, identify the element to be cut, and accept/reject the proposed solution. As an example: To cut L3 using the other element, place L1, L2 and the curve into a MicroStation selection set, activate the tool, and select as the element to be cut.

Cut by Distance: The original COGO element is divided into segments of the user specified length starting at the beginning point of the element. The length of the original element determines the number of segments. The final segment will be shorter than the others unless the length of the original element is evenly divisible by the segment length. After identifying the element to be cut, the tentative solution is displayed, which can be accepted or rejected.

Cut by Interval: Divides a COGO element into segments of equal length. The number of segments is determined by the value entered into the field to the right of the Mode toggle. After identifying the element to be cut, the tentative solution is displayed, which can be accepted or rejected.

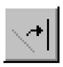
6.7 Manipulate Elements

The Manipulate Elements tools allow the user to adjust previously created COGO elements. If an element is moved, the redefine toggle must be turned on. The following tools are in the Manipulate Elements toolbox.

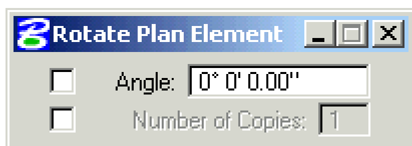


6.7.1 Move Plan View Element

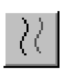
Moves or copies a COGO element. The **Number of Copies** toggle determines if the element is moved or copied. If activated, the number of copies may be specified. To use the tool, identify and accept the element, data point to locate an origin point and data point a second time to locate the end point.



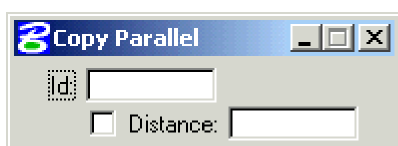
6.7.2 Rotate Plan View Element



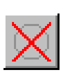
Rotates the element about a specified point. The user may specify the **Angle** of rotation and the **Number of Copies**, if any. After identifying and accepting the element, data point to locate the point of rotation, data point to locate a first point, and data point to locate the second point or to accept the solution using the specified angle.



6.7.3 Copy Parallel



Copies an element parallel to the original element. The user may specify an offset distance by activating the **Distance** toggle and providing the value. If this option is not activated, the user provides the parallel offset dynamically.

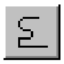


6.7.4 Delete Element

Deletes an element from a coordinate database (GPK file). **Warning**: There is no undo for this command. The tool functions just like it's MicroStation counter part.

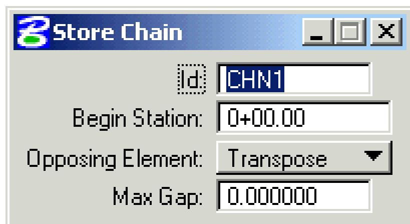
6.8 Groups

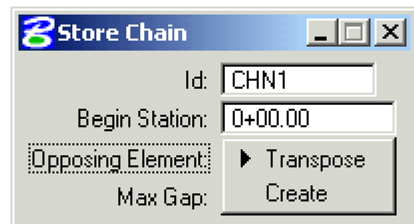
The Groups tools allow the user to create a chain or parcel from a series of COGO elements that are connected end to end. The elements cannot overlap or have a gap greater than the **Max Gap** amount specified. The following tools are contained in the Groups toolbox. If COGO encounters an **Opposing Element**, the user has the option to **Transpose** the original element or to **Create** a new element going in the right direction. **Redefine** must be activated for an element to be transposed.

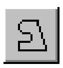


6.8.1 Store Chain

Stores a chain from previously stored COGO elements. The user selects the first element and data points to accept each element connected to the previous element. When all elements are selected, the user is prompted to data point for the direction of the stationing.

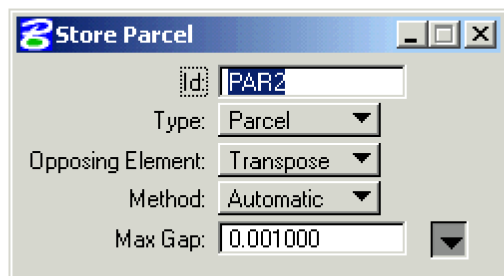


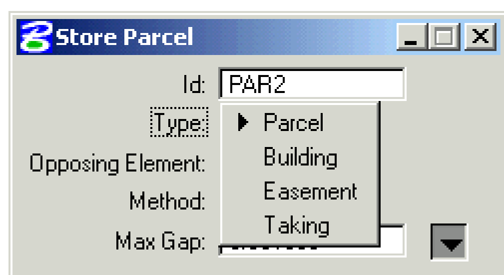




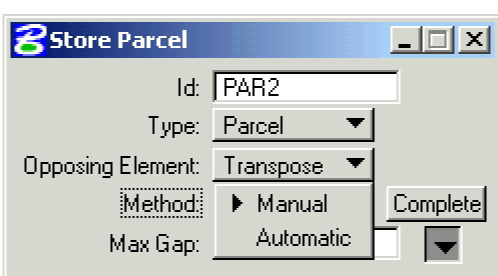
6.8.2 Store Parcel

The tool stores property information to the GPK from previously stored COGO elements. For a given piece of property, the **Parcel** must be stored first. Once this is gone, the **Type** toggle may be switched to the other right of way features that are supported: **Building**, **Easement**, and **Taking**. When the type is set to Parcel, the dialog may be expanded to enable the user to store the **Owner Name** and an **Improvement** description.

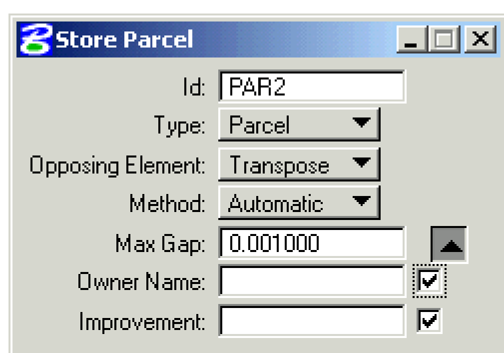




The **Opposing Element** option works the same as it does for Store Chain. **Method** defines the way the elements are selected. **Automatic** causes the tool to select elements in the same way as Store Chain. **Manual** allows the user to select the individual elements and click on the **Complete** button to store the element.



When all of the elements are selected, the user is prompted for the direction of the parcel, and the point of beginning.



Chapter 7

Horizontal Alignment Generator

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7.1 Objectives

Create and store horizontal alignment elements using COGO based graphical tools.

7.2 Definitions

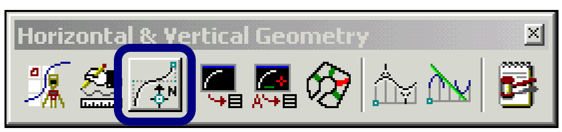
The **Horizontal Alignment Generator** enables the user to create or modify horizontal alignments elements and automatically stores them in the active coordinate geometry (COGO) database. Because of this, a GEOPAK COGO session must be active before the generator can be used. Spirals, curves, tapers, and ramps can all be placed according to user-defined parameters.

As the tools in the generator are presented in the rest of the chapter the required mouse clicks will be described as follows:

Data point—a regular mouse click, which is the left button on a standard mouse configuration
Accept—a regular mouse click, which is the left button on a standard mouse configuration
Reject—an alternate mouse click, which is the right button on a standard mouse configuration
Reset—an alternate mouse click, which is the right button on a standard mouse configuration
Snap—a center button click

7.3 Accessing

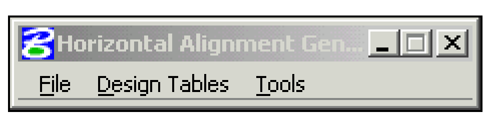
The **Horizontal Alignment Generator** can be accessed from the Road tool frame, from the MicroStation Application pull down menu, or from the Road Project flowchart. To access it from the Road tool frame, click on the third icon in the Horizontal & Vertical Geometry tools shown below.



Or select **Applications > GEOPAK Road > Geometry > Layout Alignments Horizontal** from the MicroStation menu bar. To access it from the **Road Project** flow chart, click on the **Horizontal Alignment** button shown below.

If the user attempts to activate Graphical COGO without an active session of coordinate geometry, a warning dialog appears advising the user that a coordinate geometry session must be started.

7.4 Menu Bar



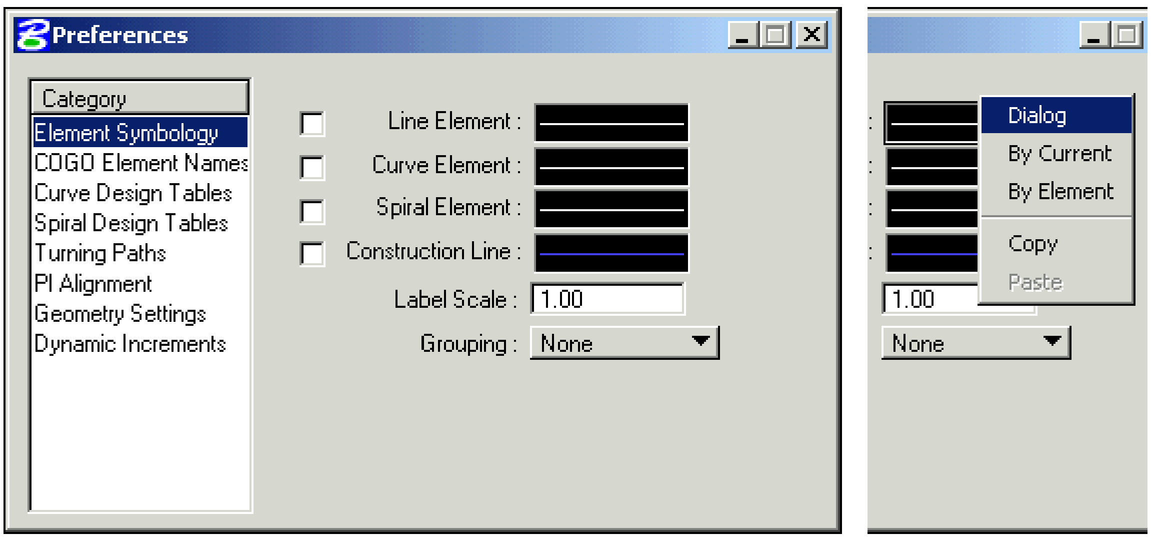
When the Horizontal Alignment Generator is started, the menu bar shown above will open. The **Horizontal Alignment Generator** menu bar has three items: **File**, **Design Tables**, and **Tools**.

7.4.1 File Menu

The **File** menu has one option: **Preferences**, which allows the user to change the following items.

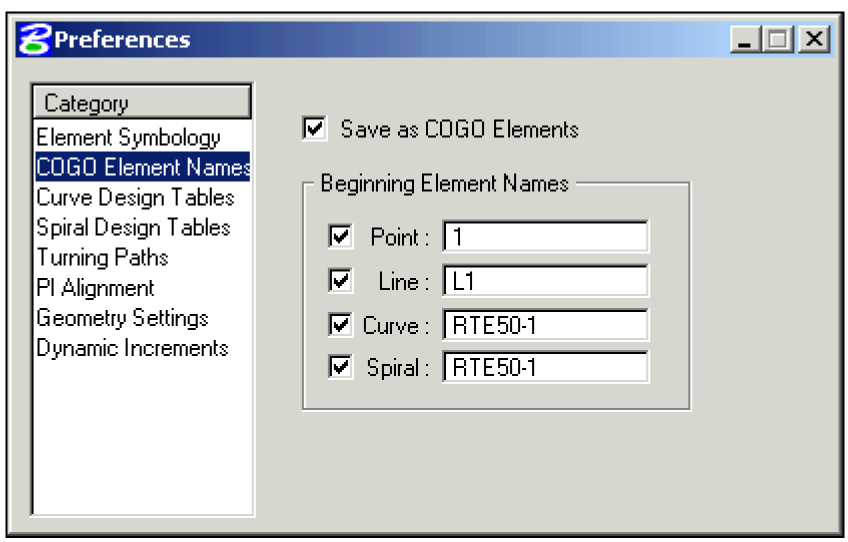
7.4.1.1 ELEMENT SYMBOLOGY

The Element Symbology section of the dialog, as shown below, allows the user to set the MicroStation symbology of NOT stored to the GPK. If the items are stored as COGO elements the settings in the MoDOT.smd file override any of these settings. To set the symbology for an item, do an alternate mouse click on the picture of the elements symbology, which brings up the menu shown below to the right. From the menu, the symbology can be set using the standard dialog, the current MicroStation symbology, the attributes of a selected element, or the symbology copied and pasted from another element. The **Label Scale** is applied to any text labels. The **Grouping** options are None and Graphic Group.



7.4.1.2 COGO ELEMENT NAMES

If the **Save as COGO Elements** toggle is activated, the Element Symbology settings described in the previous section are ignored. Default **Beginning Element Names** can be set by activating the type of element and entering a name for the first item of each type. For example, using the settings shown below, the first curve stored would be RTE50-1, the second would be RTE50-2, etc.



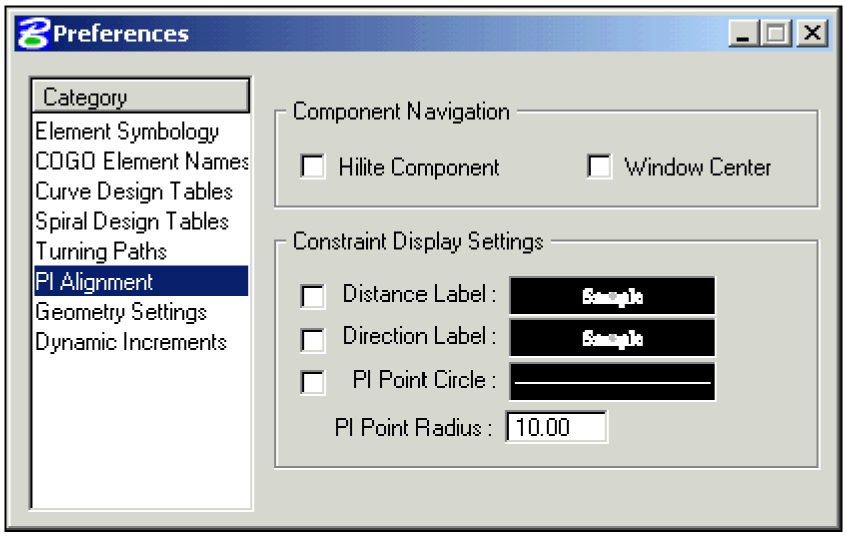
7.4.1.3 CURVE AND SPIRAL DESIGN TABLES

These two sections of the preference dialog set the design tables to be used for curves and spirals. The tables are used to calculate the required geometry parameters based tool settings. CADD Support has configured GEOPAK to make use of the current standard curve tables being utilized by MoDOT and the user does not need set these standards. Since MoDOT uses two super elevation max e values (8 and 4%) the user needs to select the appropriate table.

7.4.1.4 TURNING PATHS

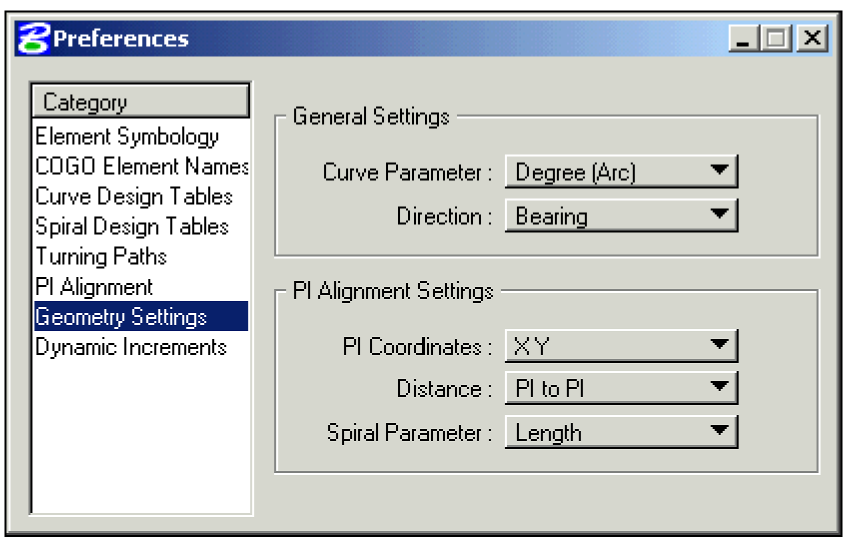
Turning Paths is a new tool that has been added to GEOPAK and may be utilized by MoDOT at some point in the future. Because MoDOT currently uses Auto Turn, which is more versatile, the GEOPAK Turning Paths tool is not supported.

7.4.1.5 PI ALIGNMENT



The PI Alignment tool allows the user to create or modify a chain in a table format. See Section 7.9 to learn about the functionality of the tool. The **Component Navigation** part of the dialog controls whether or not the element corresponding to the line in the PI Alignment Table is hilited or centered in the active MicroStation window. The **Constraint Display Settings** controls whether or not the items listed are displayed and the attributes of the items if they are displayed.

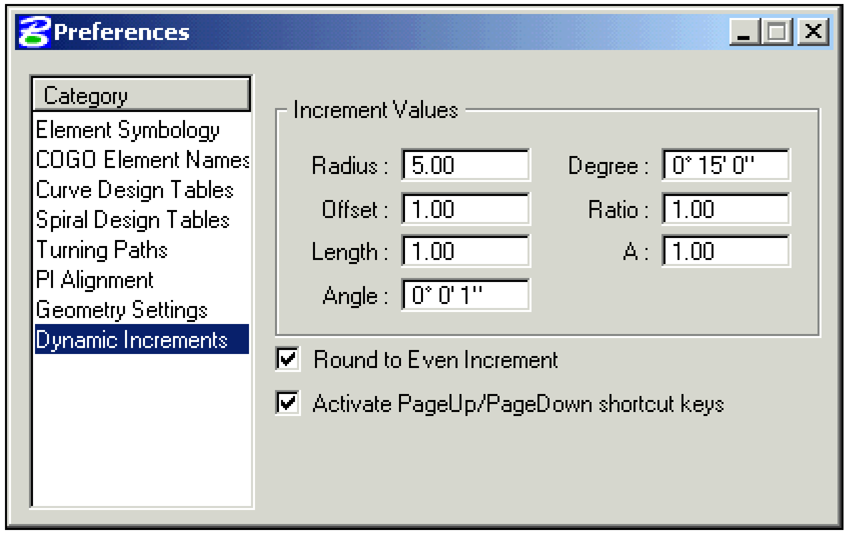
7.4.1.6 GEOMETRY SETTINGS



Geometry Settings controls the parameters for individual design elements. The **Curve Parameter** may to be set to ***Radius***, ***Degree (Arc)***, or ***Degree (Chord)***. The **Direction** may be displayed in ***Bearing*** or ***Azimuth***. **PI Coordinates** may be given in ***XY*** or ***NE*** format. The straight **Distance** may be displayed as the distance form ***PI to PI*** or as the length of the ***Tangent Segment***. The **Spiral Parameter** may be ***Length*** or ***A***. Consult the MoDOT Project Development Manual for the current parameters to be used.

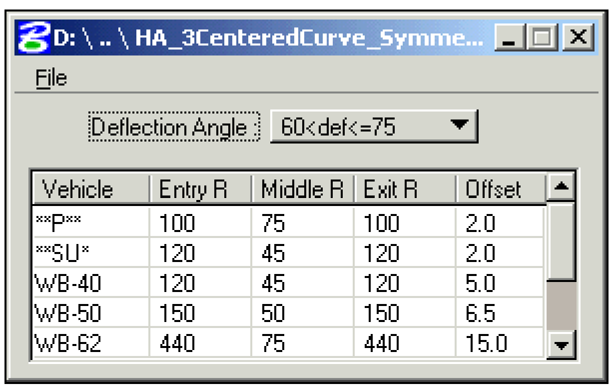
7.4.1.7 DYNAMIC INCREMENTS

Dynamic Increments allows the user to set **Increment Values** for various design parameters. The **Round to Even Increment** toggles controls whether the increment is rounded to the next even value (on) or applied to the current value without rounding to the next even value (off). **Activate PageUp/PageDown shortcut keys** allows the user to use the keyboard up and down arrow keys as shortcut keys for clicking on the increment up or down arrows in the individual tool dialog boxes.



7.4.2 Design Tables

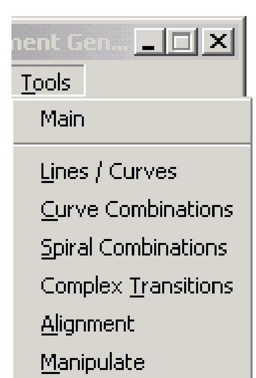
This pull down menu allows the user to view and/or set the Design Tables for a **Symmetrical 3 Centered Curve**, an **Asymmetrical 3 Centered Curve**, a **Symmetrical Taper Curve**, an **Asymmetrical Taper Curve**, and a **Spiral Curve**. Default design parameters are provided for various vehicle types and deflection angles. Users should not vary these values since they are based on the current AASHTO standards utilized by MoDOT.



Vehicle	Entry R	Middle R	Exit R	Offset
P	100	75	100	2.0
**SU*	120	45	120	2.0
WB-40	120	45	120	5.0
WB-50	150	50	150	6.5
WB-62	440	75	440	15.0

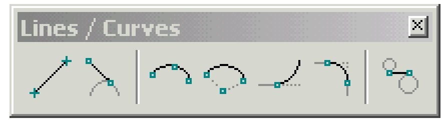
7.4.3 Tools

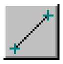
The **Tools** menu (shown to the right) allows access to the Main Alignment tool frame (shown below) or to any of the individual Horizontal Alignment tool pallets. The rest of the chapter discusses the individual tool pallets.



7.5 Lines/Curves Tools

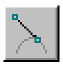
The **Line/Curves** tools allow the user to place line and curve elements by various methods. The **Line/Curves** toolbox (shown to the right) contains the following tools.





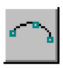
7.5.1 Store Line By 2 Points

Stores a line and its endpoints. It functions like its Graphical COGO counter part except that the name of the line is determined by the COGO Element Names preference discussed above.



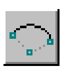
7.5.2 Store Tangent Line

Stores a line tangent to a curve and the endpoints of a line. It functions like its Graphical COGO counter part except that the name of the line is determined by the COGO Element Names preference discussed above.



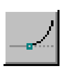
7.5.3 Store Curve By 3 Points

Stores a circular curve by selecting the beginning point, the ending point of the curve, and a point on the curve. It functions like its Graphical COGO counter part except that the name of the line and the curve design parameter are determined respectively by the COGO Element Names and the Geometry Settings preferences discussed above.



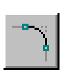
7.5.4 Store Curve By Center

Stores a circular curve by defining the center point, radius, and delta angle. It functions like its Graphical COGO counter part except that the name of the line and the curve design parameter are determined respectively by the COGO Element Names and the Geometry Settings preferences discussed above.



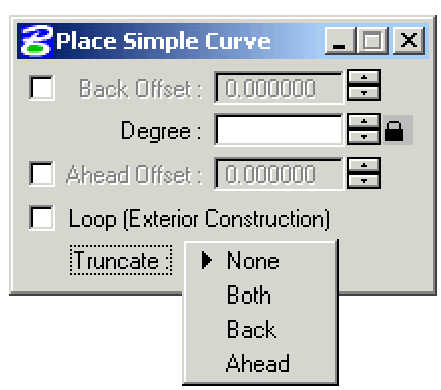
7.5.5 Store Tangent Curve Unconstrained

Places a curve tangent to a line or curve, and through a specified point. It functions like its Graphical COGO counter part except that the name of the line and the curve design parameter are determined respectively by the COGO Element Names and the Geometry Settings preferences discussed above.

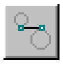


7.5.6 Place Curve Between Two Elements

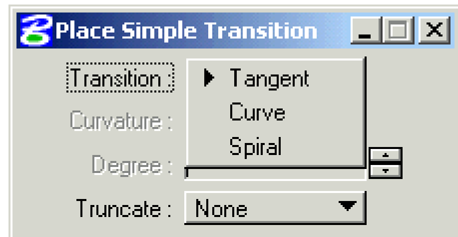
Places a circular curve between two elements. A **Back** and **Ahead Offset** may be specified as well as the curve design parameter (**Degree** or **Radius** of curve) set in the Geometry Settings preferences. The user may increment the values in these and similar fields by using the adjacent up and down increment buttons or up and down arrow keys if that option has been enabled. An exterior **Loop** can be constructed by activating that option. There are four **Truncate** options for the intersecting elements: **None**, **Both**, **Back**, and **Ahead**.



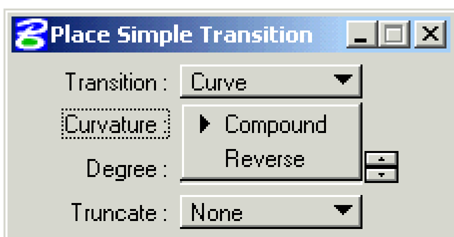
To use the tool, specify the curve design parameter value (Degree or Radius) and the optional offset values. Following the prompt in the lower left hand corner of the MicroStation window: identify (data point) and accept/reject the first element; identify the second element with a data point; move the cursor to view the possible solutions; and data point with the desired solution displayed to initiate construction or reset to reject all solutions. **Note**: See Section 7.2 for the definition of a data point, accept, reject, and the other mouse clicks used in this chapter.

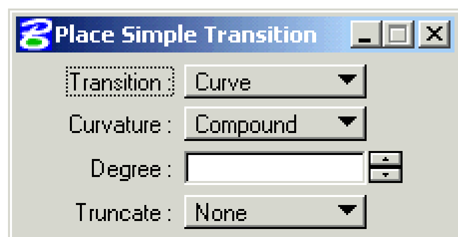


7.5.7 Place Simple Transition



Draws a transition element between two arcs or a line and one arc. The **Transition** element may be ***Tangent***, a ***Curve***, or a ***Spiral*** as shown to the right. If a Curve transition element is chosen, the resulting **Curvature** combination can be set to ***Compound*** or ***Reverse*** and the value of the defining the amount of curvature needs to be specified, as shown below. The curvature must be flat enough so the transition can span the two elements at either end of the transition.

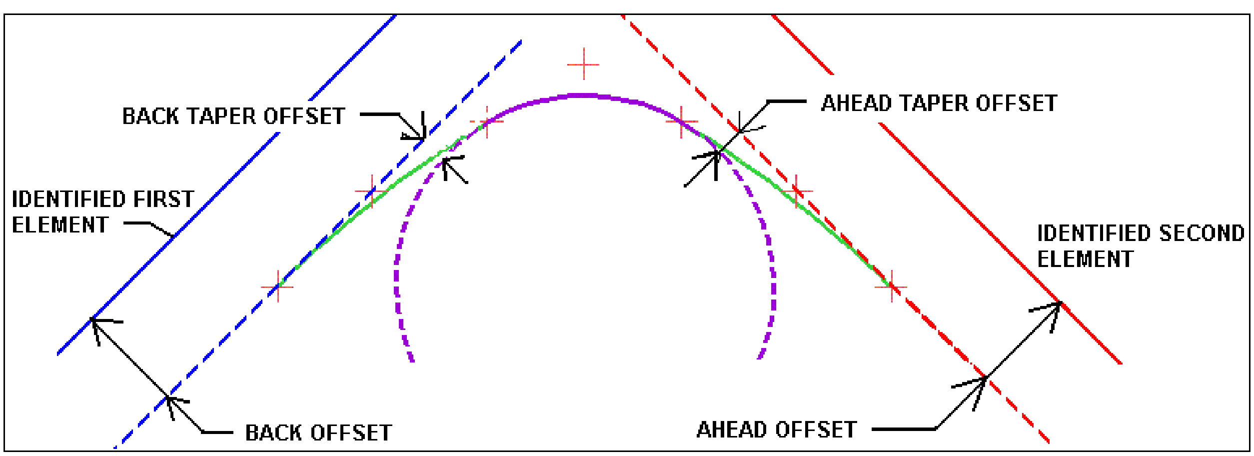




If the transition element is a spiral, the beginning and ending radius are determined by the elements at each end of the transition. The Truncate options are **None**, **Both**, **Back**, and **Ahead**.

7.6 Curve Combination Tools

The **Curve Combination Tools** allows the user to define simple turning paths and to place compound, three centered, tapered, and reverse curves, using the tools shown to the right. Many of the tools utilize the definitions shown in the following figure.

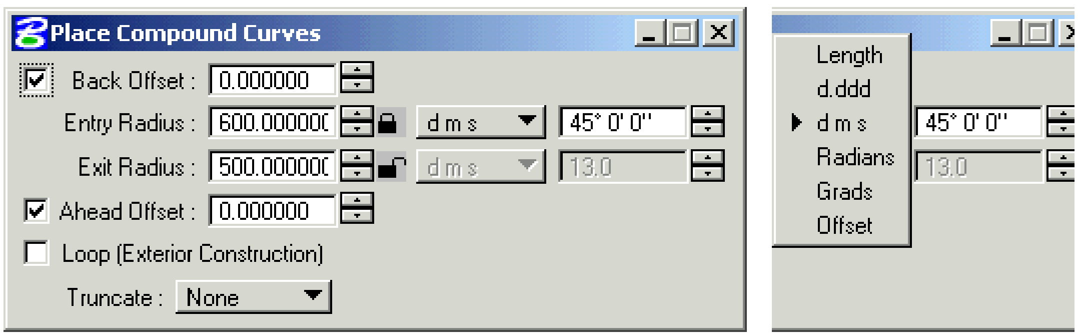


7.6.1 Place Turning Paths

MoDOT currently uses Auto Turn to define turning paths because that tool is more versatile than the GEOPAK tool. For this reason Place Turning Paths is not supported.

7.6.2 Place Compound Curves

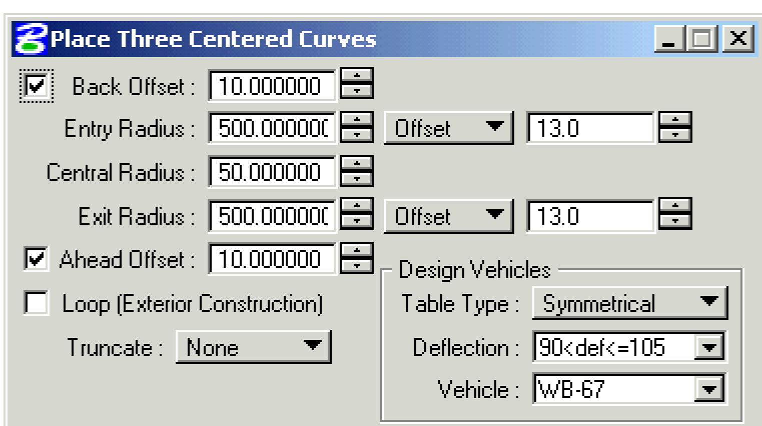
Places a compound curve between two elements using the dialog shown below. Optional **Back** and **Ahead Offsets** to the two elements may be specified. The **Entry Radius** and **Exit Radius** must be specified. A parameter to define the length of either the entry or exit curve must be supplied, which may be the **Length**; the deflection angle in decimal degrees (**d.ddd**), degrees-minutes-seconds (**d m s**), **Radians**, or **Grads**; or the **Offset**, as shown in below in the figure to the right. A **Loop** for **Exterior Construction** may be constructed by checking that option. The standard **Truncate** options of **None**, **Both**, **Back**, and **Ahead** are supported.



After entering the values in the dialog, construction is begun by selecting and accepting the two elements. Once a tentative solution is shown, the up and down arrows to the right of each of the fields can be used to dynamically adjust the solution. It is also possible to change the quadrant of the solution by movement of the cursor. A data point confirms the desired solution.

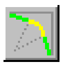
7.6.3 Place Three Centered Curves

Stores a three-centered curve between two elements. In addition to specifying the offsets and curve radii, as was possible with the previous tool, this tool allows the user to fill in some of the parameters using the **Design Vehicles** section in the bottom right corner of the dialog.



Selecting the **Table Type** (**Symmetrical** or **Asymmetrical**) and the **Deflection** range determines which of the Design Table is used. The default design tables are based on the AASHTO Green Book. Which set of tables is used is part of the determined by the user preferences (Horizontal Alignment Generator pull down menu File > Preferences.) The individual tables can be viewed by selecting the desired set of tables from the Horizontal Alignment Generator Design Tables pull down menu.

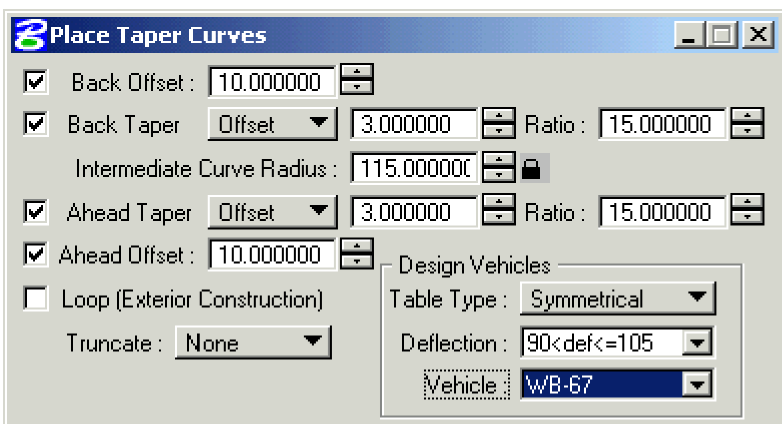
After completing the desired portions of the dialog, construction is begun by selecting and accepting the back and ahead elements. If the deflection angle between the elements does not match the one selected in the dialog, GEOPAK displays an alert and adjusts the deflection range to match the two elements. Once a tentative solution is shown, the up and down arrows to the right of each of the fields can be used to dynamically adjust the solution. It is also possible to change the quadrant of the solution by movement of the cursor. A data point confirms the desired solution. The **Truncate** options are **None**, **Both**, **Back**, and **Ahead**.



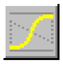
7.6.4 Place Taper Curves

Places a curve and tapers between two elements. This tool has the same options as the previous one plus the ability to add a **Back and Ahead Taper** at the beginning and ending of the curve. The tapers are defined by specifying the taper **Ratio** and the either its **Offset** or **Length** using the pull down toggle for each taper.

As with the previous tool, the user may fill in some of the parameters using the **Design Vehicles** section in the bottom right corner of the dialog.



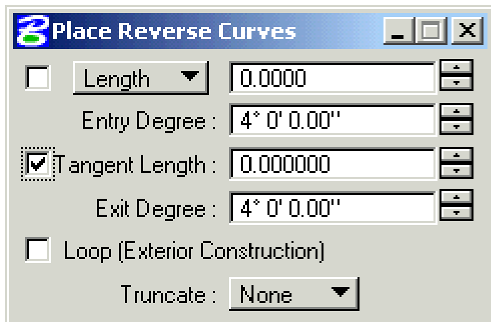
After completing the desired portions of the dialog, construction is begun by selecting and accepting the back and ahead elements. If the deflection angle between the elements does not match the one selected in the dialog, GEOPAK displays an alert and adjusts the deflection range to match the two elements. Once a tentative solution is shown, the up and down arrows to the right of each of the fields can be used to dynamically adjust the solution. It is also possible to change the quadrant of the solution by movement of the cursor. A data point confirms the desired solution. The Truncate options are **None**, **Both**, **Back**, and **Ahead**.



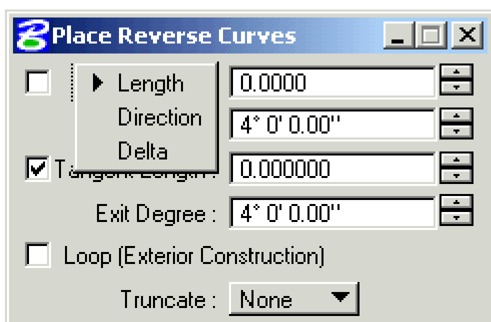
7.6.5 Place Reverse Curves

Stores reverse curves between two elements. A tangent section between the curves can also be stored. To use this option, activate it (as show by the check mark in the figure below) and provide the **Tangent Length**.

The user must specify the **Entry** and **Exit** curve parameter and has the option to set the start of the reverse curves by activation the top toggle in the dialog below.



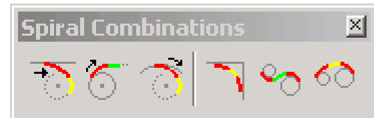
If the back element is a line, only the **Length** option is available, which specifies the distance from the start of the back element to the start of the reverse curve. However, if the back element is curved the user may determine the start of the reversed curve by specifying the back Length, Direction, or Delta angle, as shown in the following figure.



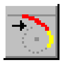
The option to create a Loop (Exterior Construction) can be chosen by activating that toggle. The standard **Truncate** options (**None**, **Both**, **Back**, and **Ahead)** are also available.

After completing the desired portions of the dialog, construction is begun by selecting and accepting the back and ahead elements. If it exists, the tentative solution is displayed. The user may modify the solution by using the up and down arrows to the right of each value field. If the first option has not been locked, movement of the cursor determines where the entry curve begins. A data point confirms the desired solution.

7.7 Spiral Combinations

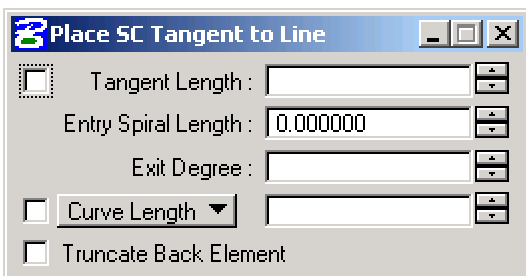


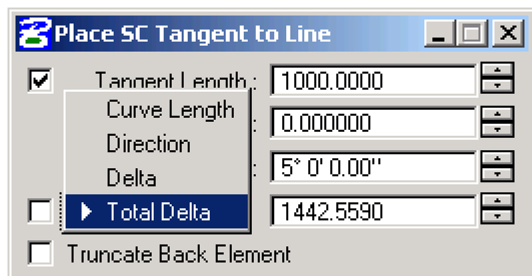
The **Spiral Combinations** tools in the toolbox to the right allow the user to place spirals with curves, tangents, and other spirals. Since MoDOT typically places only spiral-curve-spiral combinations between tangents, only that tool is discussed in detail.

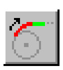


7.7.1 Place SC Tangent To Line

Stores a **spiral-curve** combination tangent to a specified line using the parameters shown below in the figure on the left. The optional **Tangent Length** is the distance from the start of the specified line to the start of the spiral. The pull down, expanded in the figure on the right below, lets the user specify the length of curve using the parameters shown.

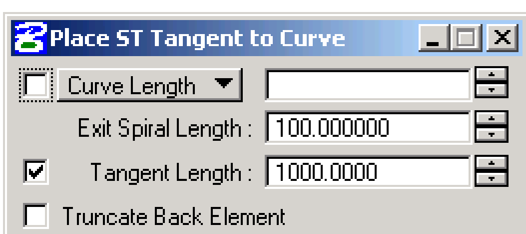


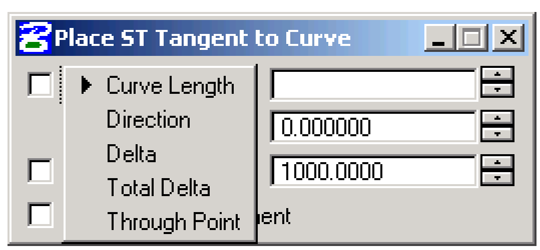




7.7.2 Place ST Tangent To Curve

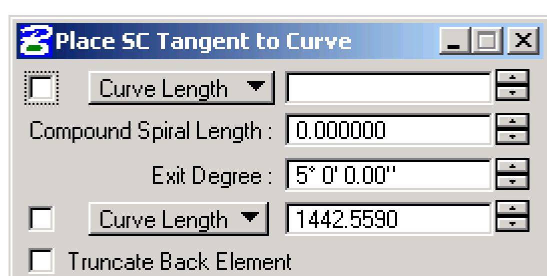
Stores a **spiral-tangent** combination tangent to a curve using the parameters shown below in the figure on the left. The pull down, expanded in the figure on the right below, lets the user specify the location of the spiral-tangent combination using the parameters shown

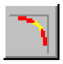




7.7.3 Place SC Tangent To Curve

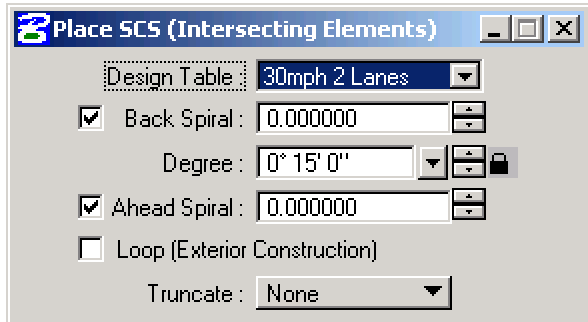
Stores a compound **spiral-curve** combination tangent to a curve. The spiral will be placed between the curves. The two pull downs contain the same options: **Curve Length**, **Direction**, **Delta**, and **Total Delta**. The top one can be used to control where the spiral starts and the bottom one can be used to control the length of the new curve.





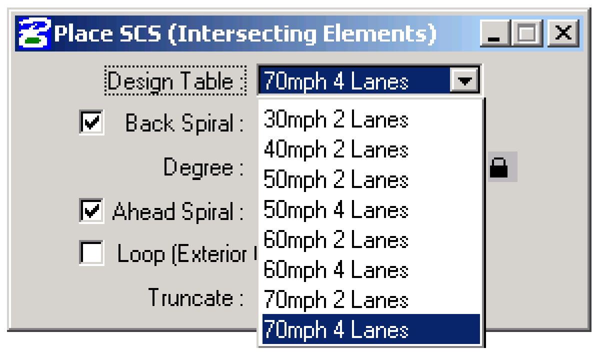
7.7.4 Place SCS (Intersecting Elements)

Stores a **spiral-curve-spira**l combination tangent to two intersecting elements. The standard truncate options for the existing elements are available. A major enhancement to this tool is the ability to have the spiral length calculated based on the design speed, the number of lanes, and the curvature of the new curve to be placed between the spirals. As described in section 7.4.1.3, the design table is set in the **Spiral Design Tables** section of the horizontal alignment preferences (Horizontal Alignment pull down menu **File** > **Preferences**). The available tables are:

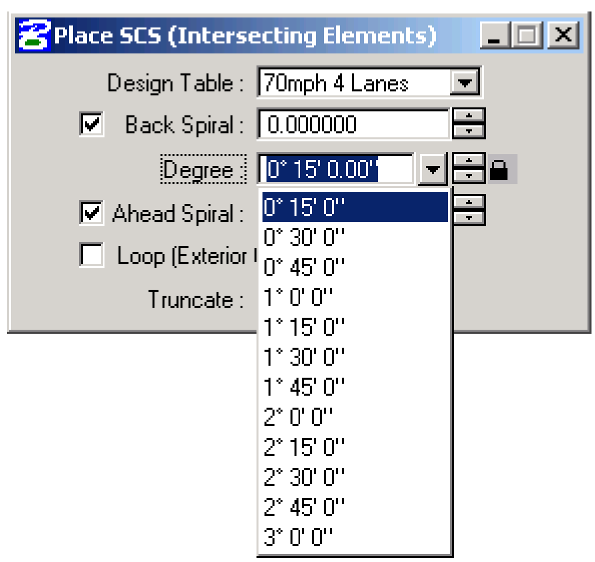


Curve Parameter	Max e	File to be used
Degree (arc)	8%	HA_SpiralCurve_eMax8_2002MoDOT.tbl
Degree (arc)	4%	HA_SpiralCurve_eMax4_2002MoDOT.tbl
Radius	8%	HA_SpiralCurve_eMax8_2001english.tbl
Radius	4%	HA_SpiralCurve_eMax4_2001english.tbl

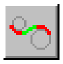
To use the tool, select the design speed and number of lanes (2 lanes for undivided and 4 lanes for divided) from the pull down options available in the **Design Table** field. The available options for rural projects with a max e of 8% are shown in the figure to the right. These conform to those shown in MoDOT Standard Plans 203.20 and 203.21.



After setting the design speed and number of lanes, the next step is to select the desired curvature for the curve from the pull down options available in the **Degree or Radius** field. The available options for rural projects with curve parameter (**Geometry Settings** section under **File** > **Preferences**) set to Degree (Arc) are shown to the right.

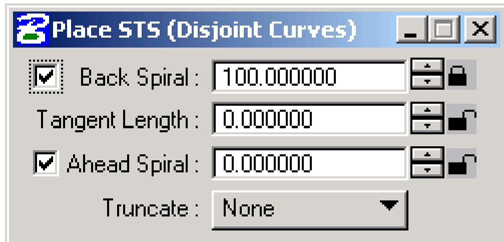


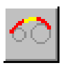
Select and accept the two intersecting elements to initiate construction. A tentative solution will be shown if it exists. Cursor location determines solution quadrant. The up and down next to the field define the curve may be used to increment its curvature. With the tentative solution at the desired location, data point to initiate construction of the SCS combination. The Truncate options are **None**, **Both**, **Back**, and **Ahead**.



7.7.5 Place STS (Disjoint Curves)

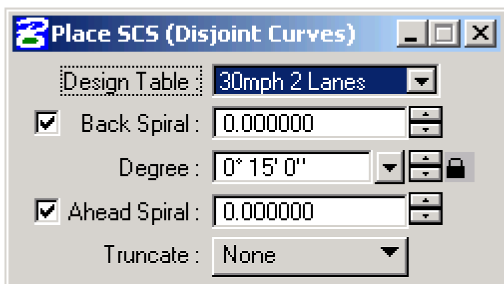
Stores a **spiral-tangent-spiral** combination between two curves using the parameters shown below. The **Tangent Length** is the length of the optional tangent between the two curves. If no tangent is desired, set the distance to zero (0). The Truncate options are **None**, **Both**, **Back**, and **Ahead**.



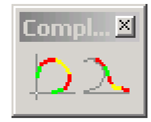


7.7.6 Place SCS (Disjoint Curves)

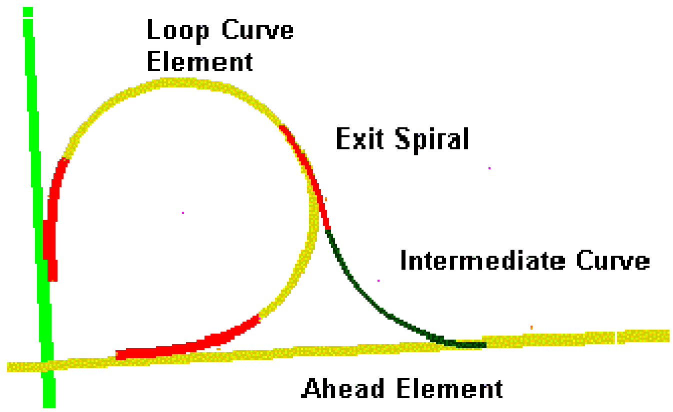
Stores a **spiral-curve-spiral** combination between two curves. The length of the spirals may be set from the design tables by selecting the appreciate **Design Table** (speed and number of lanes) and the curve parameter. The Truncate options are **None**, **Both**, **Back**, and **Ahead**.

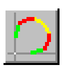


7.8 Complex Transitions



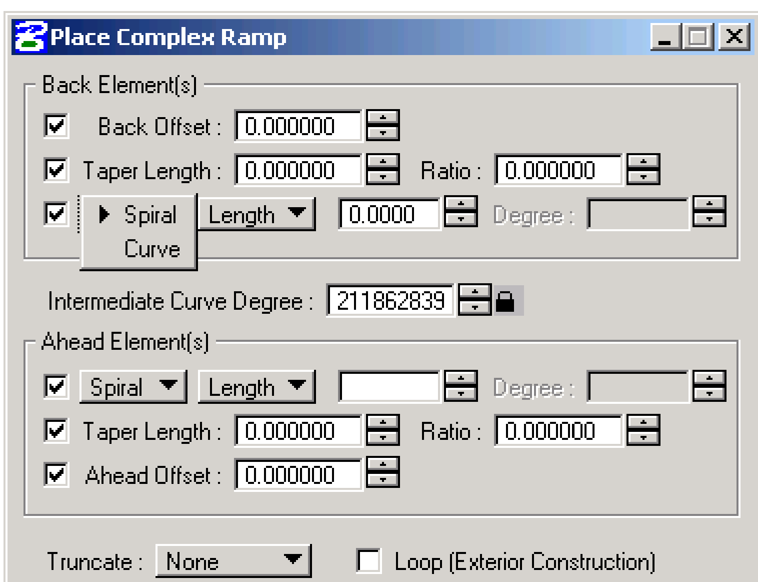
The two **Complex Transitions** tools allow the user to place simple to complex ramps and ramp connectors with a variety of options. Both tools support the four standard Truncate options are **None**, **Both**, **Back**, and **Ahead**. The curve parameter may be either Degree (Arc) or Radius, as set in the **Geometry Settings** section of the **File > Preferences** dialog. The following picture illustrates what can be constructed using these tools.





7.8.1 Place Complex Ramp

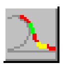
Places simple to complex ramp geometry using the parameters shown below. The back and ahead elements may be either a spiral or a curve. If a spiral is chose, the design parameter used by MoDOT is the spirals length. If a curve is used, the length of the ahead and back elements may be set using the curves length, as shown below, delta angle or offset from the intersecting elements.



The back and ahead elements may be offset from the intersection elements by toggling on the **Back** and **Ahead Offsets**, respectively, and entering an offset distance. Tangent tapers may also be included before the back and after the ahead element by toggling on that feature and defining the **Taper Length** and **Ratio**. The **Intermediate Curve** parameter is defined in the middle of the dialog by either degree (as shown above) or radius. The ability to draw a **Loop (Exterior Construction)** ramp is activated using its toggle at the bottom of the dialog.

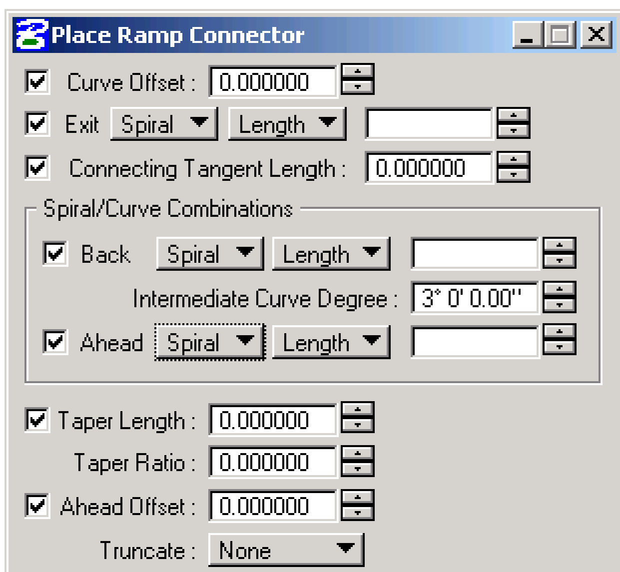
To initiate construction:

1. Select the tool.
2. Populate the dialog using the options described above.
3. Data point on the back element and accept it.
4. Data point on the ahead element and accept it.
5. The location of the cursor determines the quadrant for the tentative solution.
6. Modify the dialog settings as desired.
7. When the desired solution appears, data point to complete construction.



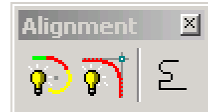
7.8.2 Place Ramp Connector

Places simple to complex ramp connector using the parameters shown below. Either an **Exist Spiral** or a **Connecting Tangent** is required in addition to the **Intermediate Curve**. The optional elements are a second transition element (exit spiral or connecting tangent), a back spiral, an ahead spiral, and a tangent taper. Although there is a pull-down for the exit, back, and ahead elements, only spirals are supported in this version. Additionally, an offset from elements being connected may be applied at the beginning and end of the ramp connector.

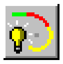


The steps to initate construction are the same as those for the previous tool.

7.9 Alignment Tools

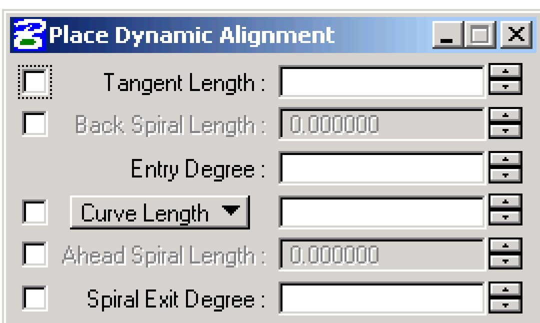


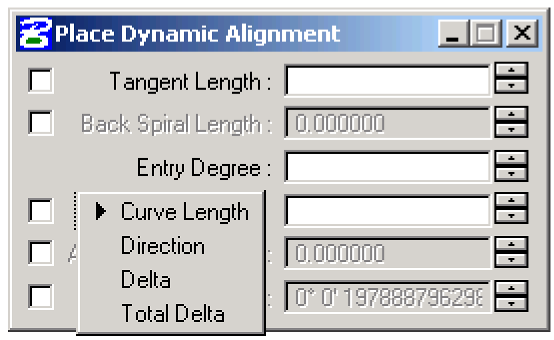
The **Alignment Tools** (shown to the right) allow the user to store an alignment dynamically, in a table format, or from existing COGO elements.

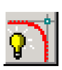


7.9.1 Place Dynamic Element

Places an alignment dynamically. The user needs to select a starting element and then specify the length of curves and length of tangents to create the alignment. The user determines the length of the tangent element either graphically by a data point on screen or numerically by activating the **Tangent Length** field and enter the desired length. Likewise, either dynamic or numerical inputs maybe used or the curve parameters. If numerical inputs are desired, activate that option and choose the desired parameter: **Curve Length**, **Direction** ahead, curve **Delta** or SCS combination **Total Delta**, as shown below in the figure on the right. The degree of curvature can be changed, and spirals can be added as the user moves along the alignment.

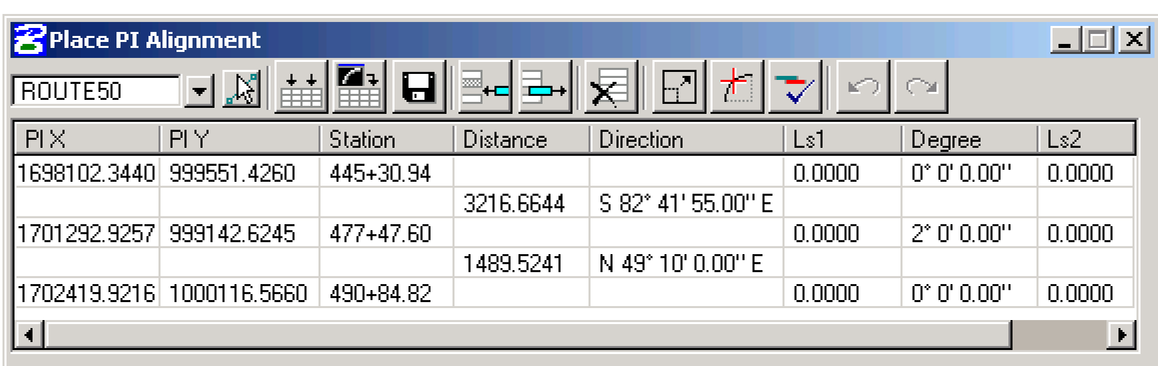






7.9.2 Place PI Alignment

Enables the user to create or modify chains in table form based on the points of intersection (PI's), as shown in the following dialog. To edit the table, double clicking in the desired field and changing the value. New PI points can be added or deleted as well as the curve or spiral-curve-spiral element at the PI.



The chain to be loaded can be selected from the pull down or picked graphically using the icon to the right. The use of this and the other icons is given in the following table taken from the GEOPAK help.

	Graphically defines the chain / alignment. Click, then select one element of the visualized chain.
	After the chain has been specified, clicking this button loads the chain into the list box.
	Saves the chain.
	Insert a PI Point - Highlight a PI line in the list box, then click.
	Delete a PI Point - Highlight a PI line in the list box, then click.
	Clear Alignment Table - clears the list box.
	Move Element - click and dynamically move the highlighted PI point.
	Remove Overlap - If two curves or spirals are overlapping, the overlap is removed.

7.9.3 Store Chain

Stores an alignment by selecting graphical elements. It is the same as the corresponding Graphical COGO tool.

7.10 Manipulate Tools

The **Manipulate** tools allow the user to move/copy, rotate, extend, and delete elements.

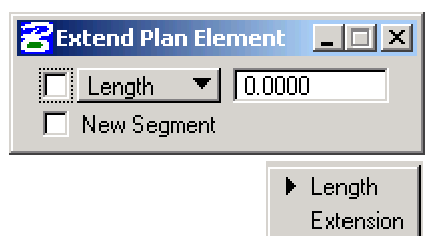
7.10.1 Move Plan View Element

Moves or copies an element. It is the same as the corresponding Graphical COGO tool.

7.10.2 Rotate Plan View Element

Rotates the element about a specified point. It is the same as the corresponding Graphical COGO tool.

7.10.3 Extend Plan View Element



Extends or shortens a COGO element graphically or numerically by activating that option and entering the final **Length** of the **Element** or the extension length. Activate the **New Segment** option to leave existing element unchanged and create a new one.

7.10.4 Delete Element

Deletes an element from the coordinate geometry database (.gpk). It is the same as the corresponding Graphical COGO tool.

Exercise 7-1

This is an individual exercise to practice storing a horizontal alignment. It is to be done outside of a GEOPAK project.

1. Open the MicroStation file **t:\br-proj\Exercise_7-1\Route_6.dgn**.

2. Use **Coordinate Geometry**, **Graphical COGO**, or **Horizontal Alignment Generator** to create the alignments as shown on the following pages.

   Do not worry about the graphics (stationing, curve data, etc.) being plotted. These items will be discussed in later chapters.

3. Upon completion of storing the alignments in coordinate geometry, close **coordinate geometry**, **graphical cogo**, and **Horizontal Alignment Generator**.

Rte 6

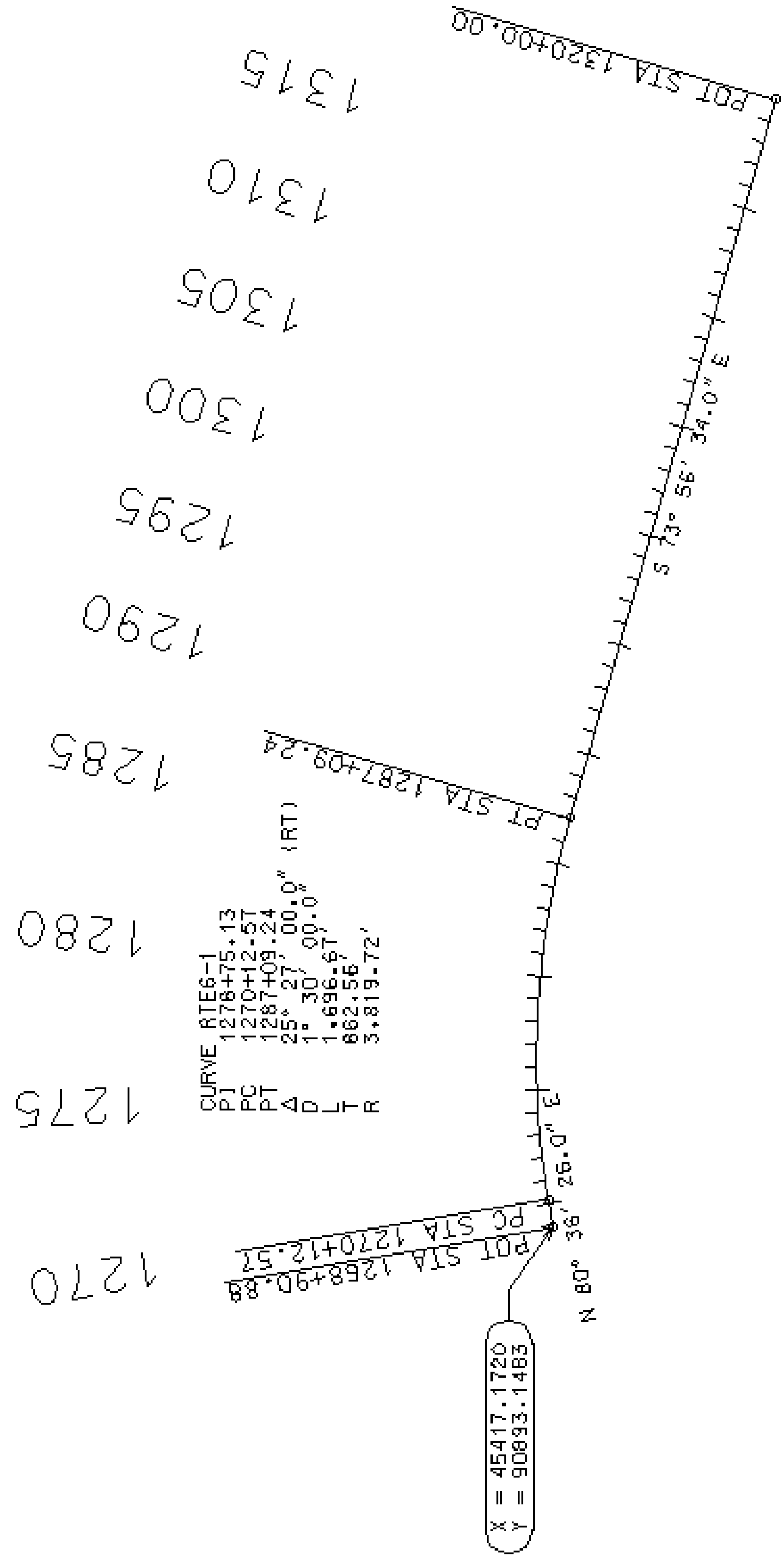
Hints:

Beginning Point is at station 1268+90.8814 with coordinates of X=45,417.1720 & Y=90,893.1483.

The PI of the curve is located 984.25’ from the beginning point along a bearing of N 80° 36’ 26” E.

Curve RTE6-1 has a decree of curvature of 1° 30’ 00.0” and a deflection to the right of 25° 27’ 00.0”.

The end point is located 3290.7634’ from the PT of the curve along a bearing curve along a bearing of S 73° 56’ 34” E, which is the ahead bearing for the curve.



Chapter 8

Design and Computation Manager

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8.1 Objectives

- Understand the use of the **D&C Manager** in creating construction plans
- Understand the format of the hierarchical database and how to use it
- Be able to use the **D&C Manager** in conjunction with Microstation to store roadway features and calculate their quantities

8.2 Definitions

The **Design and Computation Manager** (D&C Manager) is a tool that allows MoDOT to standardize graphics elements for drafting and pay item quantities.

8.3 Database

A hierarchical database is used with the **Design and Computation Manager**. For MoDOT the default database is either **MoDOT_English.ddb** or **MoDOT_Metric.ddb**. The database stores information concerning functional classification and display preferences for each feature and item used in a Microstation file.

Categories are used to group and classify the features and items used in creating construction drawings. The content the MoDOT databases are divided into four overall categories **– Design Standards/, Drafting Standards**/, **Pay Items**/, and **3PC Tools**. The first three categories each contain sub-categories. The sub-categories break down each classification into more specific sections. (See dialog box next page). **3PC Tools** has a list of the various tools available.

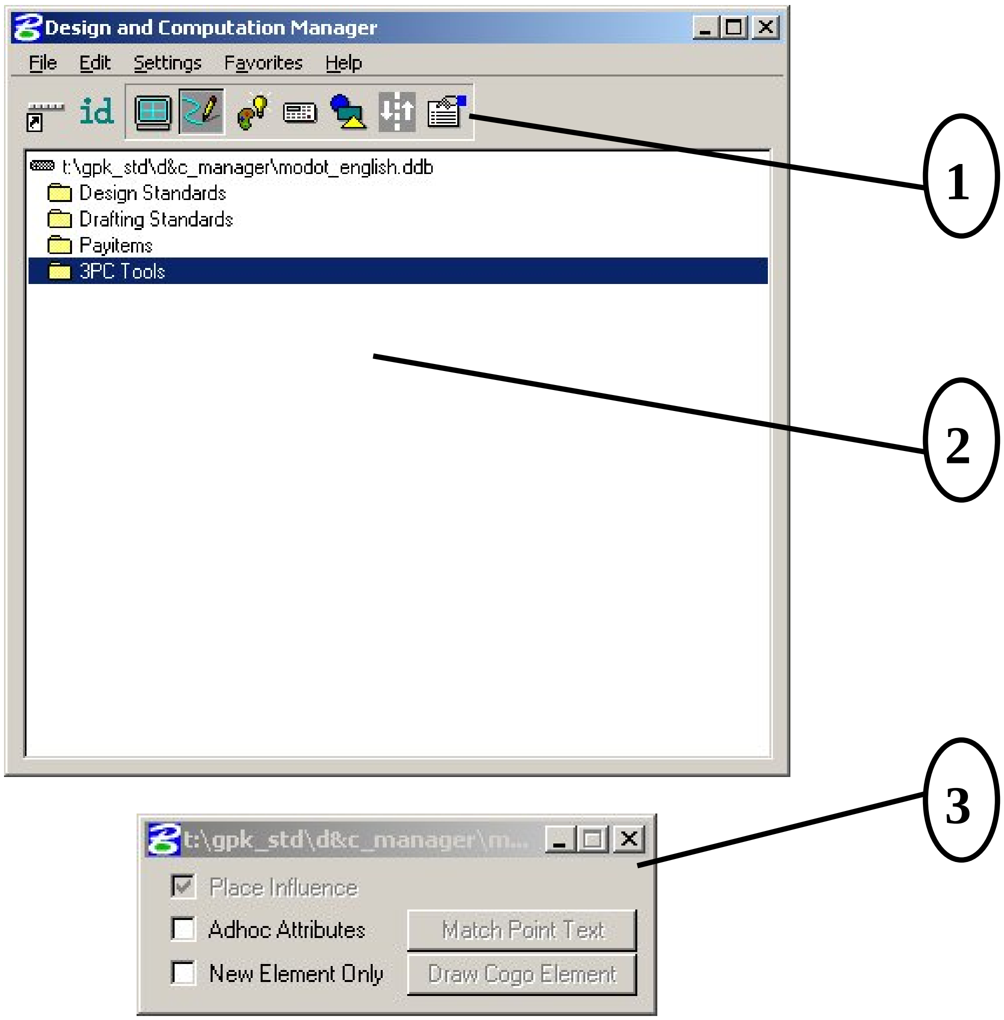
For example, **Pay Items**/ is broken into several additional categories like **Pipes/** and **Lighting and Signals/**. **Pipes/** is broken into many different categories representing various types of pipes and pipe features that may be used in the design of your project like **Flared End Sections/**. Within the category **Flared End Sections/** the different pay items for flared end sections are listed.

CADD Support personnel maintain this database. You will find commands within the D&C menu that require a password before execution. This is a security measure to protect the integrity of the database file and ensure its consistent application on a statewide basis.

8.4 Accessing

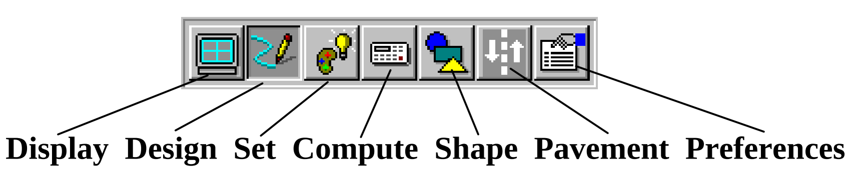
Design and Computation Manager can be accessed from **Project Manager >> Plan View Quantities** or from the **Design and Computation Manager** icon.

The following dialogs will appear.



The D&C Manager dialog box is composed of three distinct areas:

1) The D&C Manager may be configured to operate in seven different modes. A single click on an icon will change operational modes. They are: **Display Design Set Compute Shape Pavement Preferences**

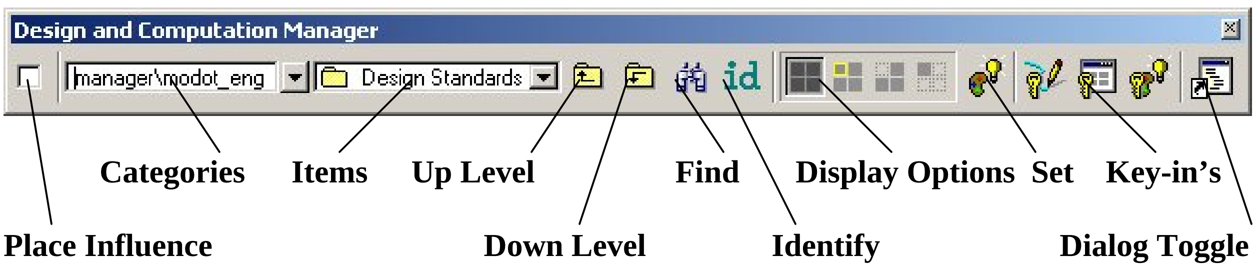


2) The **Content box** lists the sub-categories or items available at your current position within the database structure.

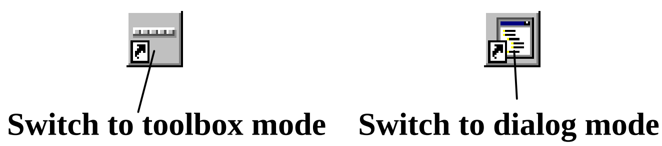
3) The **Operations box** will appear differently depending on the set mode of operation.

The D&C Manager dialog box can be used in two different modes. The dialog mode as shown on the previous page, allows the user to access items in from a "directory tree" structure. The icons at the top of the dialog allow the user to access the different operational modes of D&C Manager.

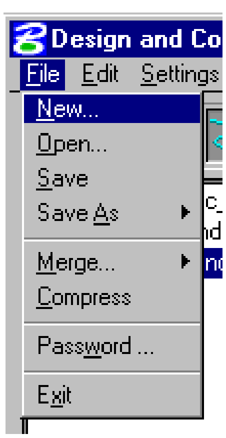
The toolbox mode as shown below, allows the D&C Manager dialog to be docked on the Microstation toolbars. With this format, the user accesses items from the pull-down menus, and can toggle the various tools from the tool bar.



The dialog box can be toggled using the appropriate icons.

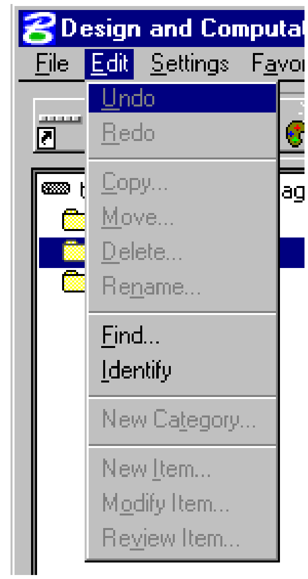


8.4.1 File Commands

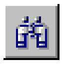


For a MoDOT Geopak user, the only file command options needed are **Open** and **Exit**.

MoDOT_English.ddb or **MoDOT_Metric.ddb** will be used for all MoDOT projects. This file is password protected, so the users will not be able to make changes to it.



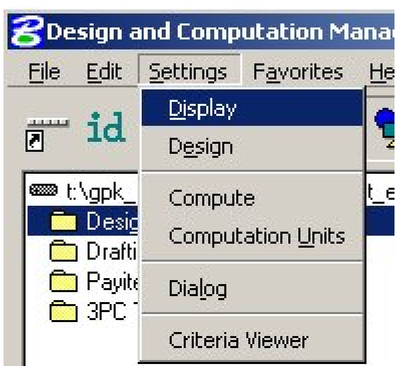
8.4.2 Edit Commands



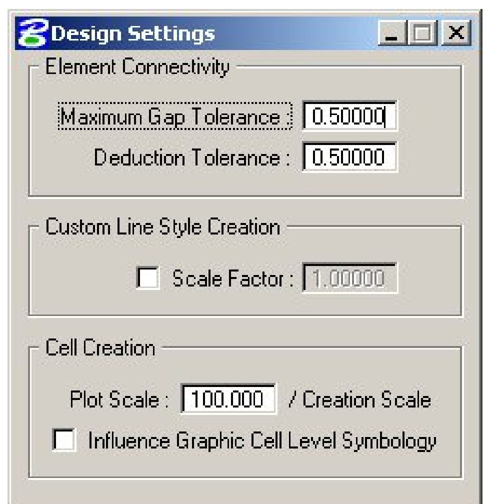
Find - will search the database (from your current location) for an item or category. The display in the D&C Manager dialog box will change to each item/category as it is found.

Identify – will show the item name and description attached to an element in the design file.

8.4.3 User Commands



Display Settings - temporarily changes the display of elements on the screen to one common color, then the user may specify additional elements to be viewed in their original colors. This tool enhances visualization when working on a complex project.



Design Settings - sets the *maximum gap* tolerance and *deduction tolerance* used in computations and the drawing scale for placing cells. **Do not use the Custom Line Style Creation option.** The **Project** in the Microstation Manager handles the line style scaling in the MoDOT Microstation configuration. This dialog also sets the cell scale to adjust the cell size appropriate to the drawing scale.

8.4.4 Recall Commands

Add to Favorites - saves current D&C Manager path for easy recall in the future.

Organize Favorites – allows the user to edit and save the Favorites list.

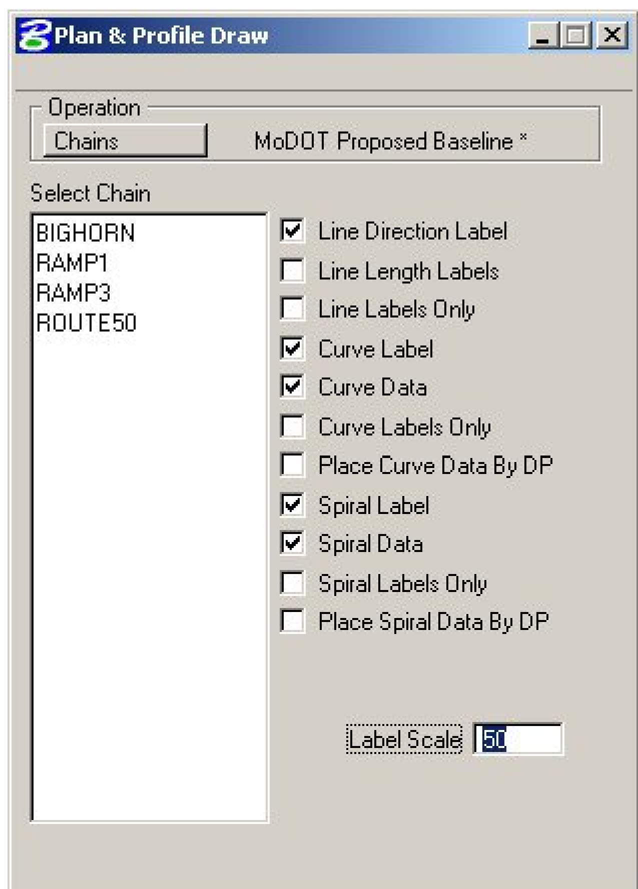
8.5 Operational Modes

8.5.1 Design 

The Design mode allows the user to tag each roadway element as it is placed in the design file based on item parameters and/or write COGO elements to the file.

Place Influence will set the level, symbology and attribute tags of elements drawn or copied using Microstation commands. When **Place Influence** is **On**, elements are drawn using the level, symbology and attributes as defined in the Geopak database file. When **Place Influence** is **Off**, elements are drawn using the active level, symbology and attributes of Microstation.

The **Draw Cogo Element** button is for drawing Cogo elements to a design file. A single click to this button prompts the user for a job number then opens a dialog box that allows the user to choose a COGO item to draw.



If a drafting item is chosen, the **Draw Cogo Element** button changes to **Draw Plan and Profile**. A single click to this button prompts the user for a job number, and then opens the **Geopak Plan and Profile Draw** box shown to the right.

There are nine possible COGO elements that may be recalled from the .gpk file: points, lines, curves, spirals, chains, stationing, parcels, profiles, and parallel chain. Each of these options changes the dialog box to offer relevant draw and label features used when placing an element in a graphics file. When using **Plan and Profile Draw**, be sure to turn off **Place Influence**.

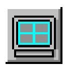
The points and lines dialog boxes have a key-in field that allows the user to specify the names of the COGO elements to be drawn. To use the line operation, the user must use point numbers to specify the ends of the line. The points/lines are drawn immediately after you enter their respective names and press the enter key. To draw more than one point or line, place a dash in-between the point numbers. To draw a line without using consecutive point numbers, use a forward slash.

The dialog boxes for curves, spirals, chains, stationing, parcels, and profiles have a list box that display the names of all stored curves and chains. Highlighting one of the available elements causes it to be drawn into the file. Each type of item has a list of options that can be plotted.

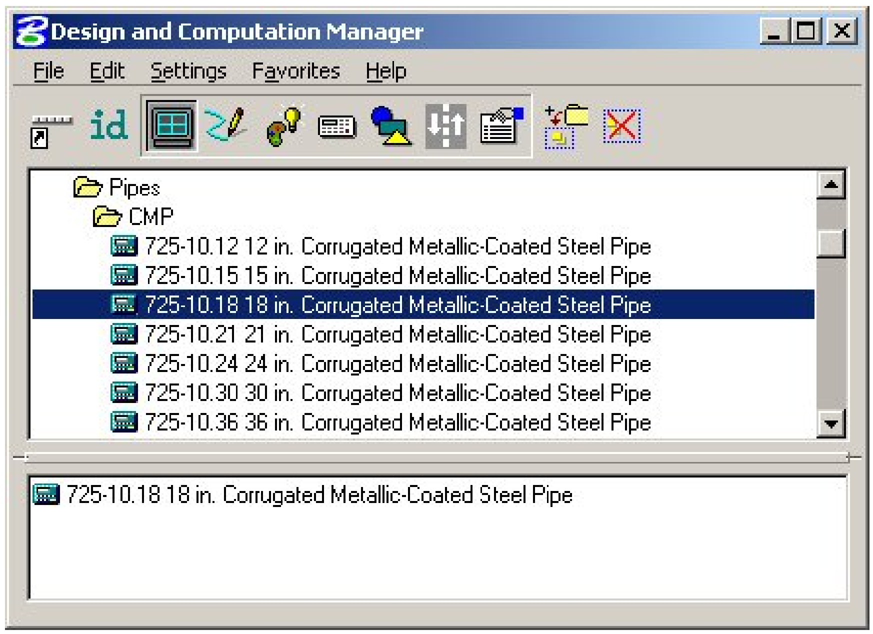
**Note that Geopak can draw elements to levels not turned on. After elements are drawn, it may be necessary to turn on appropriate levels and fit screen.

Remember that **Place Influence is for drawing Microstation elements. **Draw Plan & Profile** is for drawing **Cogo** elements. **<u>Do Not</u>** have **Place Influence** on when using **Draw Plan & Profile**.

8.5.2 Display



Display mode is used to enhance on screen visualization.

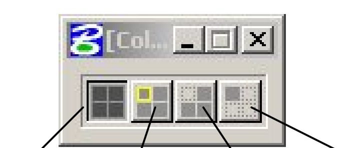


The pay item to be visualized is added to the **Collection** box. Three display options are available for the display of the items in the **Collection** box.

Highlight - will change those items stored in the collection area to the Microstation highlight color.

Not - simply turns off the display of the collection items leaving everything else on.

Only - will turn off everything but the collection items.



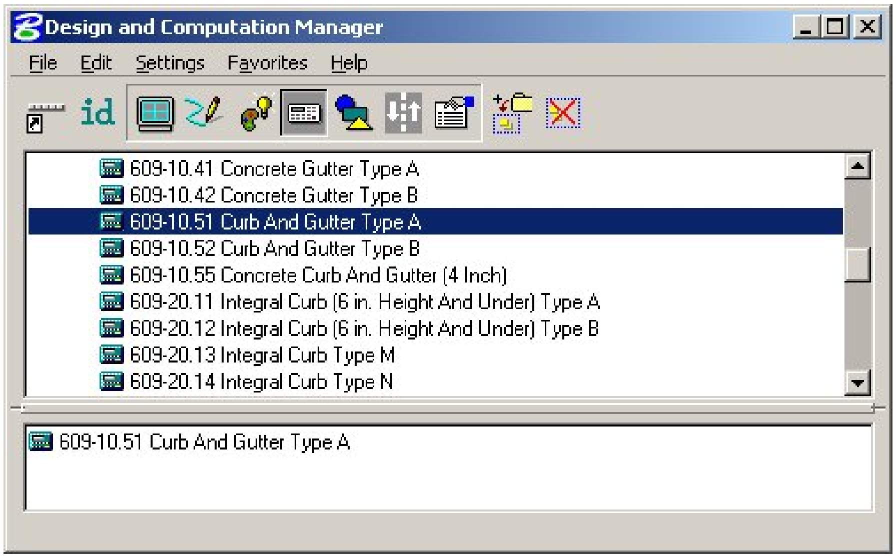
8.5.3 Set

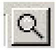
The **Set** mode allows you to assign attributes from the D&C Manager database to existing graphical elements in the file. With the Use **Complex Chain** option turned off, the **Set** mode is the same as MicroStation *Element Select*. The user may tag several elements by depressing the Ctrl key while data pointing each element or by using the MicroStation *Power Selector*. This allows you to affect multiple elements with one Set command.

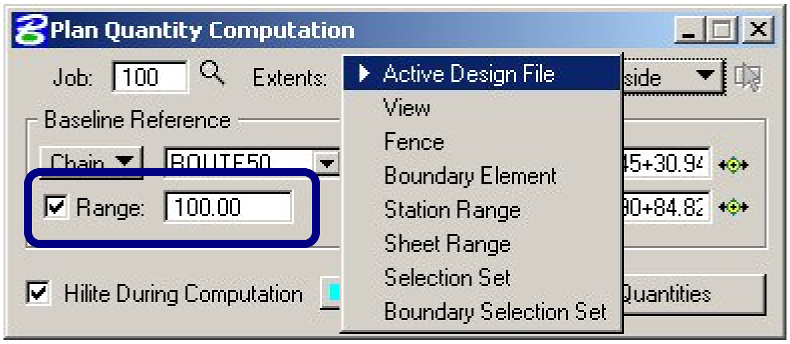
The **Complex Chain** option automatically creates a chain from graphic elements and applies the attributes of the highlighted item in the content box.

8.5.4 Compute

The **Compute** mode provides quantity calculations from graphic elements placed using the **D&C Manager**. Desired items for inclusion in the computation are added to the collection box at the bottom of the main D&C dialog as shown to the right.



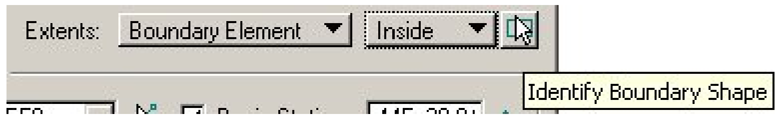
When the compute mode is invoked the Plan Quantity Computation dialog appears. The user can type in the job number in the field or select the  icon.



The items to be computed can be chosen by various options provided in the **Extents** pulldown, which include **Active Design File, View, Fence, Boundary Element, Station Range, Sheet Range, Selection Set and Boundary Selection Set**.

The **Active Design File** option will allow all elements found in the active design file and within the specified **Range** to be considered for computation, while the **View** option will allow only those elements in the current view to be used for computing quantities. If the view includes elements outside range, the range will override.

The **Fence** option determines which elements to be used for computation based on the Fence options chosen as well as the range. The fence modes include **Inside, Overlap, and Clip**. However, the **Clip** mode applies only to non-shape elements.

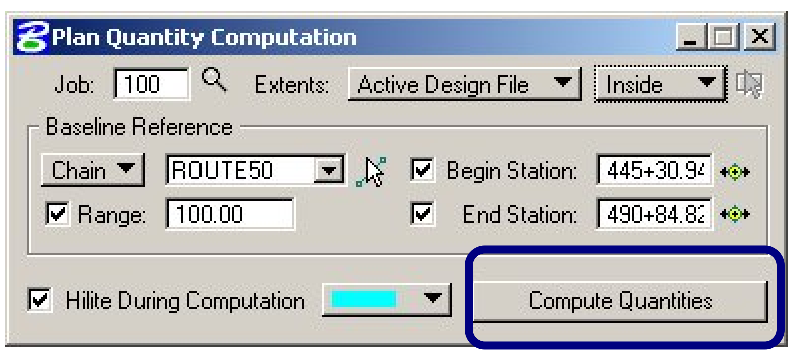


The **Boundary Element** option allows the user to select a previously placed closed element to represent the boundary for computation. This option is sensitive to the *MicroStation* **Inside, Overlap and Clip** modes. Similarly, the Boundary Element Set allows the user to use an element to specify the boundary for element selection to be included in the computation; however, the **Boundary Element Set** mode requires the user to create the selection set of the boundary prior to computing.

The **Station Range** option allows the user to compute quantities based on a station range for a particular cogo chain or *Microstation* baseline. The **Station Range** can be typed in the Begin/End Station fields or it can also be selected by data pointing.

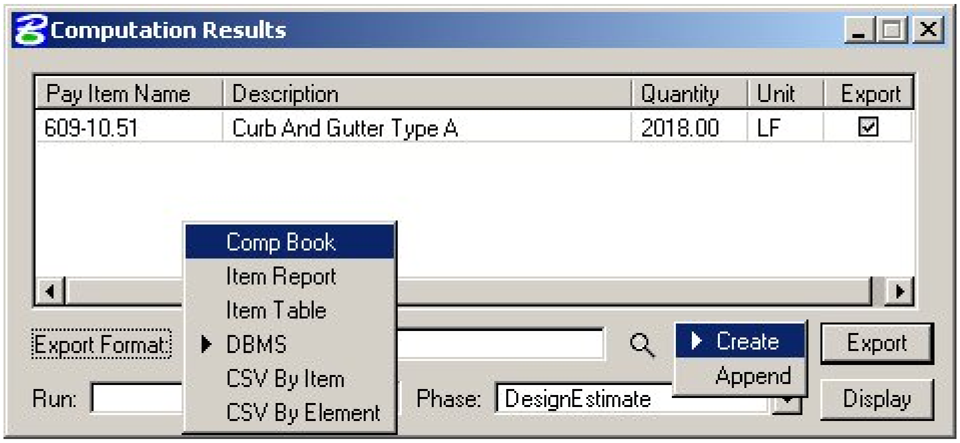
The **Sheet Range** option allows the user to compute quantities within GEOPAK generated plan/profile sheets by specifying a sheet range.

The **Selection Set** option allows the user to create a selection set of the elements to be included in the computation prior to computing quantities.



The **Highlight in Computation** toggle will highlight all MicroStation elements utilized in the computations if activated.

Once the computation options are set, the user can start the computation by selecting the **Compute Quantities** button and the **Computation Results** dialog appears.



Each item computed is listed in the **Computation Results** dialog. For each item the dialog lists the *Pay Item Name*, a *Description*, the computed *Quantity*, the *Unit* used for computation, and a toggle for *Exporting* to a report. At this point, the user can create a file containing the calculations by specifying the format of such report. Once a file has been created, the user can append other computed quantities. Once the type of format has been selected, select the **Export** button to create the output file. There are six types of report that can be exported.

Comp Book – This is a report that lists pay item name, description, quantity summaries and their respective station/offsets for each occurrence of the pay item. This file is in an ASCII format.

Item Report – This reports lists a total quantity for each pay item, giving the description, unit used for calculation. This file is in an ASCII format.

Item Table – contains the same information as an Item Report. It produces an ASCII formatted quantity table to be included in a drawing file or imported into the estimate program.

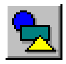
DBMS – provides very detailed information including calculated and rounded quantities, geometric properties, pay item numbers, descriptions, station / offset values, etc. The format is the selected database (i.e., Microsoft Access, Oracle, SQL Server, and dbase.

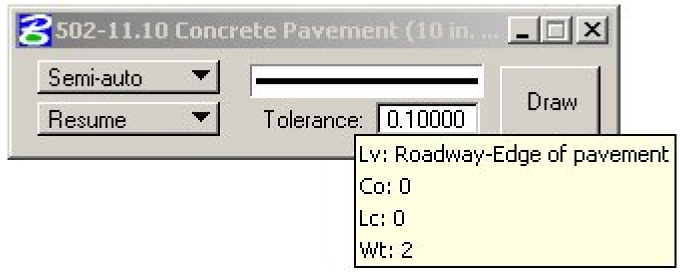
CSV By Item – is similar to Item Report, except that the file is in a CSV (comma separated value) format.

CSV By Element – produces a more detailed report that lists not only quantity summaries, but also geometric properties such as plan view coordinates and station/offsets for located elements. File output is in CSV format.

The **Run** and **Phase** fields are used only for the DBMS format for subsequent use in the Quantities Manager Tool. MoDOT currently uses the Estimate 2000 software for estimating quantities.

8.5.5 Shape

Shape mode  provides tools for creating shapes to be used for area calculations such as pavement.



Three options are available for choosing the elements to create the shape.

Semi-auto – allows the user to trace around the elements to create the shape. The user picks an element, and then GEOPAK finds an intersection on that element. The user clicks the data point button to accept the intersection, or reset to choose another intersection. GEOPAK will then find the next intersection, which the user can accept or choose another. This is repeated until the beginning of the shape is reached.

During the Semi-auto mode of shaping, the user can select various *Ball Options* to adjust the size of the circle showing the points determining the boundary of the shape. The Ball Options include ***Resume, Time Out, Ball Enlarge, Ball Reduce, and Ball Restore*.** The default is set to Resume.

***Resume* –** This option deletes the drawing circles automatically upon completion of drawing the shape.

***Time Out* –** This option suspends the shaping process to allow the user to use any MicroStation window commands, such as Zoom In, Zoom Out, etc.

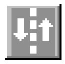
***Ball Enlarge* –** This option allows the user to enlarge the size of the drawing circle. This can be selected an unlimited number of times while drawing the shape.

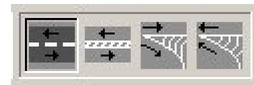
***Ball Reduce* –** Opposite of the Ball Enlarge.

***Ball Restore* –** Resizes the circle to the radius size when the Draw button was last selected.

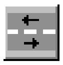
Automatic – creates the smallest shape possible. The user selects a data point inside the shape they are trying to create. GEOPAK then moves up until it intersects an element, then traces around intersecting elements to create the shape.

Exclusive – works the same as the **Automatic** mode, but allows the user to select elements that will create a whole in the shape.

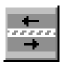
8.5.6 Pavement 



The **Pavement** mode allows the user to place pavement marking including striping, and symbols.



Striping – allows the user to place single or double, solid or skip pavement stripes.



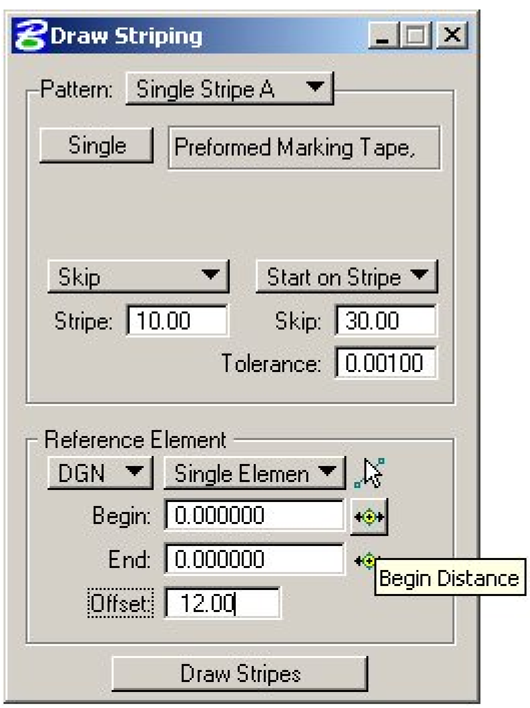
Separation – allows the user to place traffic separation pavement marking.

Chevron Diverge – allows the user to place pavement chevrons in areas of diverging traffic.

Chevron Merge – allows the user to place pavement chevrons in areas of merging traffic.

These are discussed further in the following pages.

8.5.6.1 SINGLE STRIPING



This box offers predefined configurations for single stripe and double stripe options so the user can easily control the type of striping being placed.

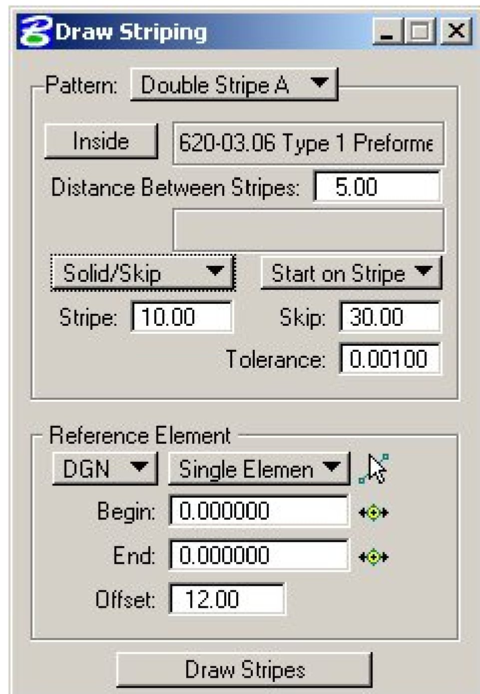
The pay item box will reflect the currently selected pay item in the **D&C Manager** dialog box; the user may change this at any time during the process.

Next, define the start option by selecting **Solid** or **Skip** (or a combination thereof). If Skip is active, the user must define the stripe and skip lengths. If an ending stripe is shorter than the Tolerance value, it will not be drawn.

The lower portion of the dialog box allows the user to set up the **Reference Element**. The reference element can be selected from an existing cogo **Chain** or from MicroStation elements in the **DGN**. If **DGN** is the method selected to set the **Reference Element**, the user then has three choices to make the selection. The three choices are *Single Element, Complex Chain, or Selection Set.* In addition, the user needs to set up beginning and ending point for the limits of striping. Once the reference MicroStation element has been chosen, the Begin/End fields will automatically populate with the total distance measured for the element. The user can adjust this distance by using the  icons to the right of the Begin/End fields. If a cogo chain is chosen, the Begin/End stationing of the chain are automatically populated. The user can then adjust the station range by utilizing the  icons.

After selecting the **Draw Stripes** button, the user must enter a data point on either side of the reference element to begin striping. Striping is placed at the indicated **offset** value; the data point controls whether striping is offset left or right. *Striping is placed as a graphic group.*

8.5.6.2 DOUBLE STRIPING

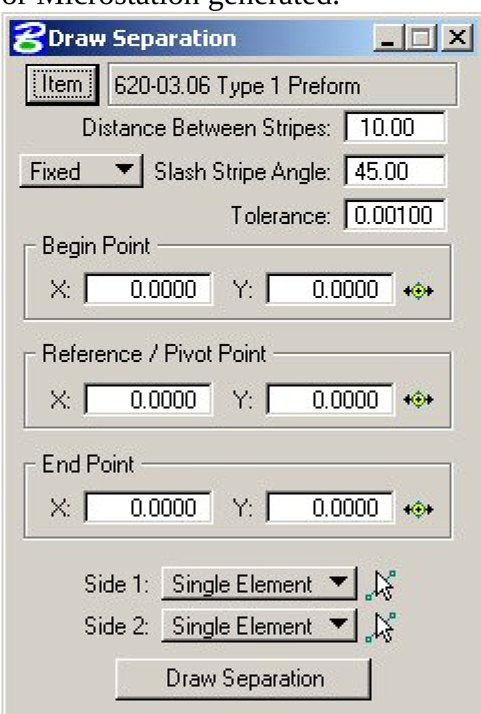


The process for Double Striping is the same as Single, except for having two pay item placement options, Inside and Outside. The user must select either the Inside or Outside button for the highlighted (D&C Manager) pay item to be displayed in the dialog box. Separate quantities are calculated for each stripe.

The remaining process is the same as described above.

8.5.6.3 SEPARATION

This option draws pavement markings between two sets of selected elements. Elements may be either GEOPAK or Microstation generated.



Once a pay item has been selected, the user may set the **Distance Between Stripes** and the **Slash Stripe Angle**. Tolerance functions the same as for striping.

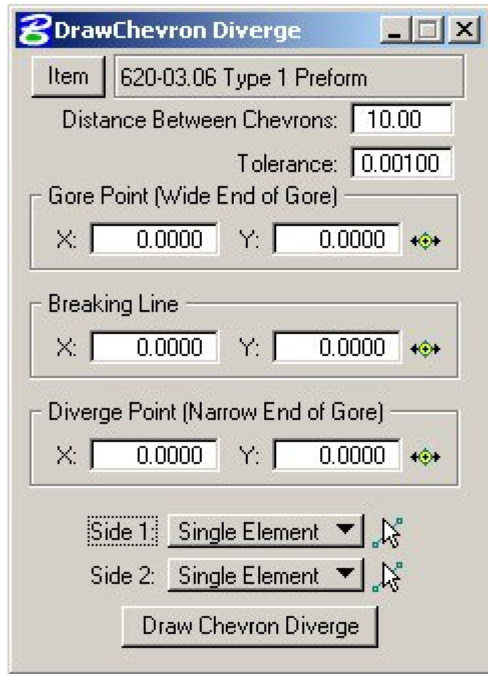
A **Begin Point** and **End Point** should be issued before the **Reference DP** is identified. The Reference Point must fall between the **Begin Point** and **End Point**. It marks the location of the first pavement marking and determines the direction of the slashed stripe. All other markings will be based on the first stripe.

Tools for defining the limits of the pavement markings are located at the bottom of the Separation dialog box. **Side 1 and Side 2** are the two edges to determine the separation marking. **Side 2** is used when turning the **Slash Stripe Angle**. GEOPAK begins on **Side 2,** and draws the marking at the specified angle until it intersects the **Side 1** element, where the marking stops. It is desirable to have the total length of the **Side 2** elements longer than those of **Side 1**.

The three methods available to select elements are the MicroStation *Single Element, Selection Set, and Complex Chain.*

After the **Draw Separation** button is selected, the user must issue a data point in the graphics file for the pavement markings to be displayed.

8.5.6.4 CHEVRON DIVERGE



Once the pay item and its relative parameters have been defined, there are three points needed to define the chevron: **Gore Point, Breaking Line** and **Diverge Point.**

The **Gore** point defines the wide end of the gore.

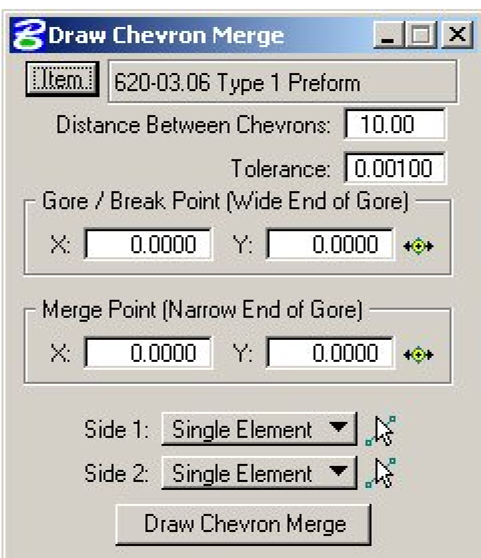
The **Breaking Line** point must fall between the two sides of the gore and sets the location of the point at which the chevron diverts in a different direction.

The **Diverge Point** represents the narrow end of the gore where chevrons are to stop.

Use the two **Side 1 and Side 2** buttons similarly to the Draw Separation tool to identify the sides of the gore.

Once the **Draw Chevron Diverge** button is selected, the chevrons are displayed.

8.5.6.5 CHEVRONS MERGE



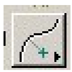
This process works similar to Chevron Diverge except the two points, Gore Point and Breaking Line, have been combined into one **Gore/Break Point** that serves both functions.

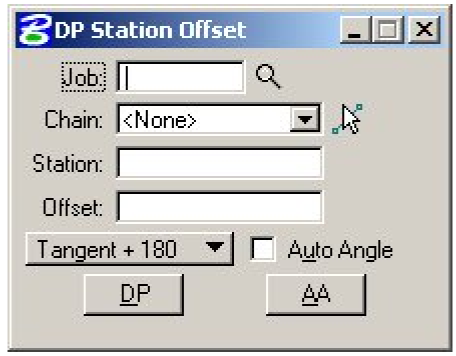
The **Gore/Break Point** should be located near the wide end of the chevron. It simultaneously sets the beginning of the pavement markings and the point at which the chevron will break.

The **Merge Point** set up works similar to the Diverge Point.

The remainder of the process is as described above.

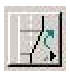
8.6 DP Station/Offset

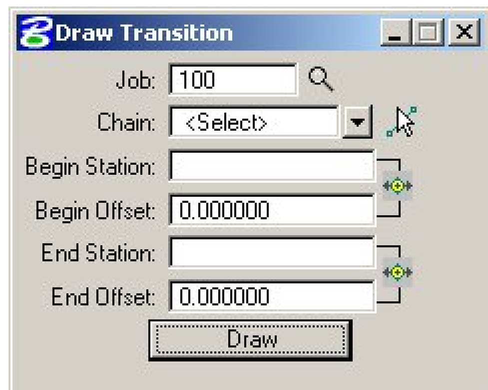




The **DP Station/Offset** command works in conjunction with Microstation commands and the D&C Manager. It can be used as the *data point* for any Microstation command. **DP Station/Offset** provides precision placement of elements based on a station and offset of a stored chain. Uses for this command include precision placement of elements and window functions.

8.7 Draw Transition

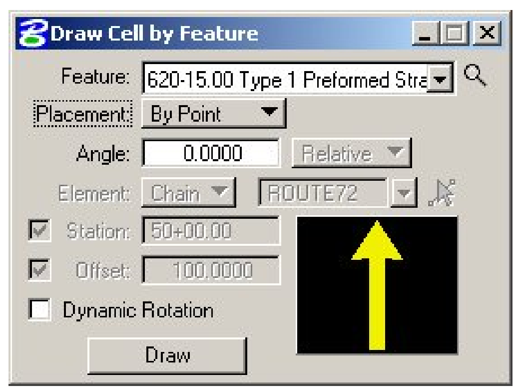




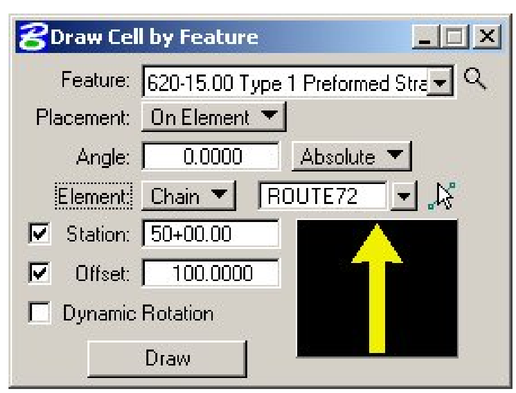
Draw Transition will draw a line/curve based on a beginning station/offset and an ending station/offset relative to a selected chain. Use of this command includes turn lanes, mail box widening and lane transitions.

Note: Elements placed with **Draw Transition** will have Microstation element type **curve** when the beginning and ending offsets are different and will have Microstation element type **line** and/or **arc** when the beginning and ending offsets are the same.

8.8 Draw Cell By Feature



Draw Cell By Feature will place cells stored in the D&C Manager pay items with the precision of a Station/Offset input.

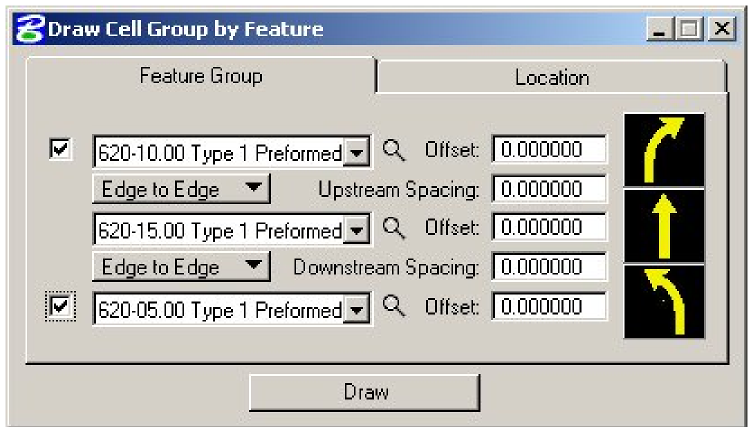


The user selects the Feature from the D&C Manager. The tool offers two settings for placement: **On Element** or **By Point**. If By Point is chosen, the user has only the options of setting the active **Angle** and **Dynamic Rotation** available. However, if **On Element** is selected, the user has additional options. The Angle can be set up **Relative** to the chain/element or **Absolute**. With the Element method of **Chain** selected, the user can select a chain stored in the active GPK file and check the **Station** and **Offset** toggles to place the cell.

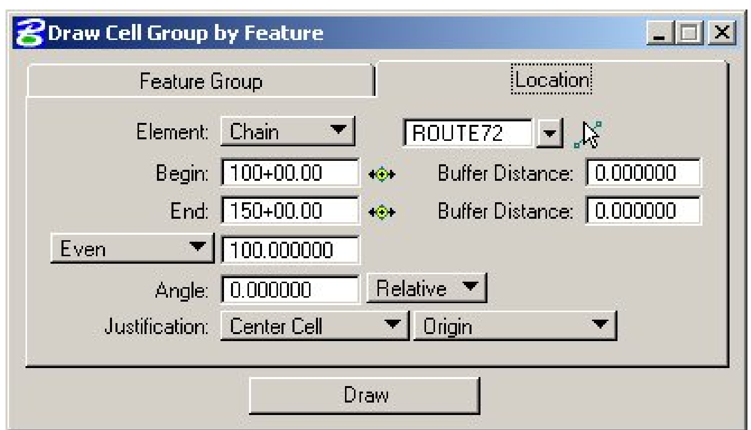
If a GPK is not available, the user can set the **Element** method to **DGN** and select a complex chain or an element from the DGN file. If the Dynamic Rotation is checked on, it will override the active angle. Once all the settings are set, select the **Draw** button to place the cell.

8.9 Draw Cell Group By Feature

Similarly, the Draw Cell Group By Feature combines the precision of a Station/Offset input with the features stored in the D&C Manager. This dialog consists of two tabs: **Feature Group** and **Location**.



The **Feature Group** tab defines the features and the offsets to be used for placing the cells based on a reference chain or element set in the **Location** tab. The tool allows for placement of cell groups in up to three different rows simultaneously. If placing groups of cell in more than one row, the user must check the appropriate toggles. Offsets are measured from the graphic element or chain defined on the **Location Tab**. The upstream and downstream spacing can be measured from origin to origin or from edge to edge of the cell. All cells are placed in a graphic group for easier manipulation.



The **Location** tab defines the reference chain element as well as the spacing of each cell within the group being placed. Both **Chain** and **Element** methods have the option for defining the begin/end placement. When using the **Chain** method, the user can enter the begin/end stations, but when using the **Element** method, the user must data point to define the begin/end stations. The **Buffer Distance** is used for cases where the begin station is known, but the user must maintain a certain distance inside that stationing. The tool offers several methods for spacing in between each cell within the group. The most commonly used are **Even** and **Increment**. The **Angle** can be set up relative to the chain or absolute. The tool also offers justification settings.

Once all the parameters are set in both the Feature Group and the Location tabs, select the Draw button to place cells.

Exercise 8-1

This is a combination group / individual exercise to introduce and practice using three GEOPAK plan view design tools: Design and Computation (D&C) Manager, DP Station/Offset, and Draw Transition. The first part of the exercise will be done together to introduce the tools. The last part is to be done individually to practice using the tools.

1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\plan_j5p0100.dgn**.

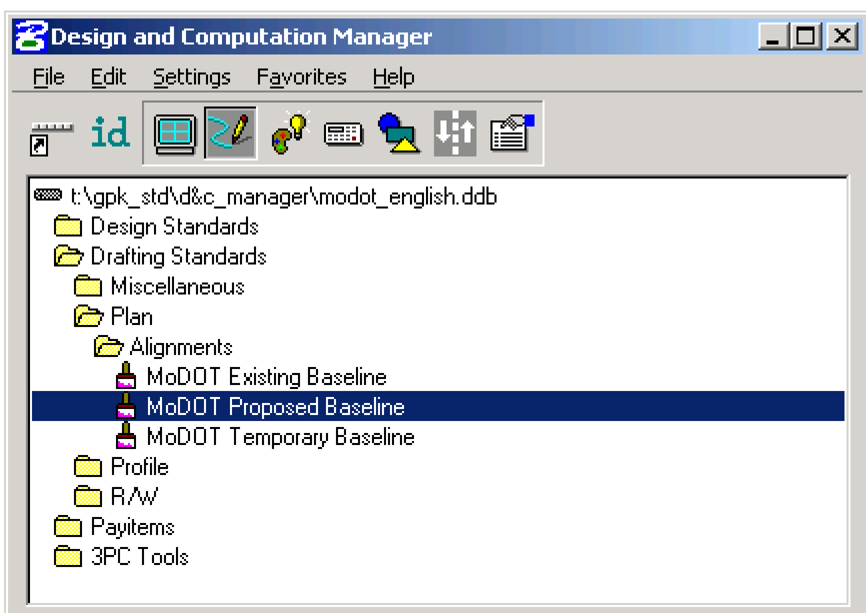
2. Open the **Design and Computation Manager** dialog. To access the tool, go to the MicroStation menu path:

   Application > GEOPAK Road Design & Computation Manager

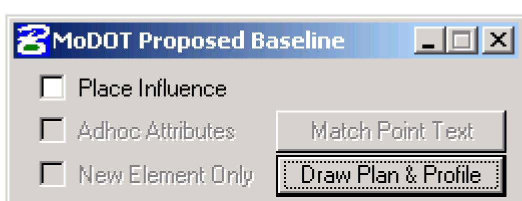
   or click on the raised icon shown in the figure to the right.

   Select the item:

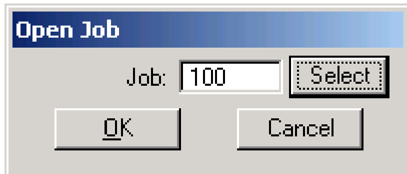
   Drafting Standards/Plan/Alignments/MoDOT Proposed Baseline



   Select the **Draw Plan & Profile** button.



3. If you open D&C Manager outside of a project, you will get the first dialog shown below on the left to indicate which GPK file is to be used. (If you are inside of a project, GEOPAK already knows which GPK file to use.) Click on **Select** to bring up the dialog shown to its right. Pick **job100.gpk** in this dialog and click **OK**. (If you do not see job100.gpk listed, ask an instructor for help.) Click **OK** in the first dialog to continue to the third dialog depicted in the bottom figure on the right side of the page.



Select the **Chain** Operation in the Plan & Profile Draw dialog.

Set the **Labeling Scale** to **50**

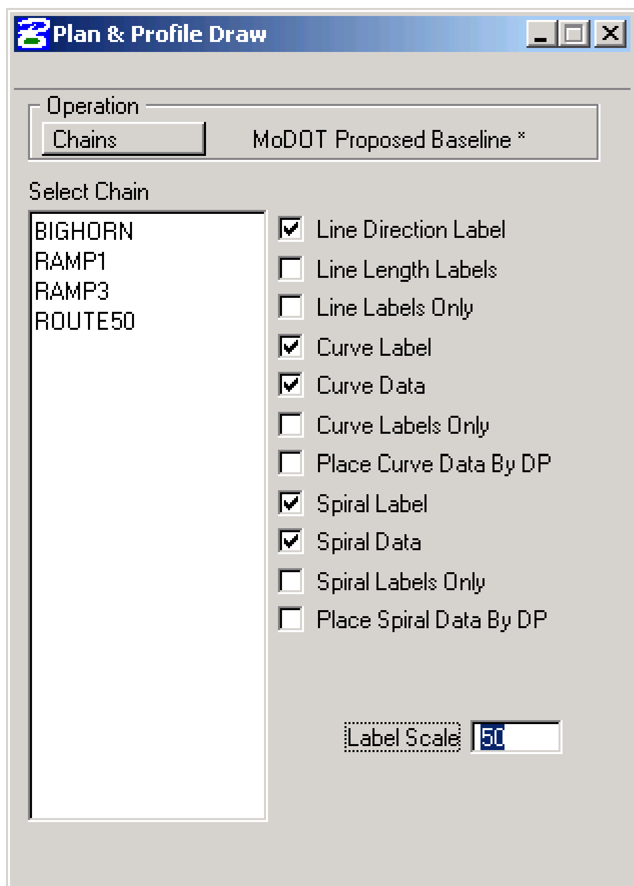
Have the following options turned on:

Line Direction
Curve Label
Curve Data
Spiral Label
Spiral Data

After all of the settings are checked, an item can be plotted by clicking **once** on its name.

Select the Chain **Route50**

Do a MicroStation **fit view** to see the plotted chain.



4. Select the **Stationing** Operation.

   Be sure the **Labeling Scale** is set to **50**.

   Have the following options turned on:

   Tick Marks
   Tick Mark Stations
   PC & PT & CS … Labels
   PI Labels

   Set the following options:

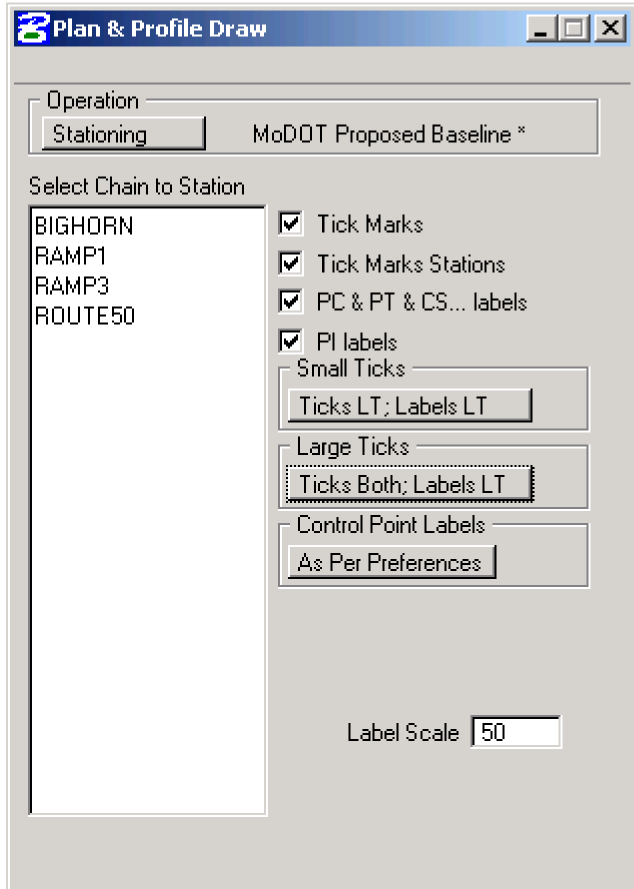
   Small Ticks:
   Ticks LT, Labels LT

   Large Ticks:
   Ticks Both, Labels LT

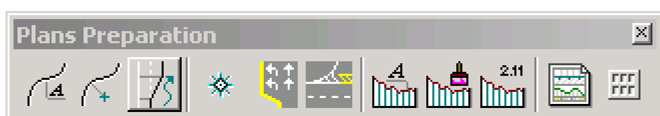
   Control Point Labels:
   As Per Preferences

   Select the chain **Route50**.

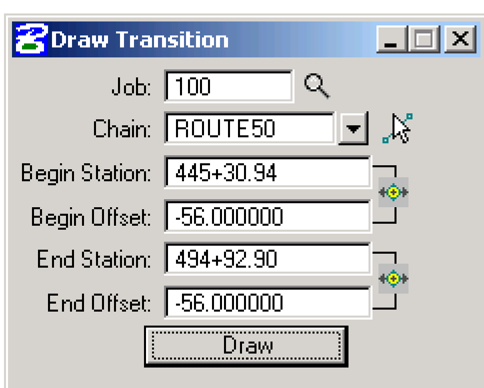
   Close the Plan & Profile Draw dialog.



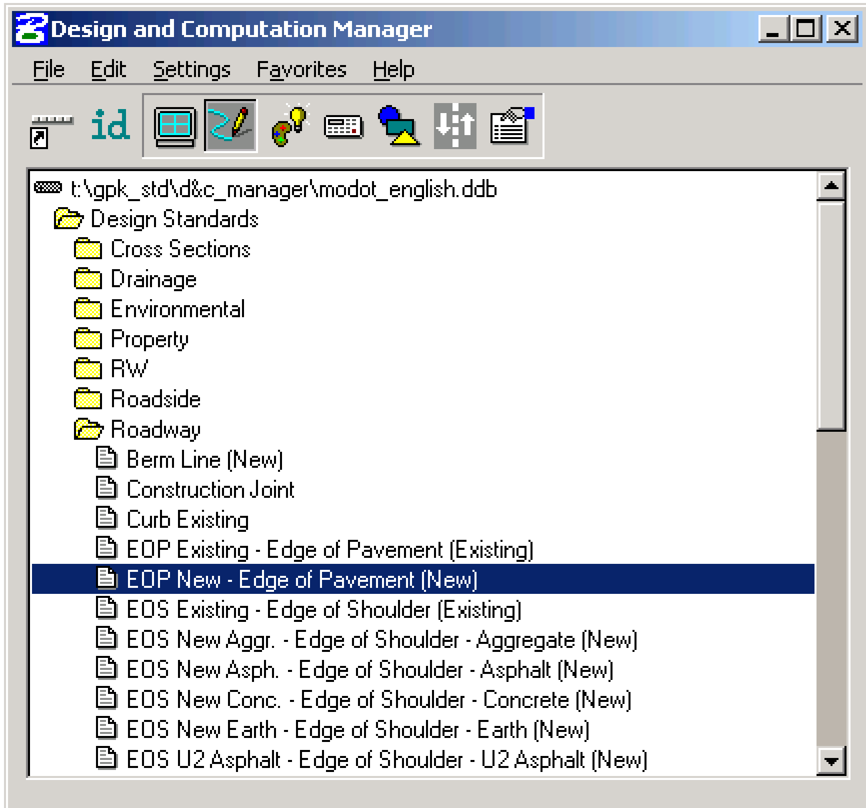
5. Open the **Draw Transition** tool by selecting the raised icon shown to the right; it is the third tool in the expanded tool palette shown below.



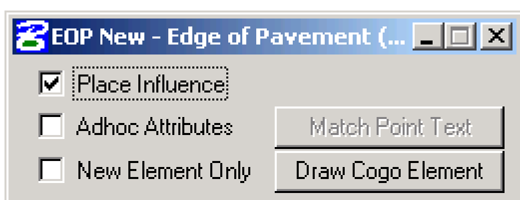
   This tool, shown below, can be used to draw linear elements relative to a chain by specifying the job number, chain, a beginning station & offset, and an ending station & offset.



6. Use **Draw Transition** to create the edges of pavement by switching to **D & C Manager** category: **Design Standards/Roadway/** and item: **EOP New – Edge of Pavement (New)**.



Be sure that **Place Influence** is checked to have the MicroStation symbology match the pay item.

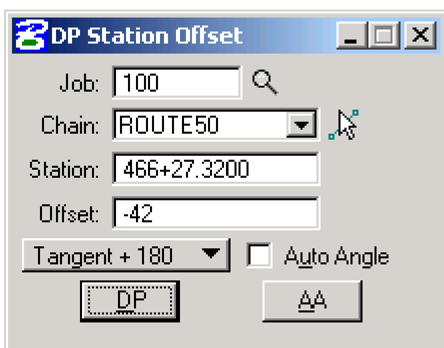


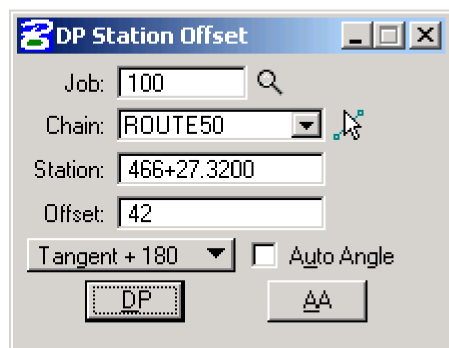
Using the following information to draw the edges of pavement:

Beginning Station	Beginning Offset	Ending Station	Ending Offset
Start of Chain	-56	End of Chain	-56
Start of Chain	-28	End of Chain	-28
Start of Chain	28	End of Chain	28
Start of Chain	56	End of Chain	56

7. There are a pair of three span bridges on Route 50 as it crosses over BigHorn Drive. From the previous step it can be determined that the centerline for the the east and west bound lanes of Route 50 are located 42' to the left and right of its chain. The **tie station** for the east bound bridge, which locates the transverse centerline of Bent 2, is located at the **466+04.6** at an offset of 42' to the Route50 chain. Furthermore, the skew of the bents for this bridge is determined by the angle of Big Horn Drive relative to Route 50 where the two chains intersect. This occurs at **Route 50 Sta. 466+27.32**. Big Horn is has a right advance skew of about 10° 49" (**10.8167°**) relative to Route 50 at that station. The **DP Station Offset** tool will be used set the tie and skew of Bent 2. Open the tool by selecting the third tool in the second tool in the Plans Preparation tool palette shown.

This tool, shown below, can be used to locate a MicroStation data point at a specific station and offset. The first step is to draw a line at **Route 50 Sta. 466+27.32** from an offset of –42' to +42'. To do this, set up the tool as shown below on the left; activate the MicroStation Place Line tool; click on the DP to start the line; change the Offset value to the one shown below on the right; and click on the DP button a second time to end the line.





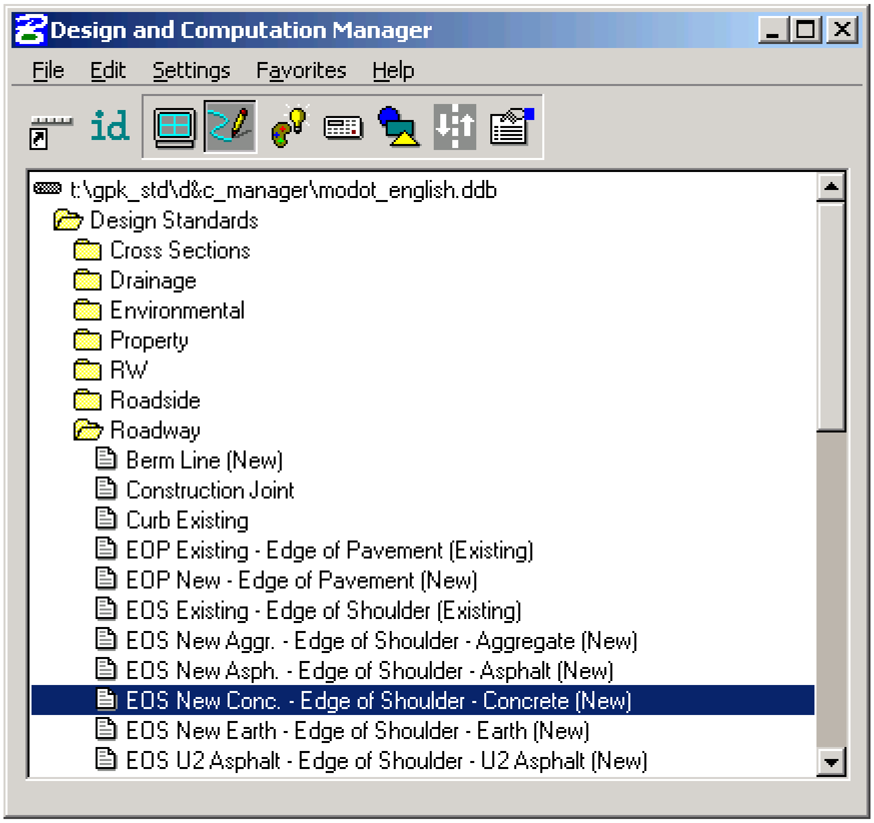
This tool, shown below, can be used to locate a MicroStation data point at a specific station and offset. The first step is to draw a line at **Route 50 Sta. 466+27.32** from an offset of –42' to +42'. To do this, set up the tool as shown below on the left; activate the MicroStation Place Line tool; click on the DP to start the line; change the Offset value to the one shown below on the right; and click on the DP button a second time to end the line.

Use the MicroStation Rotate tool to create a copy of the line at an active angle of **10.8167°**.

Use the MicroStation Copy tool in conjunction with the GEOPAK DP Station Offset tool to copy the rotated line from its current location to Route 50 Sta. **466+04.6** at an offset of 42' to the right. This last placed line locates the transverse centerline of Bent 2.

8. On your own, use **Draw Transition** to create the edges of shoulder for the alignment with the following parameters.

   Use **D & C Manager** category: **Design Standards/Roadway/** and item **EOS New Conc. Edge of Shoulder - Concrete (New)**.



   Be sure that **Place Influence** is checked.

Beginning Station	Beginning Offset	Ending Station	Ending Offset
Start of Chain	-64	End of Chain	-64
Start of Chain	-26	End of Chain	-26
Start of Chain	26	End of Chain	26
Start of Chain	64	End of Chain	64

Exercise 8-2

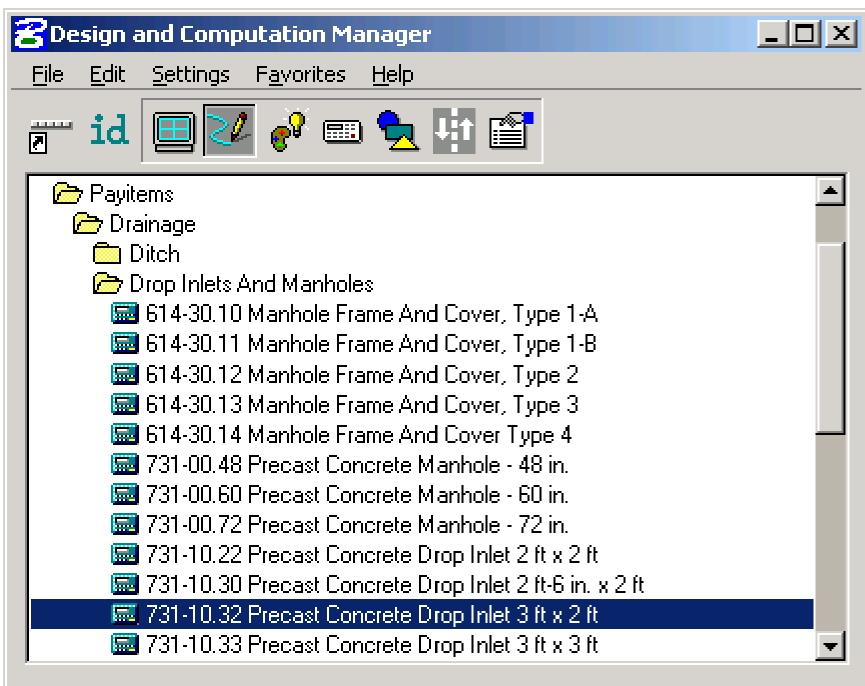
This is an optional exercise to show additional uses for thee GEOPAK plan view design tools.

1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\plan_bh_j5p0100.dgn**. Window in on the area where the ramps intersect Big Horn Drive.

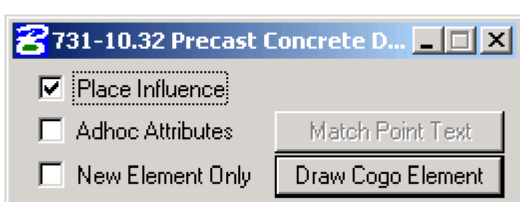
2. DP Station/Offset and Design and Computation Manager will be used to plot some drop inlets and a culvert to demonstrate the use of this tool combination. Open **DP Station/Offset** by selecting the raised icon shown to the right. It is the second icon in that tool palette.

   To place the correct item, open D&C Manager category:
   Payitems/Drainage/Drop Inlets And Manholes.

   Double click on the item: **731-10.32 Precast Concrete Drop Inlet 3 ft x 2ft**. This will activate the MicroStation Place Active Cell tool.



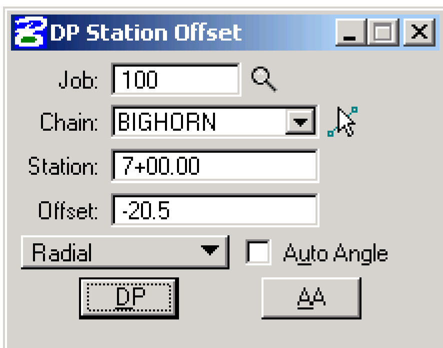
   Be sure that **Place Influence** is checked or else the correct cell will not be placed.

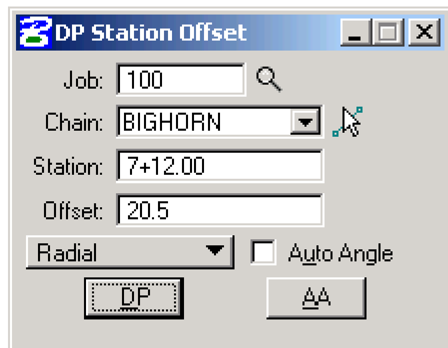


3. Place the cell using **DP Station/Offset** at the following locations:

Chain	Station	Offset	Orientation	Auto Angle
BIGHORN	7+00	-20.5	Radial	Checked
	7+12	20.5	Radial	Checked

The dialogs for placing the cells are shown below. After entering the correct information into the dialog, click on DP to place the cell. (**Note**: Before pressing DP, make sure that Place Cell is still the active MicroStation tool since DP Station/Offset will work with and MicroStation or GEOPAK tool that requires as data point.)





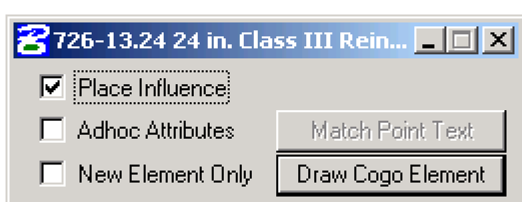
The instructor will demonstrate the other orientation options.

4. Use **DP Station/Offset** or **Draw Transition** to draw the culvert between the two drop using the following beginning and ending stations and offsets.

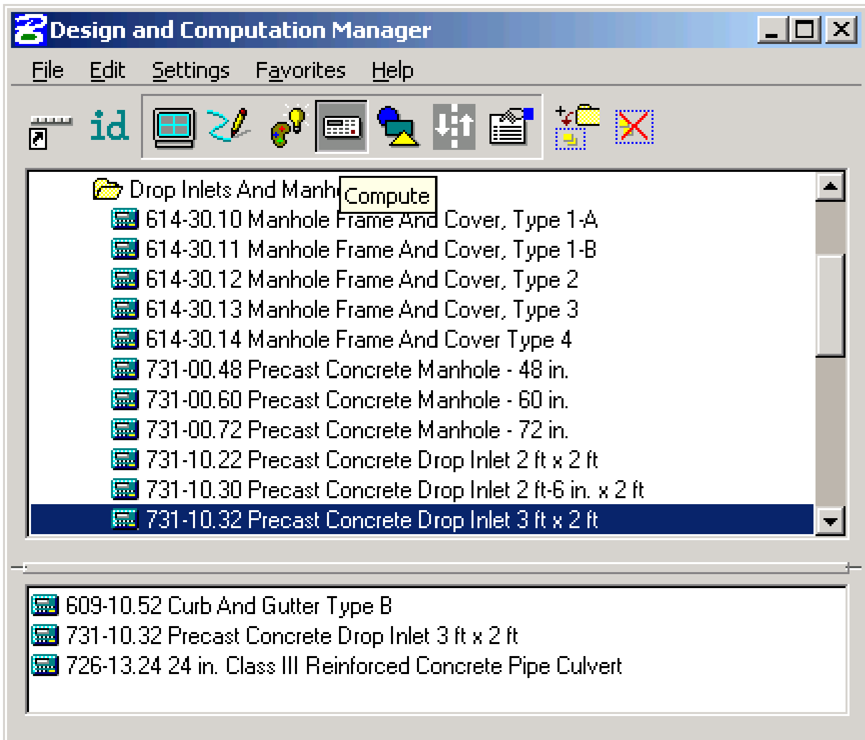
	Beginning		Ending	
Chain	Station	Offset	Station	Offset
BIGHORN	7+00	-19	7+12	19

Use **D & C Manager** category: **Pay Items/Pipes/RCP/**
and item **726-13.24 24 in. Class III Reinforced Concrete Pipe Culvert**.

Be sure that **Place Influence** is checked to have the MicroStation symbology match the pay item. (**Note**: If you use DP Station/Offset, make sure that **Place Line** is still the active MicroStation tool.)

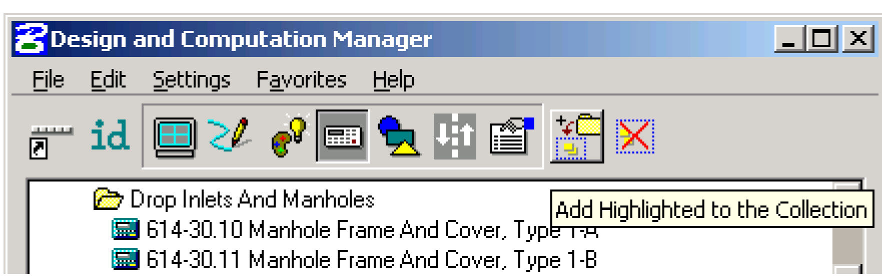


5. After placing the culvert, switch the **D & C Manager Mode** to **Compute** by clicking on the shaded icon shown below. A new section, called the Collection Box, is added to the main D&C Manager dialog. This mode can be used to compute quantities for items placed using D&C Manager.



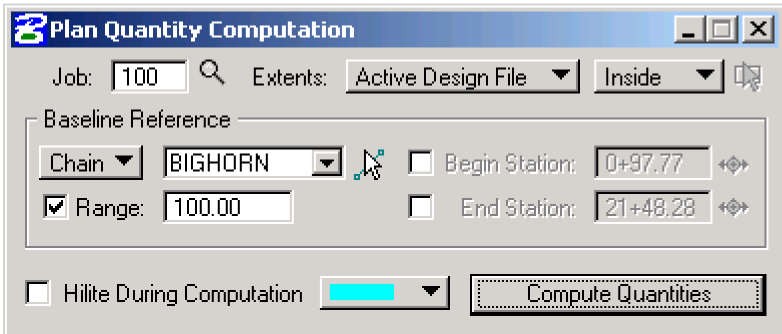
Add the items shown above to the collection box by navigating to the pay item and either double clicking on the item or clicking on the Add to Collection icon shown below.

The **id** icon in D&C can be used to aid in navigating to the items in the Payitems list. This is done by clicking on the icon and then data pointing on the plotted item in the MicroStation file. The instructor will demonstrate the use of this option.

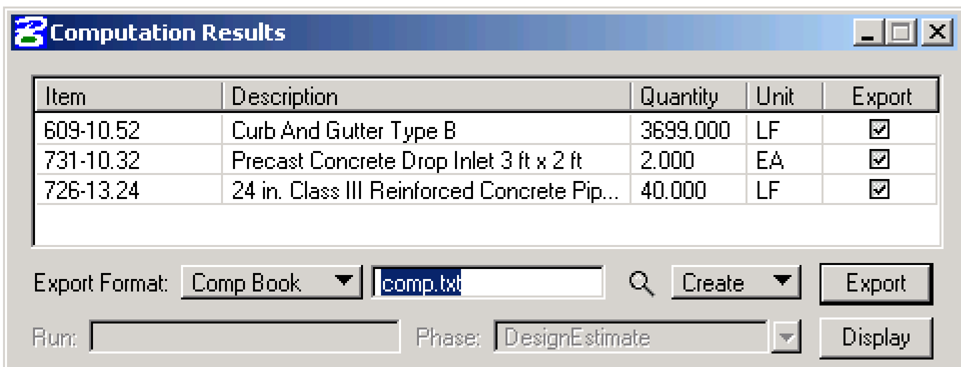


After adding the items to the collection box, zoom out in the MicroStation window until all of BIGHORN chain is visible. This needs to be done in order to compute all of the curb and gutter.

6. When D&C Manager is in Compute Mode, the Operations Box switches to the form shown below.



Set up the dialog as shown above and click **Compute Quantities**. The results of the computation will be displayed in the **Computation Results** window shown below. If you want a permanent record of the output, chose the type of report you want, type in the name of the output file you wish to use (comp.txt is used in the figure), and click on Export.



To see the other types of computation reports that D&C can generate, switch the **Export Format** to **Item Report** and **Item Table** and generate a report using these options.

Chapter 9

Labeling

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9.1 Objectives

- Learn how to label information with Plan View, Profile View, and Cross-Section Labeler

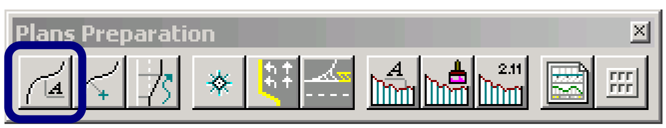
9.2 Definitions

The GEOPAK **Labeler** is a tool that allows the user to construct labels using text inserts, computed inserts, and key-in text. In Road there is a different **Labeler** available for the plan, profile, and cross-section views. Although a labeler is also available for the other GEOPAK Suite projects (Drainage, Survey, etc.) only the labelers available in Road are discussed in this chapter. The other labelers work similarly to the ones available in Road.

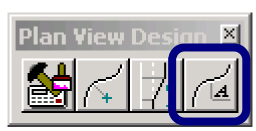
9.3 Accessing

9.3.1 Plan View Labeler

The Plan View Labeler can be accessed from one of three locations. It is available in the menu path **Applications > GEOPAK Road > Plans Preparation > Plan View Labeling**. It can also be selected from Plans Preparation tool pallet, which is the pallet outlined in the Road toolbox shown to the right. It is the first icon in the **Plans Preparation** tool pallet shown below.

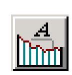


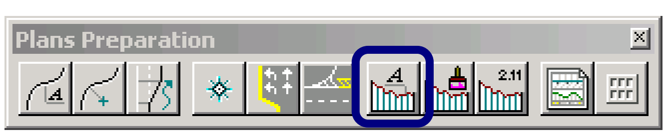
The third way that the Plan View Labeler can be accessed is from the **Road Project** dialog by clicking on **Plan View Design**, shown below on the left. This will bring up the Plan View Design tool pallet shown below on the right. The Plan View Labeler is the last one in that tool pallet, as outlined below.



9.3.2 Profile View Labeler

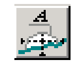
The Profile View Labeler can be accessed from the menu path **Applications > GEOPAK Road > Plans Preparation > Profile View Labeling** or by selecting the icon shown to the right. As shown below, it is the seventh (or fifth from the right) icon in the **Plans Preparation** tool pallet.

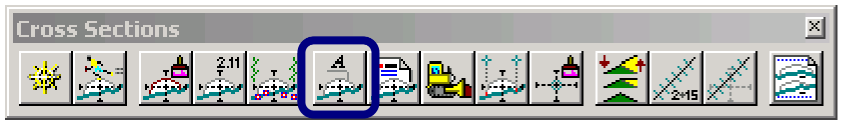




9.3.3 Cross Section Labeler

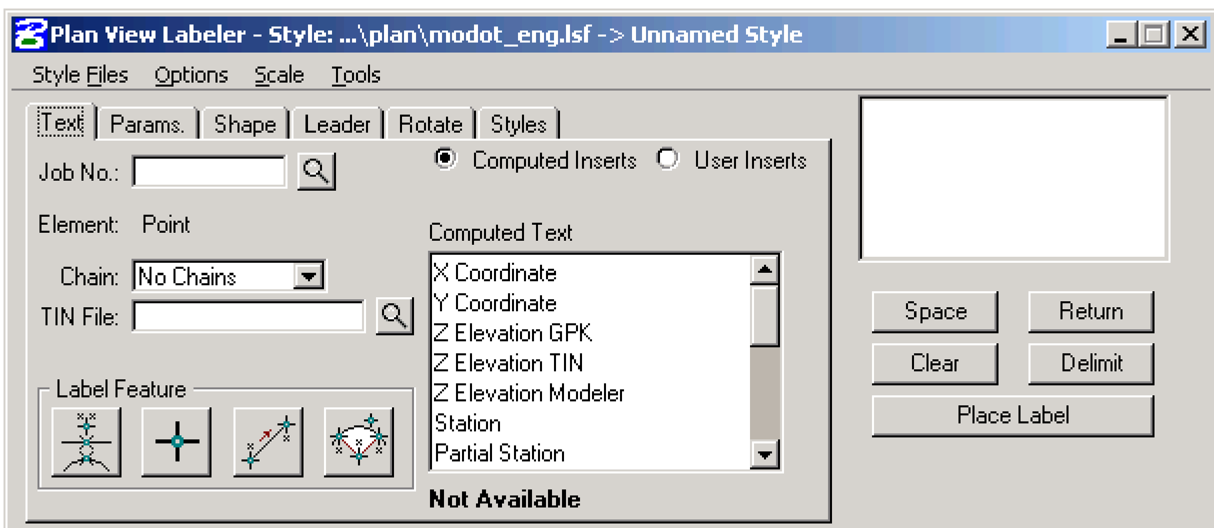
The Cross Section labeler can be accessed from the menu path **Applications > GEOPAK Road > Cross Sections > Cross Section Labeling** or by selecting the icon shown to the right. It is the sixth icon in the Cross Sections tool pallet shown below. The Cross Sections tool pallet is located in the lower left hand corner of the Road toolbox as shown to the left.





9.4 Basic Dialog

When you enter one of the labelers, a dialog similar to the one shown below appears. The dialog has four different parts.



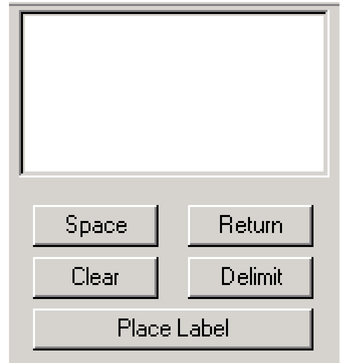
9.4.1 Banner

The window banner (shown below) displays which labeler is active, the name of the labeler style file (LSF), and the name of the style selected. If a predefined style from the active LSF is not selected, the banner displays "Unnamed Style." In the following figure the Plan View Labeler is active, the name of the LSF is "…\plan\modot_eng.lsf", and a predefined style is not selected.

9.4.2 Menu Area

Immediately under the window banner are the pull-down menus shown below. The menu options are discussed below in Section 9.11 Menus.

9.4.3 Label Content



The label to be placed is displayed in the box on the right side of the dialog, shown in the figure to the right. Clicking in the box activates a text curser, which indicates where information will be placed in the label. With this cursor active, the user may use the keyboard to type text for the label.

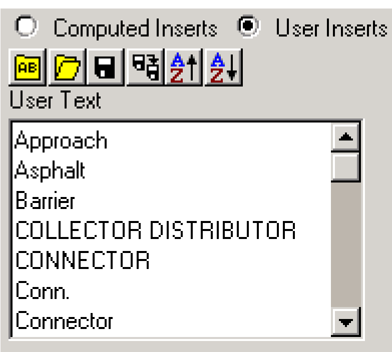
Under the box are several buttons. The **Space** button puts a space in the label at the cursor position. The **Return** button starts a new line. The **Clear** button clears the box to start a new label. The **Delimit** button places a line above or below a line of text. The **Place Label** button starts the place label process. **Note**: Follow the **Status Bar** prompts located in the lower left hand corner of the MicroStation window when placing a label.

9.4.4 Option Tabs

The final area (shown below) contains tabs, which allow the user to define various options for the label. Each of these tabs are discussed next

9.5 Text Options

The **Text** tab allows the user to add either **Computed Inserts** or **User Inserts** to the label. If the User Inserts is selected, the right side of the text tab changes to the one shown below. This allows the user to view and insert predefined text into the label from a User Insert File (INS). The contents of the file are displayed in scrollable window below the icons. Double click on one of the predefined pieces of text to add it to the label.



The icons serve the following functions:

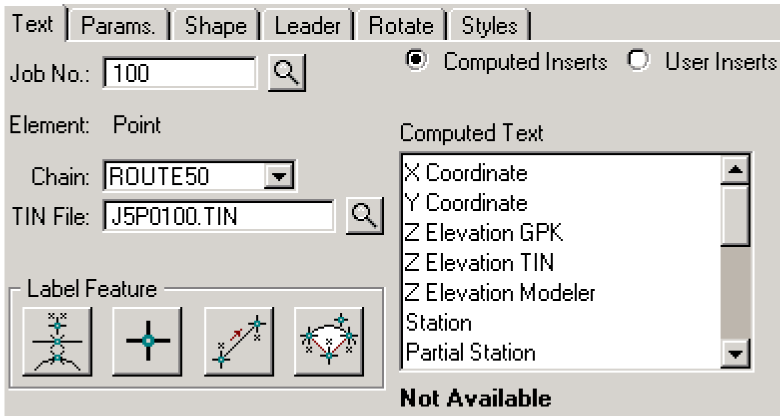
- Edit the Insert File.
- Open an Insert File.
- Save the Insert File.
- Save the Insert File As…
- Sort the contents in ascending alphabetical order.
- Sort the contents in descending alphabetical order.

Often it is easier to type directly into the label content box unless the user is unsure of spelling or acceptable abbreviation. The predefined user insert files are those that come with GEOPAK. The user is able to edit these files or create one. If you do have a personal inserts file, it is a good idea to save it to some location other than the GEOPAK …\bin\ folder to keep in from being overwritten during program upgrades.

The Computed Inserts section and the contest of the rest of the text options tab changes depending on which labeler is active. Each of these is presented in the following subsections.

9.5.1 Plan View Labeler Computed Text Options

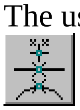
The text options tab for the Plan View Labeler using Computed Inserts is shown below.

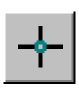


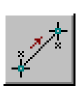
To use the station and offset computed inserts, the job number and the chain need to be selected. If elevations are to be calculated, a .tin file must be chosen. The **Job No:** may be typed in or the GPK may be selected from a list of available files in the working directory by clicking on the magnifying glass icon  to the right of the Job No: field.

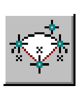
The **Computed Inserts** are items that Geopak has the ability to calculate for the chosen item. The list of **Computed Inserts** changes with the type of element that is chosen. If a line is chosen, the list of **Computed Inserts** will show inserts of bearing, and length. If a curve is chosen the list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

The user can select different elements by using the icons in the **Label Feature** section.

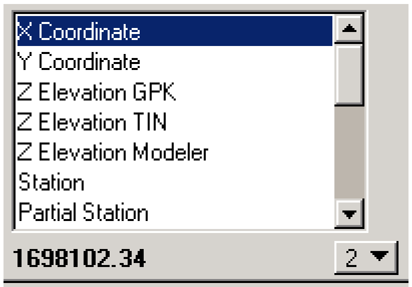
 Allows the user to select a graphical element such as a point, line, or curve.

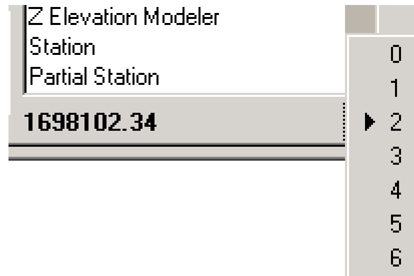
 Allows the user to data point a location on the screen.

 Allows the user to choose two visualized COGO points to represent a line.

 Allows the user to select the curve start point, ending point, and either the curve center or a point on curve using visualized name COGO points. Only elements listed as Points in the COGO navigator may be used for this option.

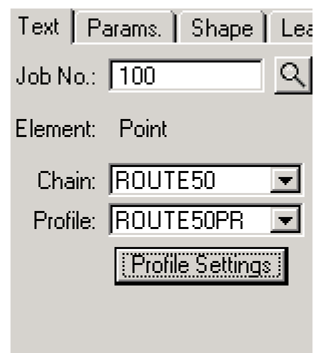
To use the computed inserts, select the Label Feature icon for the type feature you want to label. Next, follow the prompts in the lower left corner of the MicroStation window to select the feature. Once the feature is selected, the list of Computed Text will reflect those values that the labeler can calculate for that type of element. To view the computed value, select one of the items from the list. The computed value will appear in the bottom center of the dialog, as shown in the following figure on the left. To change the decimal accuracy of the value, click on the pull down to the right of the value and select the desired accuracy as shown below in the figure on the right.



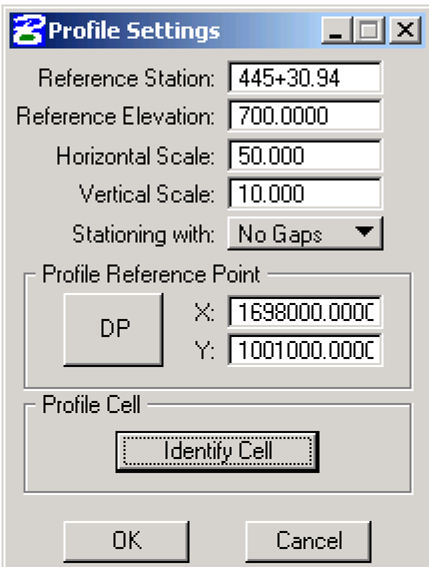


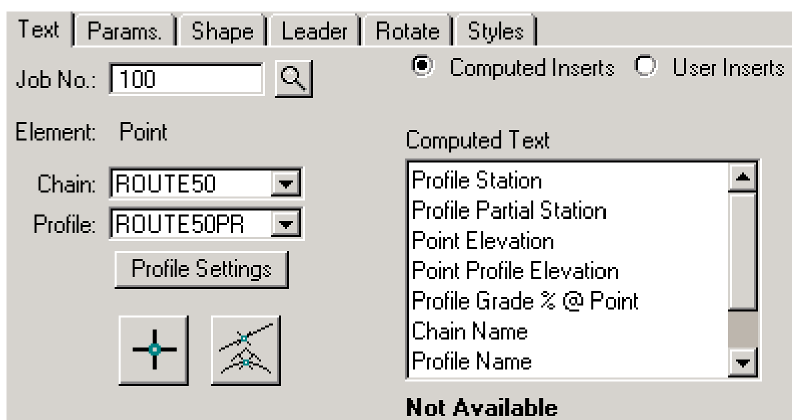
Once the accuracy is set, double click on the highlighted item in the Computed Text list to add the value to the label being created.

9.5.2 Profile View Computed Text Options

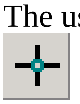


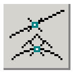
When the Profile Labeler first opens there are no Label Feature icons, as shown to the right. This is because the profile location is unknown. To proceed with the tool, click on the **Profile Settings** button. This brings up the dialog shown below on the left. The information may be entered manually or, if a profile cell has been utilized, the user may click on the **Identify Cell** button and data point / accept on the cell. Click **OK** to save the settings, which causes the two icons to appear.





The user can select different elements by using the following icons:

 Allows the user to data point a location on the screen. The available computer inserts are station, elevation, grade, chain, and profile information.

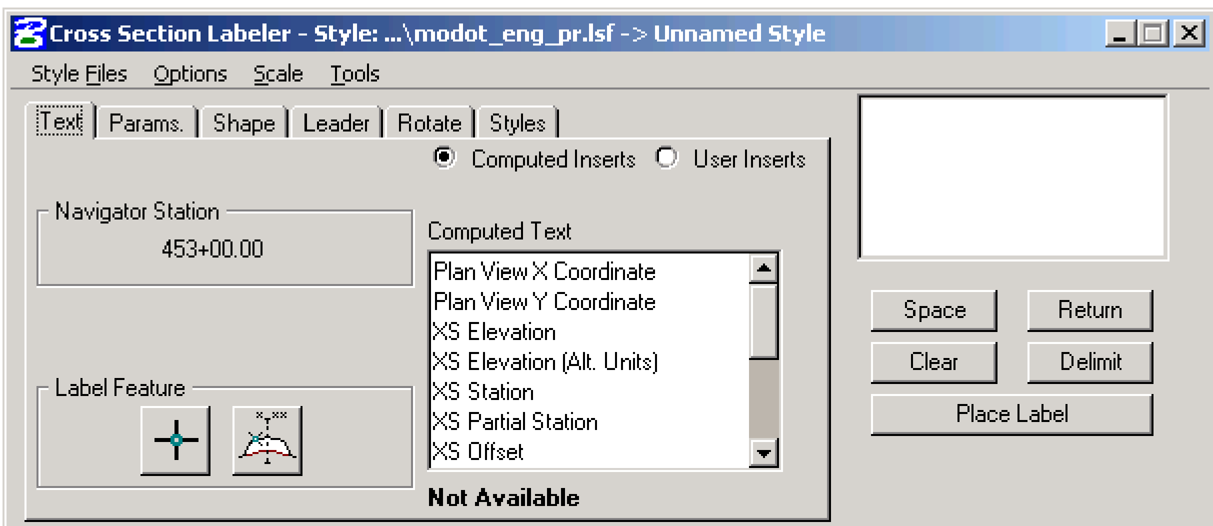


Allows the user to select a GEOPAK profile element on the screen. If a tangent element is selected grade and change in elevation information is available. If a vertical curve is selected, station and elevation information are available for VPC, VPI, VPT, and High-Low Point as well as the usual curve data (length, K value, stopping sight distance, etc.) and profile & chain names.

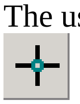
The rest of the Profile Labeler compute text options works the same as the Plan View Labeler.

9.5.3 Cross-Section View Computed Text Options

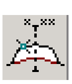
Launching the **Cross Section Labeler** also opens the Cross Section Navigator, which is used to navigate from cross section to cross section. This is because the active cross section for the labeler is the same as that for the navigator, as shown in the following dialogs.



The user can select different elements by using the following icons:



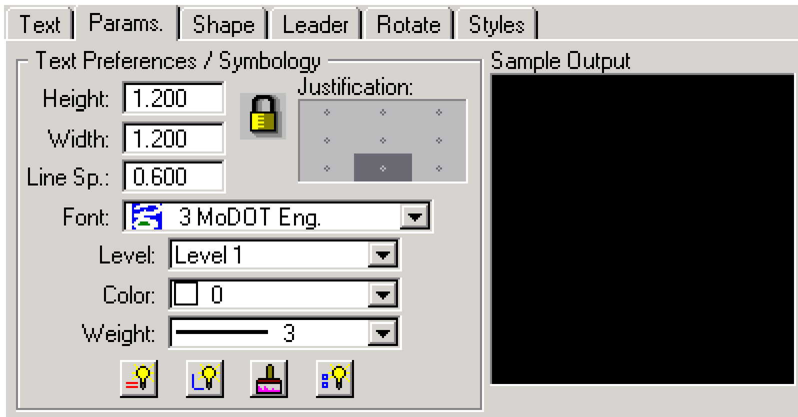
Allows the user to data point a location on the screen. The available computer inserts are plan view coordinates, elevation, station, offset distance, offset direction, and chain information.



Allows the user to select a cross section element. Slope in differing formats and delta elevation information is available.

9.6 Parameters Tab

The **Parameters** Tab controls the text settings for a label. It is exactly the same for all three labelers. The tab lets the user set the text **Height**, **Width**, **Line Spacing**, **Justification**, **Font**, and placement symbology, as shown in the following figure.



The buttons at the bottom of tab allow the user to quickly set all of the symbology as follows:

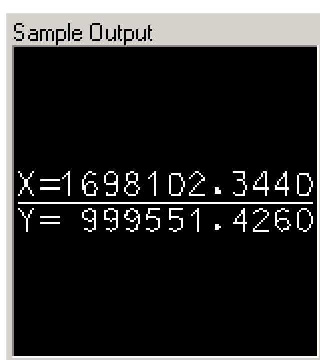
 Sets the symbology to the current MicroStation settings.

 Allows the user to set the symbology by choosing a MicroStation element.

 Sets the symbology using D&C Manager symbology

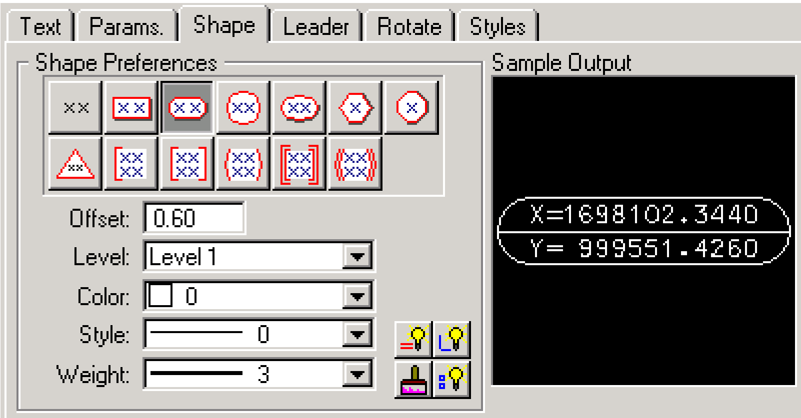
 Sets the symbology for all of the other label element tabs (Shape and Leader) to match the settings in the current tab.

The Sample Output section of this and the remaining tabs gives a preview of the label. The sample output of a coordinate label is shown below.

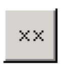


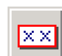
9.7 Shape Tab

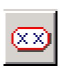
The **Shape** tab allows the user to place a shape around the label and set the symbology for the shape. The user can select the shape to be placed around the text. The shape **Offset** is used to determine the distance between the shape and the text. The symbology icons are the same as those described under the Parameters tab. An example with a balloon shape and an offset equal to half of the text height and width is shown below.

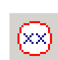


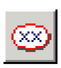
The **Shape Preferences** are:

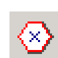
 None

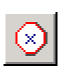
 Rectangular

 Balloon

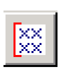
 Circle

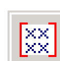
 Ellipse

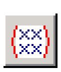
 Hexagon

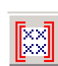
 Octagon

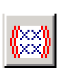
 Triangle

 Single Square Bracket

 Square Bracket

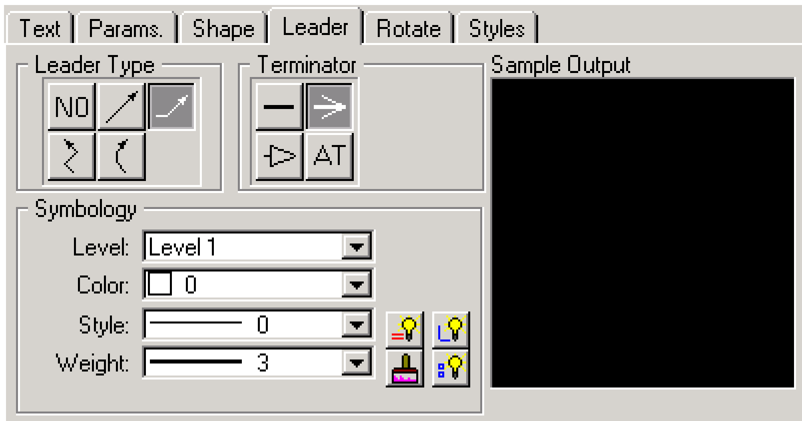
 Round Bracket

 Double Square Bracket

 Double Round Bracket

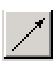
9.8 Leader Tab

The **Leader** tab allows the user to attach a leader from the label to the label. Different leader types and terminators are available. The active terminator, as defined in MicroStation pull down menu Element> Cell can also be used. The symbology icons are the same as those described under the Parameters tab.

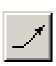


The **Leader Types** are:

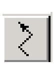
No Leader



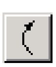
One Point Leader with no bends in the leader



Two Point Leader with a single bend in the leader

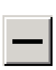


Three Point Leader with two bends in the leader

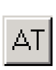


Arc Leader.

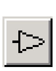
The **Terminators** are:



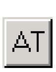
No Terminator



Open Terminator



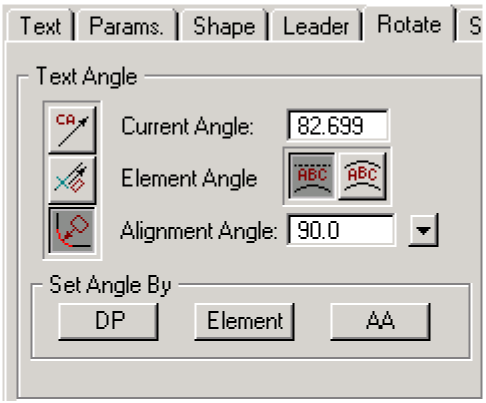
Closed Terminator (filled or unfilled)



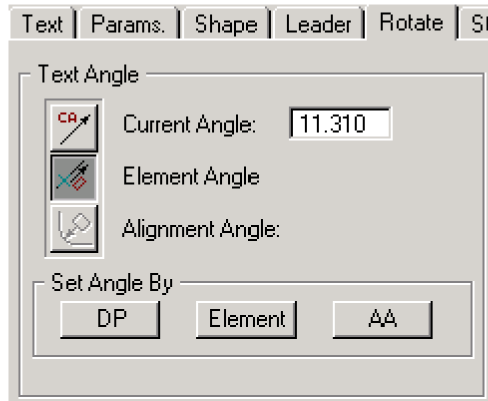
Active Terminator

9.9 Rotate Tab

The **Rotate** tab allows the label to be rotated.



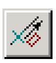
Plan View Labeler Rotate Tab



Profile and Cross Section Labeler Rotate Tab

The following **Text Angle** icons may be used to set the rotation of the label:

Rotates the label text to the current angle, which is displayed and may be set in the field to the right

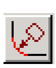


Rotates the label text to the angle of the element being labeled. The **Plan View** text maybe plotted:

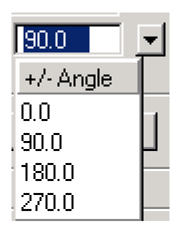
Straight or

Curved

Profile and **Cross Section** Labels must be plotted as straight text.



The alignment angle rotated by +/- 0°, 90°, 180°, or 270° using the pull down shown to right.



The user may also rotate the label by using the follow **Set Angle By** options:

DP Set the text angle by two data points

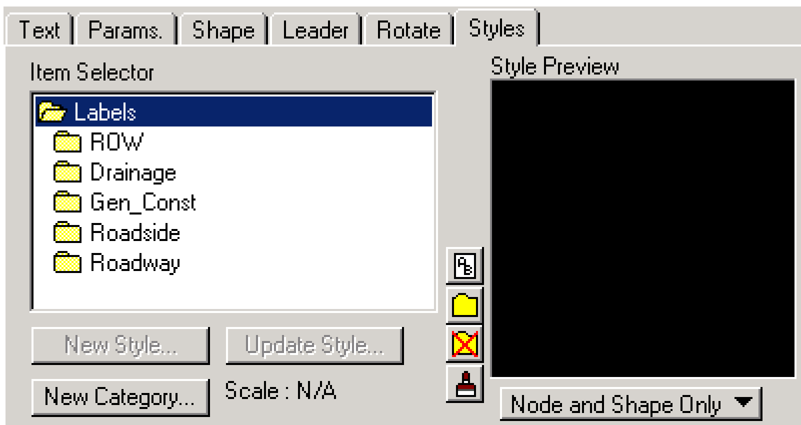
Element Set the text angle by any MicroStation element

AA Set the text angle by the MicroStation active angle

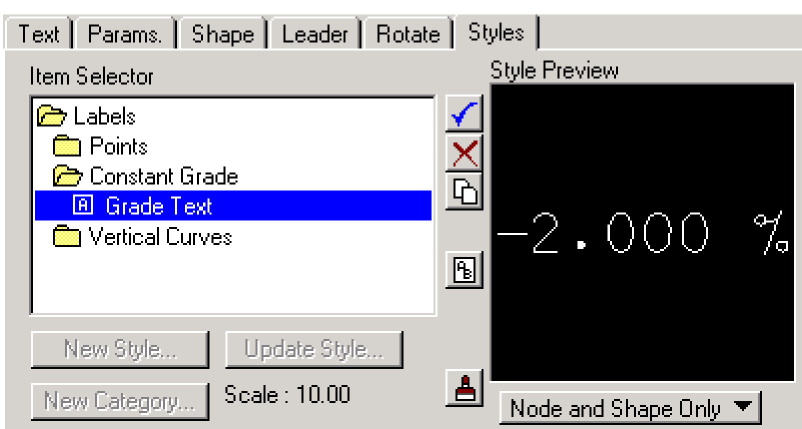
9.10 Styles Tab

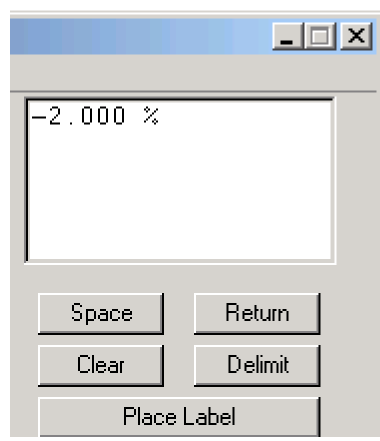
The **Styles** tab allows the user to choose label formats from a library of pre-defined styles. When the user chooses a style, all of the parameter, shape, leader, and rotate options are set. Both the Plan View Labeler and the Profile Labeler have MoDOT default files. The styles are grouped in folders

The **Plan View Labeler Style File** contains the five folders shown in the following figure. Most of the items in the plan LSF file are regular text. Computed text labels have been created in the **ROW** folder for existing and proposed right of way and easement points. They plot the partial station and offset. The **Roadway** folder contains to labels with computed text for the station and offset of pavement and shoulder points.



The **Profile Labeler Style File** has three folders, as shown below on the left. All of the labels in this LSF contain computed text.



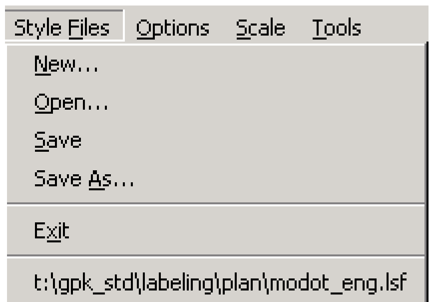


When an individual label style is selected, a preview of the label is given in the **Style Preview** window, as shown above on the left. (**Note**: The **Scale** value in that figure list the scale used to create the label, not the current scale.) The style can be transferred to the box in the upper right hand corner of the labeler dialog by clicking on it.

9.11 Menus

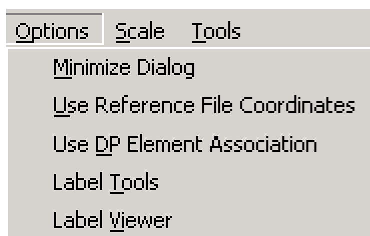
9.11.1 Style Files

The **Style Files** menu allows the user to manage style library files. While the default MoDOT style files will load automatically, the user may create a personalized file by saving a file to a location with write permission. Recently opened style files appear at the bottom of the menu. This allows for quickly switching between files,

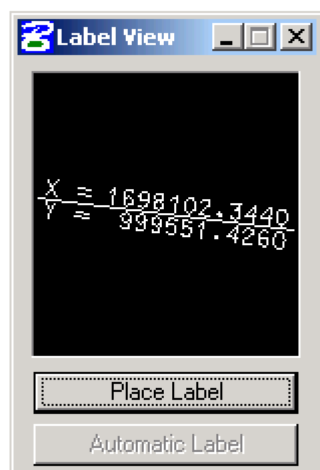


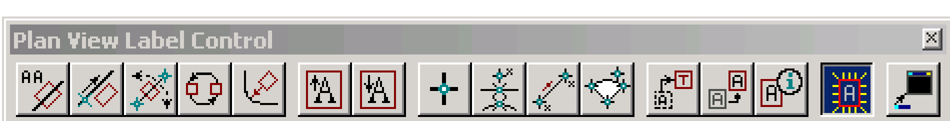
9.11.2 Options

The **Options** menu offers several ways to customize the way the labeler works.



Minimize Dialog only works with the Plan View Labeler. If it is checked, the labeler dialog box minimizes when **Place Label** is chosen and the **Label Viewer** (shown to the right) and the Plan View Label Control (shown below) boxes open. This allows the user to see more of the screen while placing a label.. You may notice that the second icon from the right in the Label Control tool pallet is active. This indicates that the labeler is in **Place Label** mode. The last icon on the right is the **Restore Label Dialog** button. Clicking on it closes the **Plan View Label Control** box and restores the full labeler dialog. The rest of the icons in the Plan View Label Control are discussed below in the section dealing with Label Tools. Many of the icons on the left side of the pallet are available in the different tabs of the labeler itself.

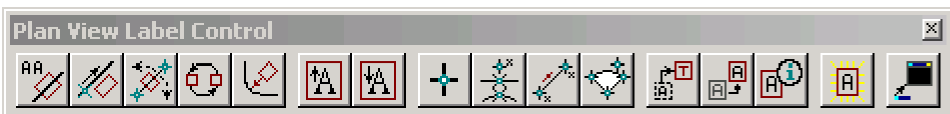


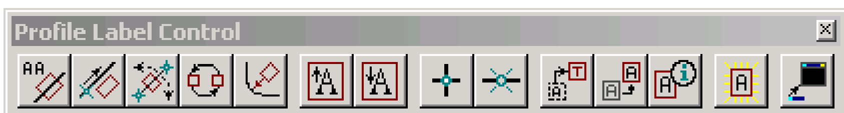


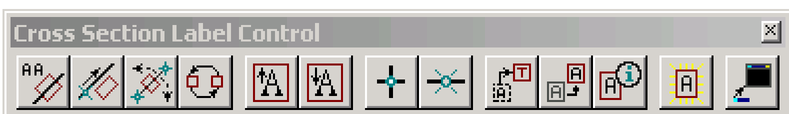
Use Reference File Coordinates is available only in the Plan View Labeler. It is intended to allow the user to use the coordinates of a reference file instead of the active MicroStation file. Since MoDOT uses the same coordinates for all of its files and attaches files using Coincident – World, the coordinates in the reference file should be the same as the active file and this option is not needed.

Use DP Element Association is also available only in the Plan View Labeler. Labels that are placed when it is checked are associated to MicroStation element. (See Associating Elements in the MicroStation Help for more information on element association.) This works with both the graphic Element and Data Point (DP) label feature icons if the DP is snapped to a graphic element. If the element is modified, the label will update automatically when the Label Update feature is used as long as the element is in the active file. The association cannot be applied to referenced geometry. See Section 9.11.4 Tools for information about the Label Updater.

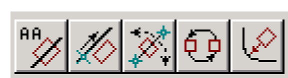
Label Tools brings up one of the tool pallets shown below. Each of the pallets corresponds to the labeler that launches it, as is indicated in the pallet banners below.

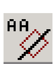


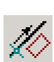


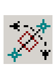


The first group of icons, shown to the right, is the label rotate icons. They provide the following options:



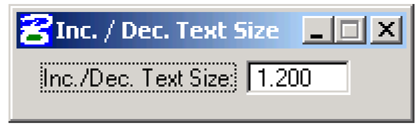
 Rotate Label To Active Angle

 Rotate Label By Element Angle

 Rotate Label By Two Data Points

 Rotate Label By 180 Degrees

 Rotate Label By Alignment Angle

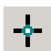


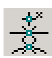
The second group icons may be used to increment the label text size by the increment value defined in the **Inc. / Dec. Text Size** dialog shown to the right. Each time the user clicks on one of the two icons in the group, the text size is incremented. The icons are:

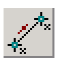
 Increase Text Size

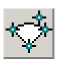
 Decrease Text Size

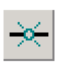
The third group of icons contains the Feature Label options. Not all options are available for all labelers. The icons are:

 Data Point

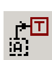
 Plan View Graphic Element

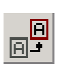
 2 COGO Points

 Arc Defined by 2 COGO Points

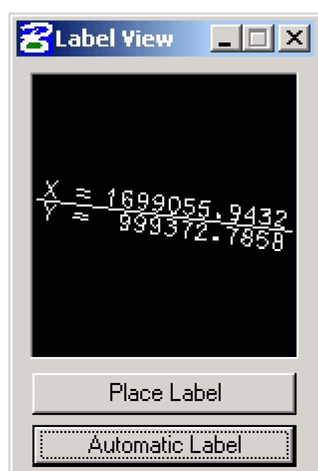
 Profile or Cross Section Element

The fourth group of icons is for label modification. The individual icons are:

 Edit Label, which allows the user to edit an already placed label. It loads the label in the labeler dialog for editing. The label must be placed again after it is edited.

 Move Label, which allows the user to move an already placed label.

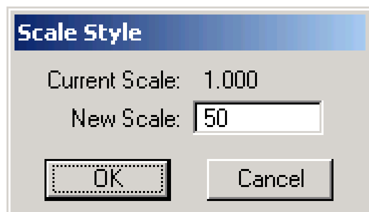
 Extract Label, which allows the user to extract the format of an already placed label and load it into the labeler so a label of the format may be placed at another location.



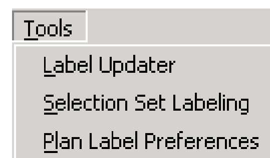
Label Viewer brings up the dialog shown to the right. It allows the user to view and place a label. **Automatic Label** copies a label with computed inserts to a new location and the newly computed values. To use this option, identify a label you want to copy by extracting or placing a label. Use a Label Feature icon to indicate another item to be labeled and click on Automatic Label. This will place a label at the new location using the placement settings as the previous label.

9.11.3 Scale

The **Label Scale** menu, shown to the right, allows the user to choose a plan scale. All labels are adjusted according to the new scale. After selecting the menu option, the following dialog appears. The user simply keys in a scale, and clicks **OK**. All size parameters are adjusted by the difference in the Current and New Scale values. **Note**: This scale should not be confused with the scale shown in the Styles tab, which gives the scale used to create the style and not the current scale. The only way to find the current scale is by the relative text size or by going to Scale > Change Scale.



9.11.4 Tools



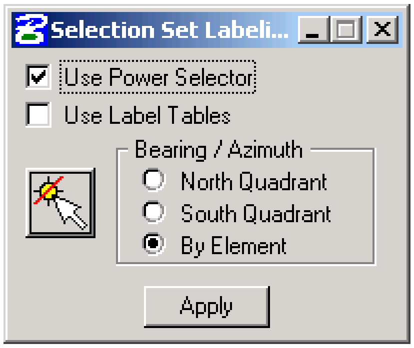
The **Tools** menu, shown to the right, provides the user with some specialized tools.

The **Label Updater** allows the user to update a label's computed inserts if any of the following is changed: the alignment, the TIN, a labels position, etc. Several **Select By** options are available, as shown in the figure below and on the right: **Single Select**, **Selection Set**, **Fence**, **All Labels**, and **Find and Replace**.

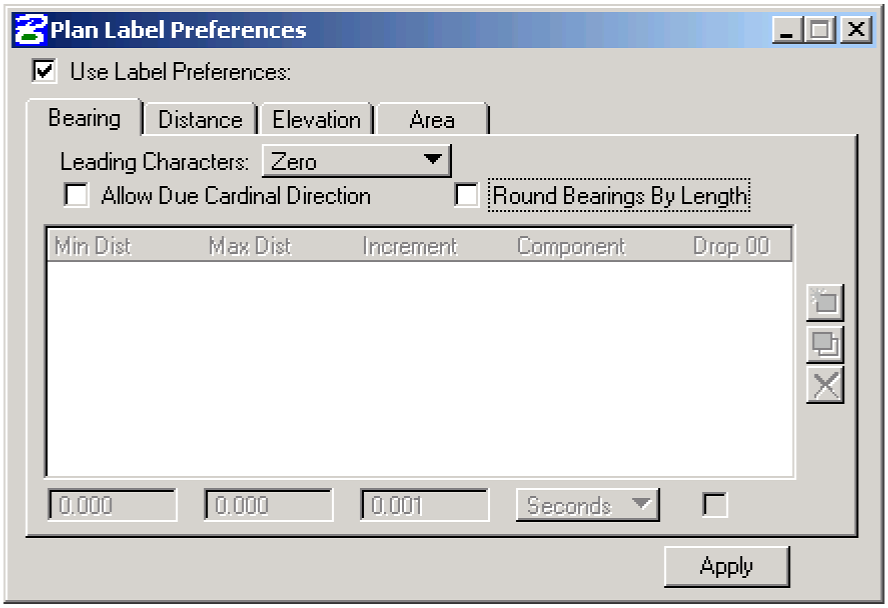
Clicking on the **Start** button starts the update process.

In addition, the **Highlight Labels** section of the dialog (shown below on the left) may be used to scan the labels and highlights those that meet the selected option. The four options are shown below and on the right.

Selection Set Labeling allows the user to update multiple labels to a selected style using a MicroStation selection set. See the GEOPAK help for more information on using this tool.



Plan Label Preferences allows the user control the label preferences. To use the tool toggle on **Use Label Preferences** and activate the options you wish to use. See the GEOPAK help for more information on using this tool.



Chapter 10

Existing Ground Profiles

10.1 Objectives 10-1
10.2 Definitions.. 10-1
10.3 Accessing 10-1
10.4 Dialog.. 10-1
10.5 Reviewing Profiles... 10-2
10.6 Plotting Profiles 10-3

10.1 Objectives

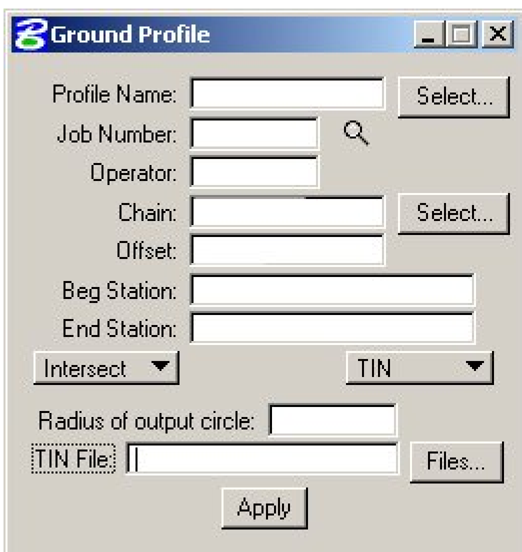
- Learn to calculate original ground profiles based on a DTM.

10.2 Definitions

GEOPAK will generate an existing ground profile based on a stored chain from either a 3D graphic file or from a triangulation file (TIN). The profile information is stored in the .gpk file with the option to create an input (.inp) file.

10.3 Accessing

Existing ground profiles may be generated in either a 2D or 3D graphics file, both methods are similar except that an additional option is available with a 3D file. To access the **Existing Ground Profile** utility, click on **Project Manager >> Existing Ground Profile**. Once the run is chosen, the following dialog box will open.



10.4 Dialog

Profile Name - Name of the profile to be stored.

Job Number and Operator - .gpk job number and user's initials.

Chain - Name of stored chain used for profile stationing.

Offset - Produces a profile at a user specified offset to the selected chain.

Beg Station and End Station - By clearing each field and hitting the Enter key the stationing will default to the beginning and ending station limits of the selected chain. The user may also key-in a station range within the limits of the chain.

There are four options that control the frequency of elevation calculations along the base chain.

Increment - based on the beginning station of the alignment, incremented by a user specified value.

Intersect - an elevation is calculated at every intersection of the alignment with a triangle side.

Even - will compute elevations at even stations rather than an incremented distance along the alignment. This is best used for alignments with station equations.

POT - calculates an elevation at each POT along the alignment

When in the **Increment, EVEN** or **POT** mode, an additional option box will provide two modes of operation for extracting data; **graphic** or **TIN**. (Only available in 3D file)

When using the **Intersect** or **POT** option *with* the graphic option, you will have an additional option for a circle to be drawn into the 3D file at the location of the intersection.

****Note:** It is recommended to use the **Intersect** option, as this will provide the most accurate existing ground profile.

10.5 Reviewing Profiles

Once a profile has been created, it may be reviewed in two ways:

1) Output viewed from the **COGO** dialog box: **Element >> Profile >> Print/List**

2) Profile drawn from the **D&C Manager**: By selecting the appropriate categories, for example:

Drafting Standards >> Profile >> Existing Ground Profile >> Profile Scale

Note: Always set an origin point for the profile display by drawing the Profile Cell.

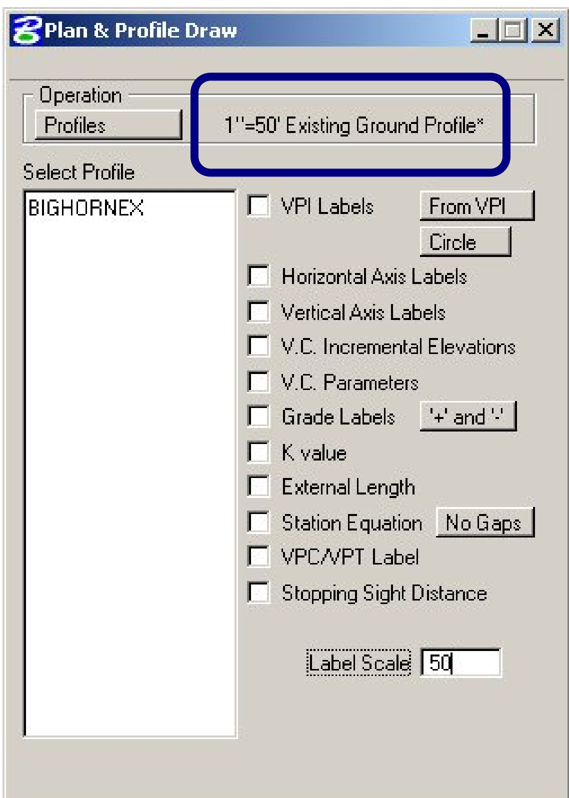
10.6 Plotting Profiles

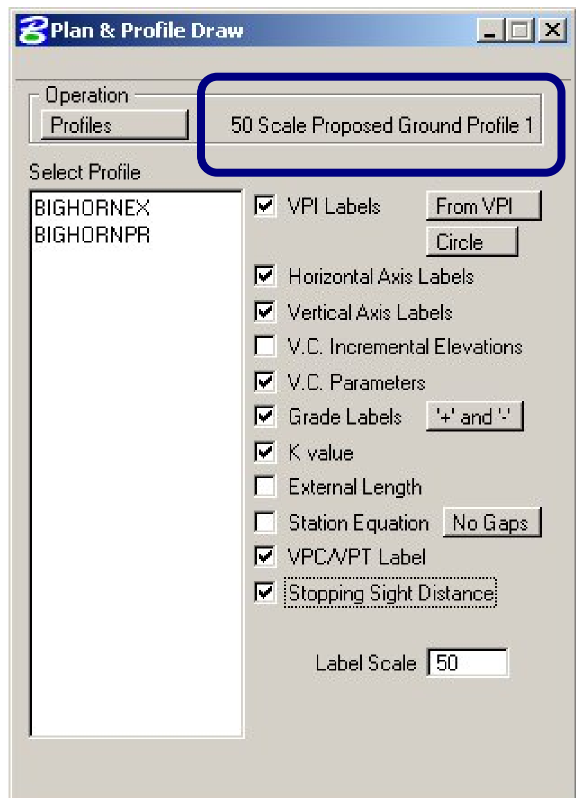
1) Draw a diagonal line to serve as a reference point.

2) Start D&C Manager.

3) From D&C Manager, choose the appropriate scale from the category **Drafting Standards>>Profile>>Existing Ground Profiles** or **Drafting Standards>>Profiles>>Proposed Ground Profiles**.
4) Choose the **Draw Plan & Profile** button.

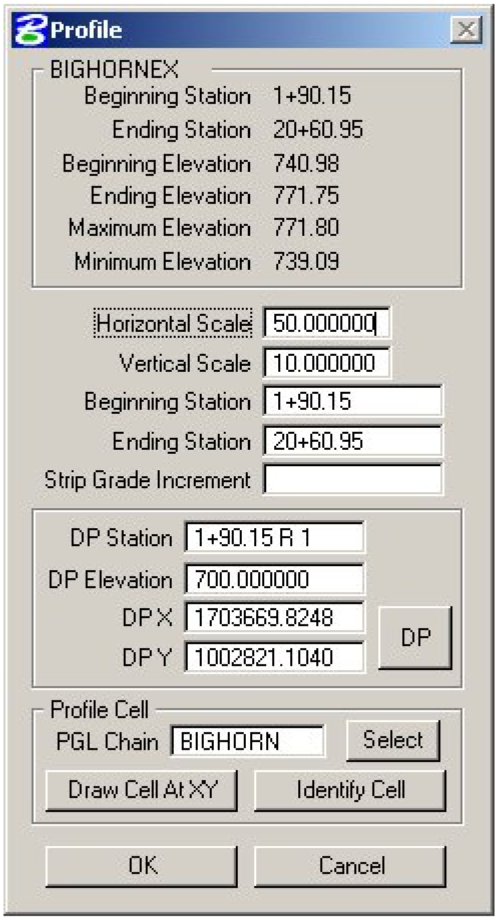
5) Set the options to be shown on the plotted profile.

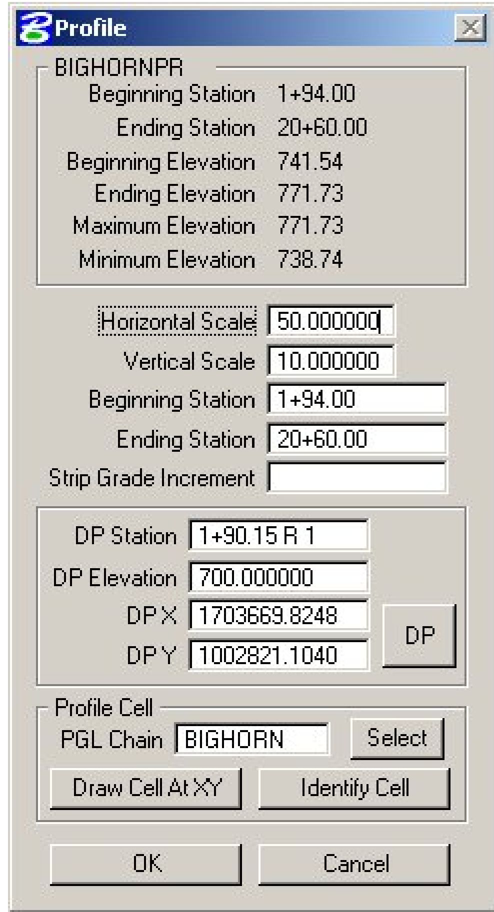




6) Choose the profile from the list.

7) Set the horizontal and vertical scales and the station range to be plotted.





8) Determine the station and elevation of the origin point. (Usually the station will be the beginning of the chain, and the elevation will be a rounded value below the minimum elevation of the profile.

9) Select the **By DP** button and snap to the end of the diagonal line plotted in step 1 and accept the location. The coordinates for that location will be filled out.

10) If a profile cell has not been previously plotted, and is desired, set the PGL Chain and choose **Draw Cell at XY**. If a cell has been previously drawn, selecting the **Identify Cell** button and choosing the appropriate cell will fill in the scale, station and DP information.

11) Select the **OK** button.

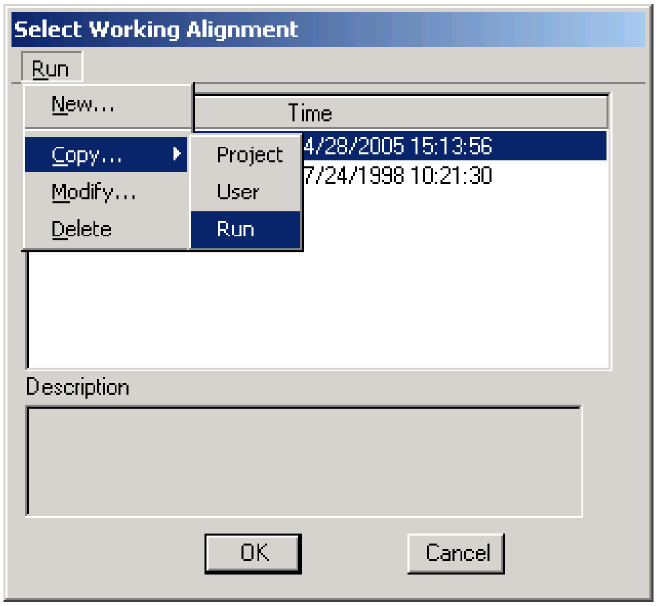
Exercise 10-1 This is a group exercise

1. Open MicroStation file **t:\br-proj\a_geopak\d2\j2p0300\data\topo_j2p0300.dgn**.

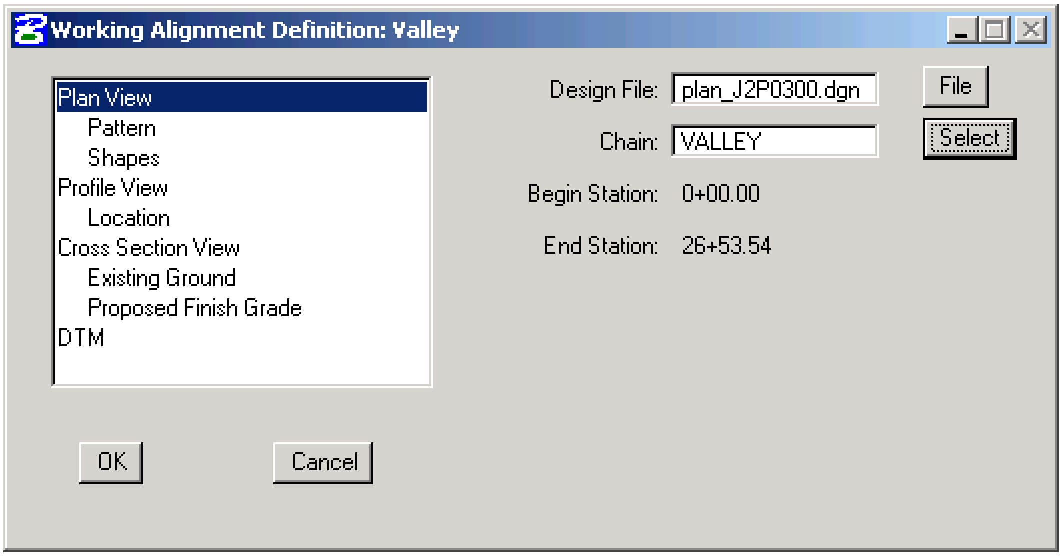
   If the line indicating the location of the valley section is not visible, use Level Manager to turn on Level 22.

2. Open the project **j2p0300.prj** as user **userc**.

   Copy the J2P0300 working alignment to **Valley** and enter that working alignment.



   Go to the **Plan View** screen in the working alignment definition and select **VALLEY** as the default chain.

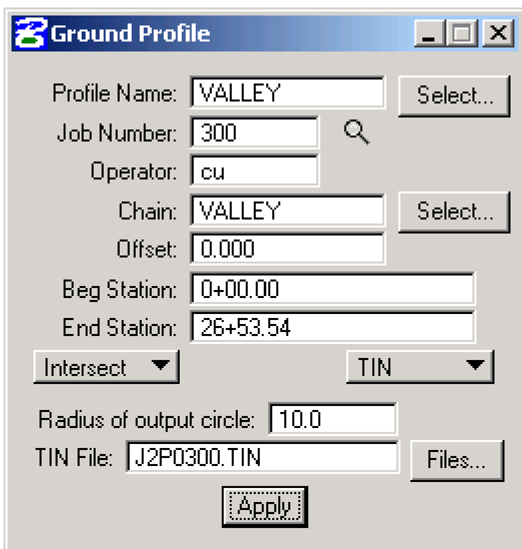


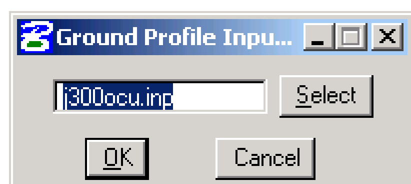
3. Choose **Existing Ground Profile** from the **Project Manager** dialog.

Copy the **MoDOT** run, name the new run **Valley** and enter the new run.

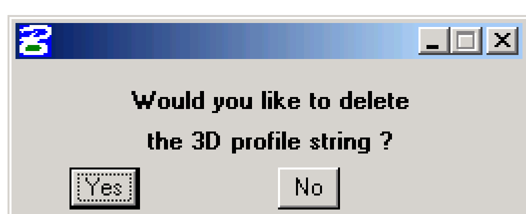
4. Create an original ground profile for the valley section.

Profile Name:	**Valley**.
Job Number:	**300**.
Operator:	**cu**.
Chain:	**VALLEY**.
Offset:	**0**.
Beg. Station:	*Will be filled in when the chain is chosen.*
End Station:	*Will be filled in when the chain is chosen.*
Mode:	**Intersect** **TIN**.
TIN File:	**j2p0300.tin**.





Click **OK** to create the ground profile input file, **Yes** to store the profile, and **Yes** to delete the 3D profile string.



Close the Ground Profile dialog, saving the settings.

5. Open MicroStation file **t:\br-proj\a_geopak_\d2\j2p0300\data\profile_j2p0300.dgn** and attach **t:\br-proj\a_geopak_\d2\j2p0300\data\plan_j2p0300.dgn** as reference files

6. Plot the existing ground profile above the plan view geometry using **D&C Manager** item **Drafting Standards \ Profile \ Existing Ground Profiles \ 1"=100' Existing Ground Profile** and clicking on **Draw Plan & Profile** in the operations box.

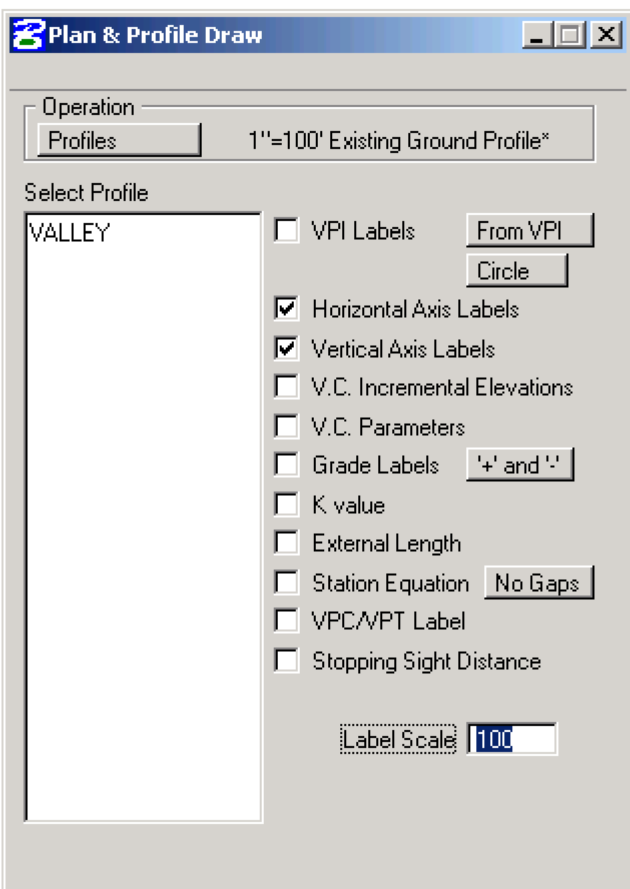
   Set the **Labeling Scale** to **100** and turn on the following options as depicted below in the figure on the left:

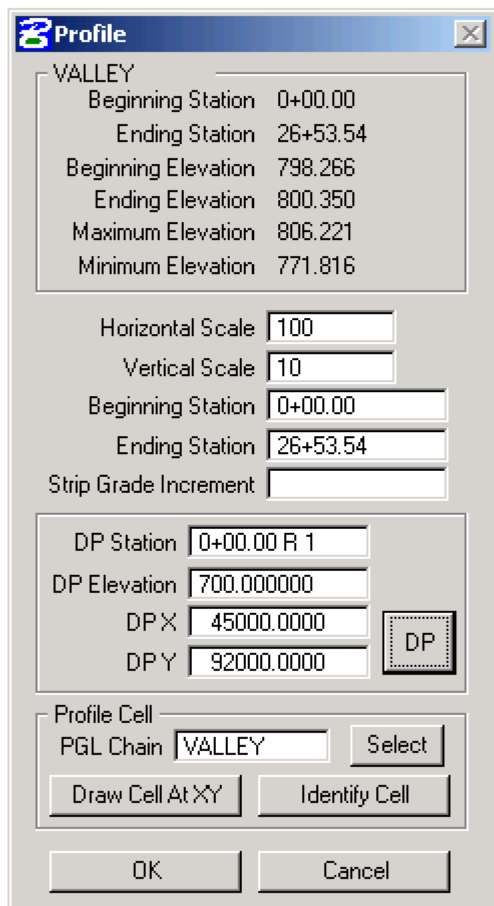
   Horizontal Axis Labels
   Vertical Axis Labels

   Choose the profile **Valley**, to bring up the dialog shown below in the figure on the right.

   Set the following parameters:

Horizontal Scale:	**100**
Vertical Scale:	**10**
DP Station:	**0+00.00**
DP Elevation:	**700**
DP X and Y:	*Press **DP** and data point on the screen in an open area above the plan view data or enter the values shown.*
PGL Chain:	**VALLEY**

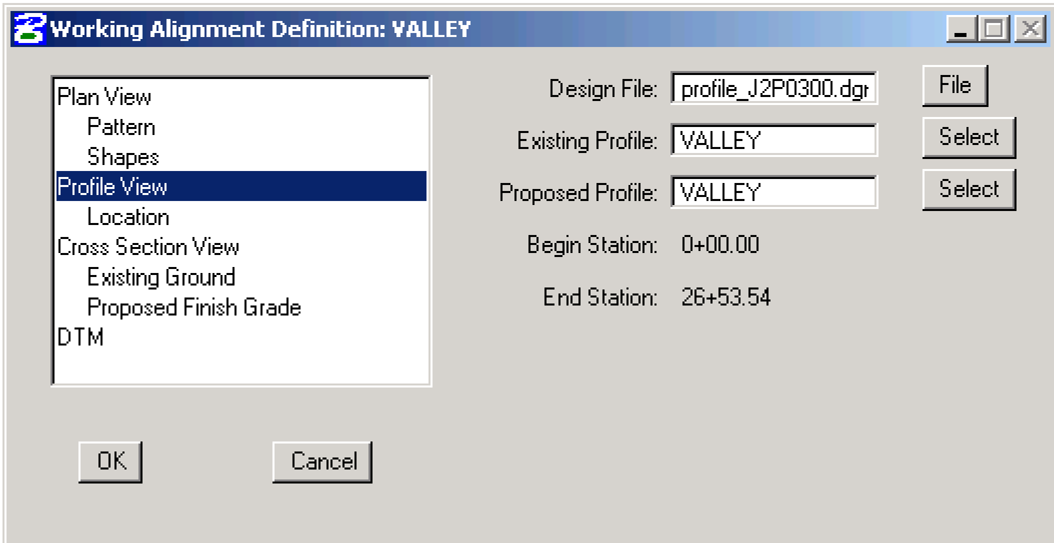




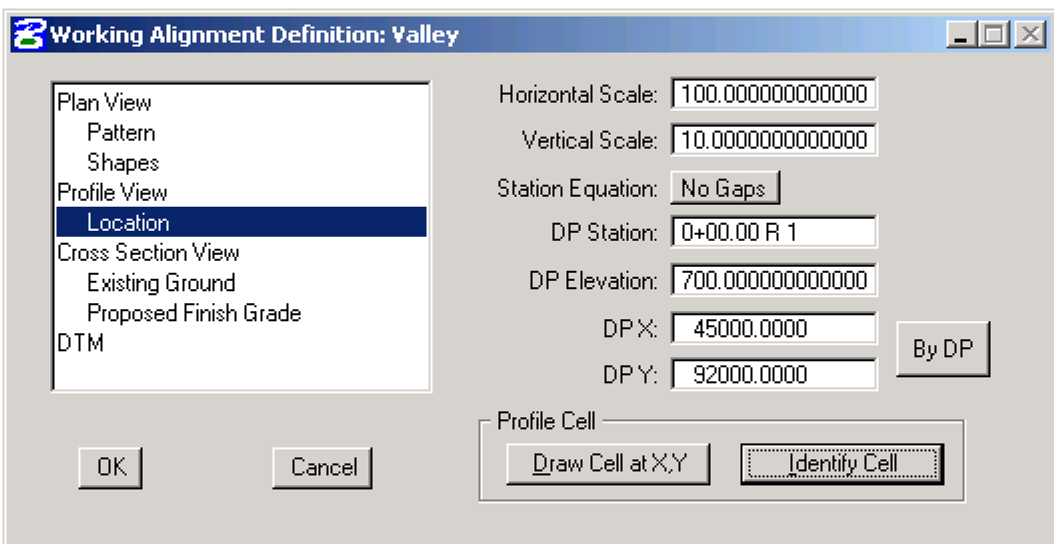
   Press **Draw Cell At XY** and **OK** buttons to draw the profile cell and existing ground.

7. Complete the **Profile View** and **Location** sections of the **Valley Working Alignment**.

   Existing Profile: **VALLEY**
   Proposed Profile: **VALLEY**



   For the **Location** section, use the **Identify Cell** button to choose the profile cell.



   Accept the changes by clicking on the **OK** button.

Chapter 11

Vertical Alignment Generator

11.1 Objectives 11-1
11.2 Definitions 11-1
11.3 Accessing 11-1
11.4 Dialog 11-2
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11.6 Precision Placement Options 11-4

11.1 Objectives

- Create and store vertical alignments using the **Vertical Alignment Generator**.

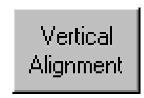
11.2 Definitions

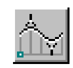
The **Vertical Alignment Generator** is a GEOPAK tool that can graphically create and modify proposed design profiles or modify an existing ground profile. These operations may be accomplished through a dialog box and/or by dynamic manipulation of graphic elements.

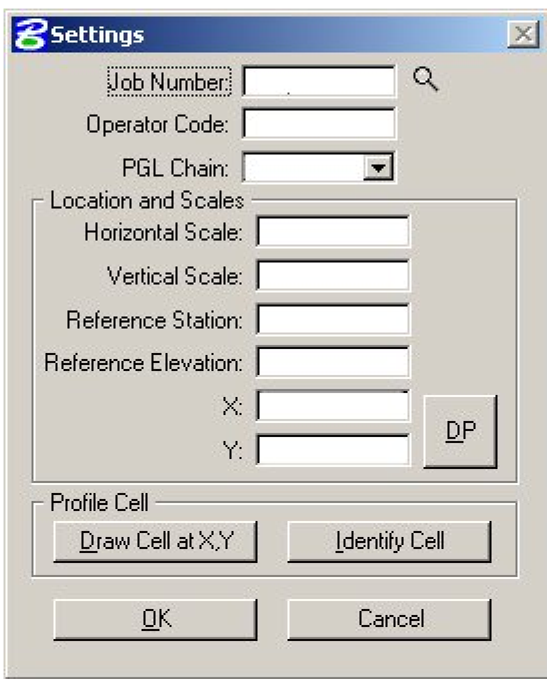
A profile may also be created with Coordinate Geometry (COGO) input.

11.3 Accessing

Vertical Alignment Generator may be invoked by **Project Manager >> Vertical Alignment** or by the **Vertical Alignment Generator** icon.





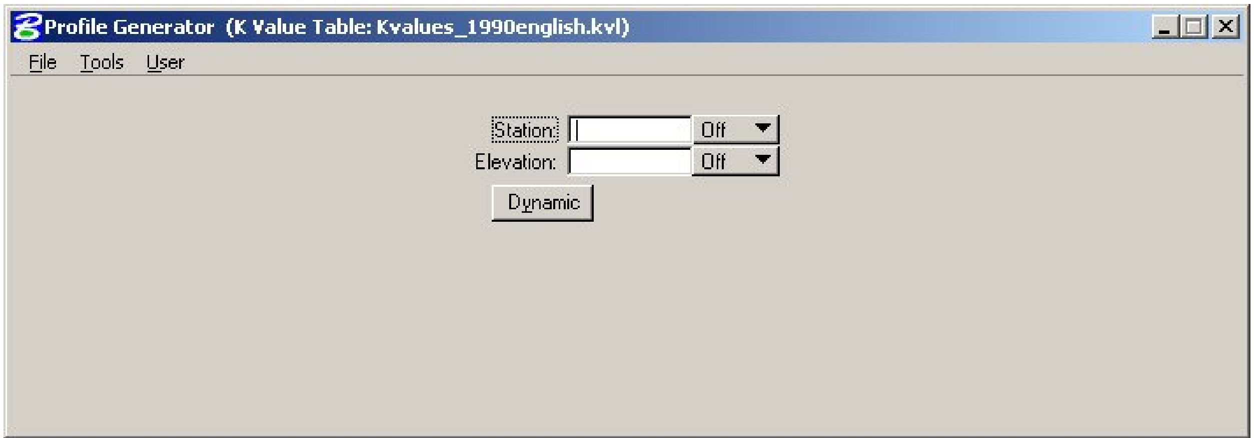


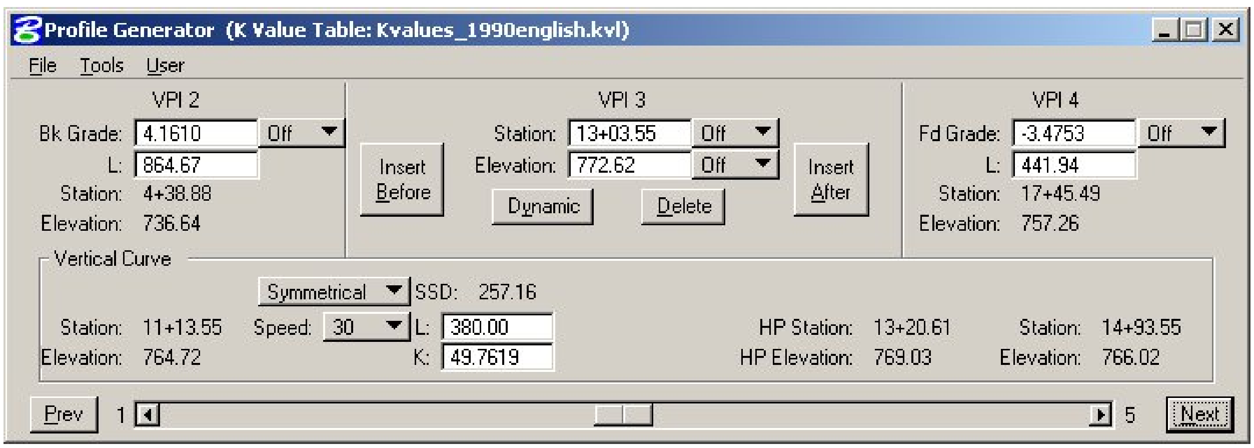
The first dialog box that appears is labeled **Settings**. The entries in this box set the parameters and define the location within the design file where the profile is to be displayed. All fields must be completed before the design process can begin. As the **OK** button is clicked, the Vertical Profile Generator dialog box will appear.

Choosing the **Identify Cell** button and selecting a profile cell can also fill in the information. If a profile cell does not exist, the **Draw Cell at X, Y** can be used to place a profile cell using the location and scale information provided in the dialog.

11.4 Dialog

This tool allows a user to load a previously stored profile or create a new profile. You will notice changes in the configuration of this dialog box as you design a vertical alignment.





Various design parameters must be defined prior to designing a new profile; we will discuss those as we look at the options provided under the three headers, **File**, **Tools**, and **User**.

11.4.1 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.

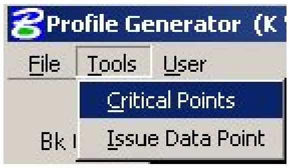
Load - retrieves a previously stored profile from the coordinate geometry database (.gpk)

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.

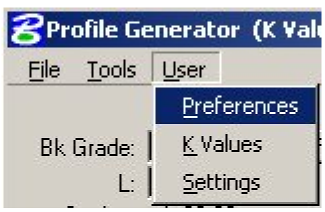
11.4.2 Tools



Critical Points - Vertical curves may also be defined by one or two critical 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 another generic operations. This is useful in displaying visual references within the profile that need to be considered in design of the vertical profile.

11.4.3 User



Preferences - sets the rounding parameters for each of the items listed in the dialog box.

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.

11.5 Creating A New Profile

Step 1 Place the first VPI (Note: The enter key must be used to ensure values are accepted.)

Four options:

i. Type station and elevation of the VPI into dialog box

ii. Enter station of VPI as precision input (type in value) Elevation is defined through dynamic cursor placement on screen

iii. Elevation is defined via precision input Station is defined through dynamic cursor placement on screen

iv. Both values for the VPI can be established dynamically on screen

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 the process from 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.

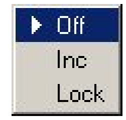
Step 5 Adjusting Curve Lengths

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

Step 6 Save the Profile

11.6 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.

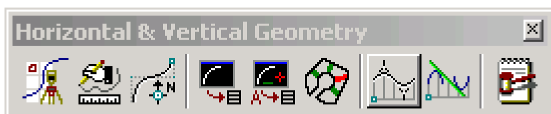
Lock (Locked) - Forces all operations to maintain the designated profile parameters.

Exercise 11-1

This is a group exercise to learn one way to store a roadway profile. A profile may also be stored using COGO commands.

1. Open the MicroStation file **t:\br-proj\a_geopak_\d2\j2p0300\data\profile_j2p0300.dgn**. The plan view DGN for Rte 6 is attached and the existing ground profile is already plotted.

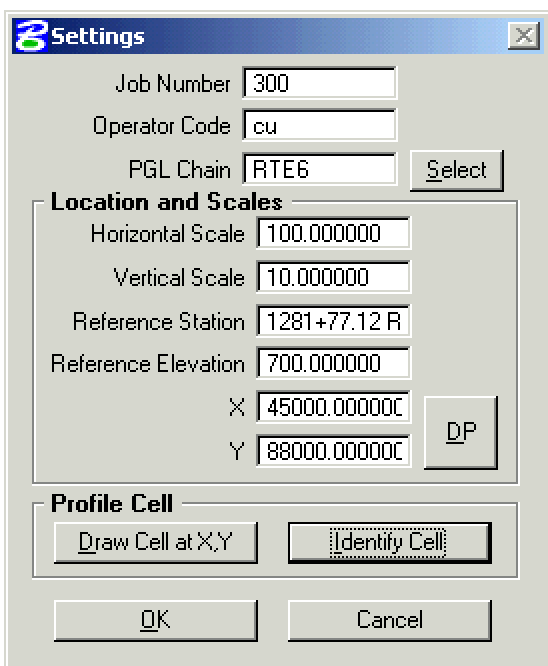
2. Use the **VPI Based Vertical Alignment Design** tool to store the Rte 6 profile. The tool is the third one from the right in the **Horizontal & Vertical Geometry** tool pallet shown below. The pallet is accessed from the upper right corner of the Road tools shown to the right.



Fill in the top portion of the **Settings** dialog using the following information:

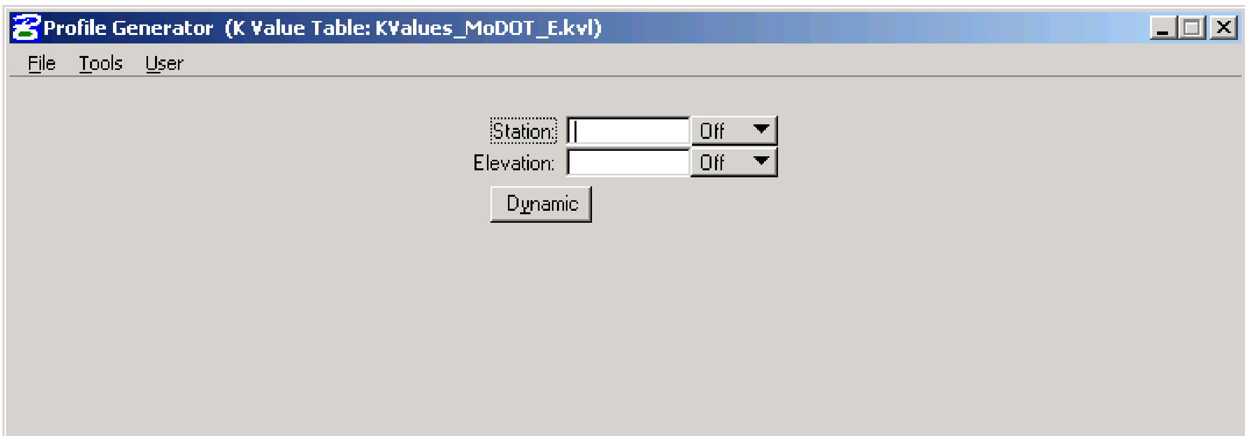
Job Number: **300**
Operator Code: **cu**

To fill in the rest of the information, click on the **Identify Cell** button and choose the profile cell already plotted in the drawing. It is the red sideways "T" at the bottom of the drawing.

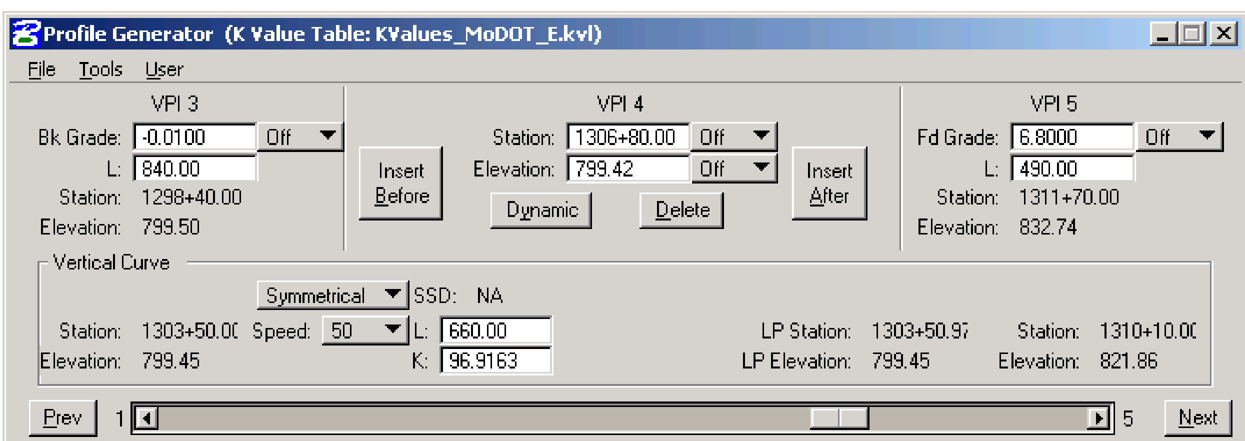


Once the Settings dialog is completed as shown above, click on OK to open the Profile Generator dialog shown on the following page.

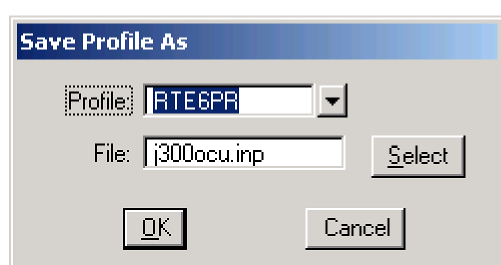
3. Use the information below the dialog to store the profile. Follow the steps used by the instructor. Because an elevation is not given for VPI 1, the information for VPI 2 will be used to start the process. It is important to add all of the VPIs first before trying to store any of the vertical curves.



VPI 1	Sta.:	1281+77.20	Fd Grade:	–6.40		
VPI 2	Sta.:	1285+35.00	Elevation:	799.50	Vertical Curve L:	600
VPI 3	Sta.:	1298+40.00	Elevation:	799.50	Vertical Curve L:	300
VPI 4	Sta.:	1306+80.00	Bk Grade:	–0.01	Vertical Curve L:	660
VPI 5	Sta.:	1311+70.00	Bk Grade:	6.80		

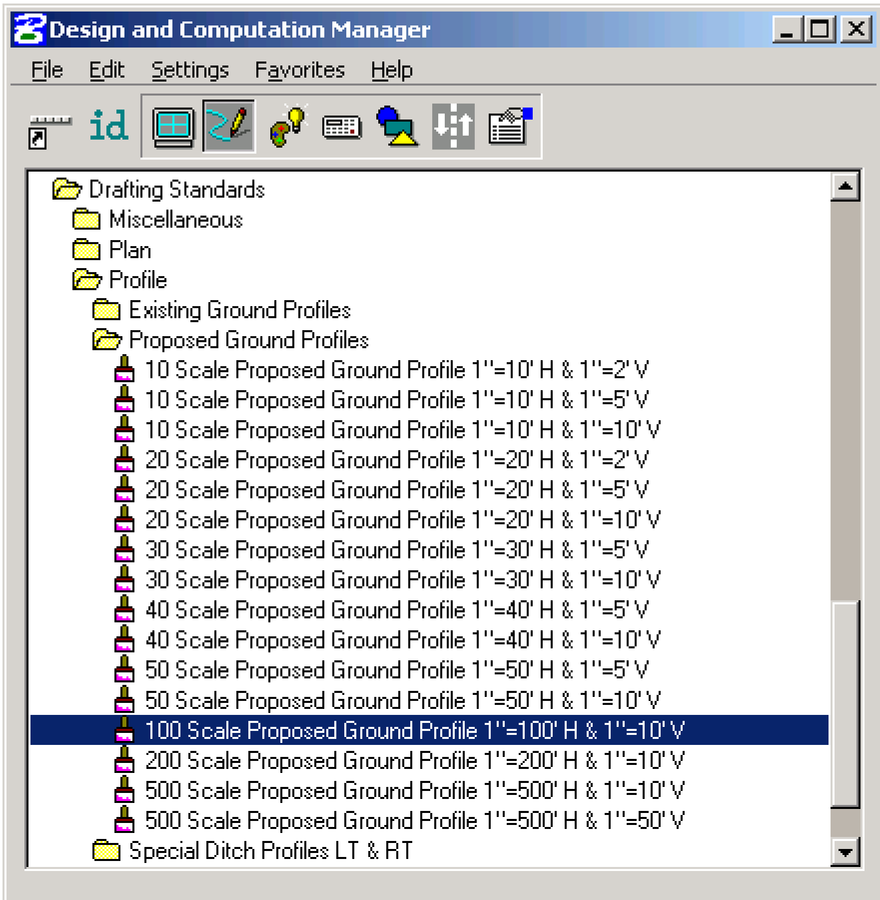


The completed profile at VPI 4 is shown above. Once all of the information has been added, save the profile as **RTE6PR** by going to **File > Save As** in the generator dialog. This will bring up the dialog shown to the right. Since this is a new profile you will need to type in the name in the Profile field, which is highlighted.

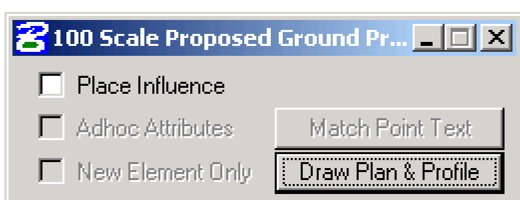


Exist the Profile Generator. If asked, do not save the profile since it was just stored.

4. Plot the existing ground profile using **Design and Computation Manager** item **Drafting Standards \ Profile \ Proposed Ground Profiles \ 100 Scale Proposed Ground Profile 1”=100’ H & 1”=10’ V** as shown in the following figure.



Select the **Draw Plan & Profile** in the D&C Manager Operations box entitled 100 Scale Proposed Ground Pr…



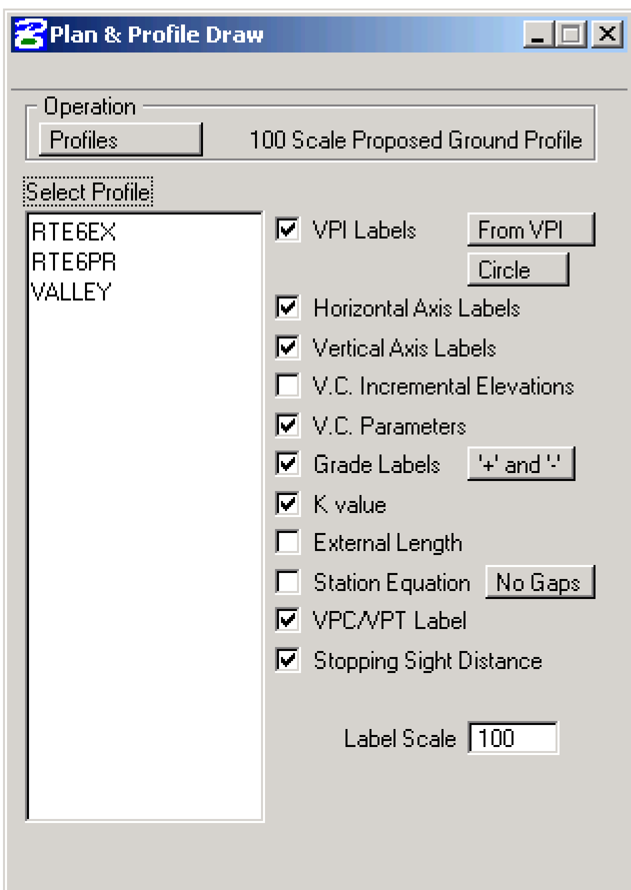
In the **Open Job** dialog that appears, select **Job 300** and click **OK**.

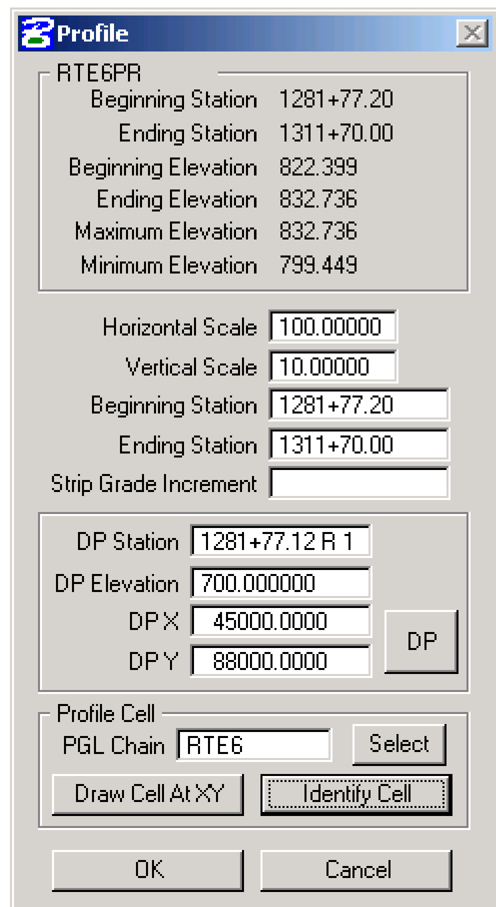
5. This will bring up the Plan & Profile Draw dialog shown below and on the left.

   Make sure that the following options are toggled on in the dialog.

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

   Choose the profile **RTE6PR**,to bring up the dialog shown below in the figure on the right.





   Use the **Identify Cell** button in the dialog to select the same profile cell used before.

   Plot the profile **RTE6PR** by selecting the **OK** button. Close D&C Manager and save the changes to the drawing.

   Compare the profile data to that given in Step 3 to make sure it agrees. If it does not you need to correct the profile.

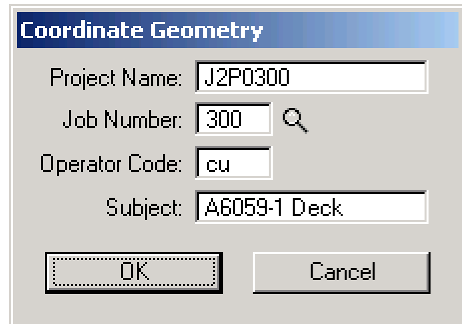
Exercise 11-2

1. Open the MicroStation file **t:\br-proj\a_geopak\d2\j2p0300\data\plan_j2p0300.dgn**.

2. Enter **Coordinate Geometry** by selecting the first icon in the tool pallet upper right corner of the Road tools.

   Enter Coordinate Geometry with the following settings:

   Project Name: **J2P0300**
   Job Number: **300**
   Operator Code: **cu**
   Subject: **A6059-1 Deck**



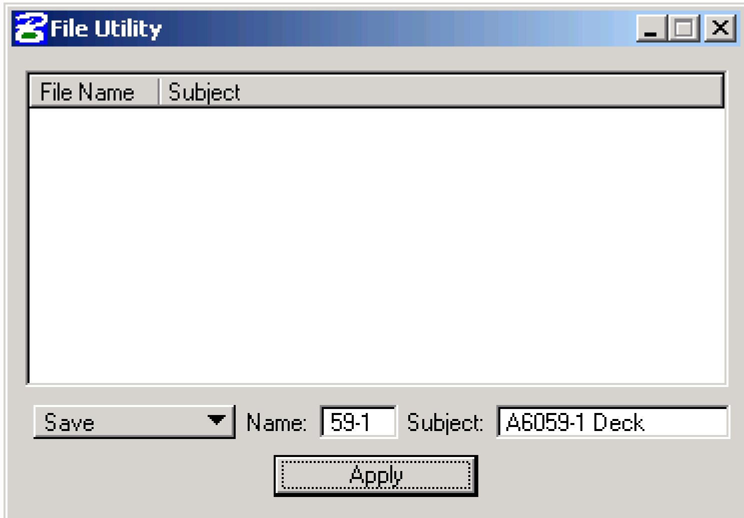
3. Use Bridge deck commands to find the quarter point elevations for the first span for Bridge A6059.

Bridge Name:	**A6059**.
Profile:	**RTE6PR**.
Tie:	**0**.
Cross Slope	**-2% (Normal Crown)**
Alignment:	**RTE6**.
Pier Direction Rt. to Lt.:	**N 13 56 34 W**.
Back Sta. CL Bearing:	**1288+26.4434**.
Ahead Sta. CL Bearing:	**1288+70.9850**.
Roadway Width:	**36'**.
Beam Spacing:	**8'-2"**.

   The needed COGO commands are given below:

```
BRIDGE A6059
PROFILE RTE6PR
TIE 0
SE 1288+00 LT -2 12 -2 RT -2 12 -2
ALI RTE6
PIER BK N 13 56 34 W AH N 13 56 34 W
SPAN 1 128826.4434 128870.9850 4 + P
FC -19.333333 19.333333
GU -18 18
BEAM OFF -16.333333 -8.166667 0 8.166667 16.333333
END SPAN
```

4. Save the COGO commands (**File** > **File Utility**) as an input file. Name it **59-1** and give it the description: **A6059-1 Deck** as shown in the following screen capture of the File Utility dialog.



Click **Apply** to create the file.

5. Use Ultra-Edit to view the file:

t:\br-proj\a_geopak\d2\j2p0300\data\a6059-1.txt.

Your results should be identical to those shown below. If not, use the COGO Editor (**Edit** > **Editor**) to correct your input file. Once it is corrected, do a **Restore/Read**. Save the corrected input file.

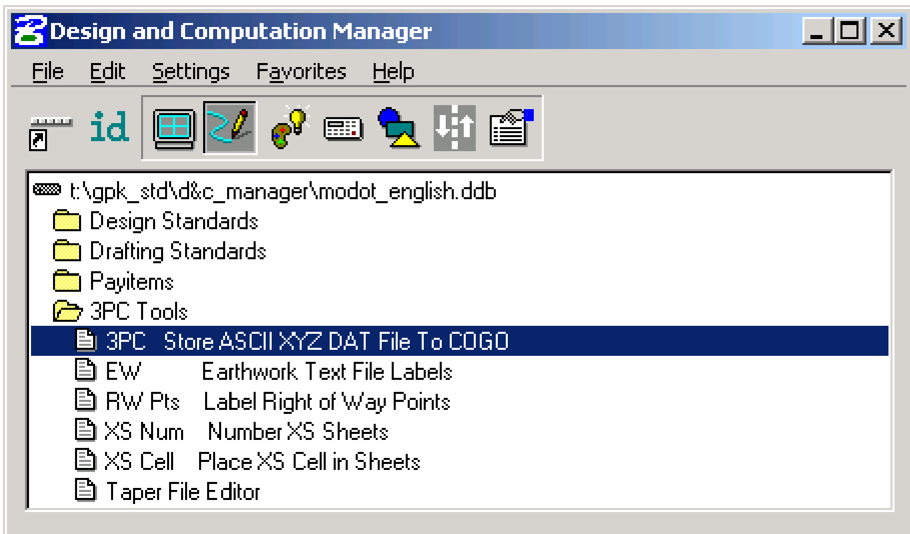
```
Bridge Deck Elevation.
----------------------
Bridge A6059
Span A6059-1  1288+26.44 R 1 to 1288+70.99 R 1

           000      001      002      003      004
----------------------------------------------------
LFC     799.1341 799.1173 799.1133 799.1133 799.1133
LGT     799.1591 799.1433 799.1400 799.1400 799.1400
BM    1 799.1906 799.1758 799.1733 799.1733 799.1733
BM    2 799.3461 799.3369 799.3367 799.3367 799.3367
BM    3 799.5039 799.5000 799.5000 799.5000 799.5000
BM    4 799.3375 799.3367 799.3367 799.3367 799.3367
BM    5 799.1733 799.1733 799.1733 799.1733 799.1733
RGT     799.1400 799.1400 799.1400 799.1400 799.1400
RFC     799.1133 799.1133 799.1133 799.1133 799.1133
PGL     799.5039 799.5000 799.5000 799.5000 799.5000
```

The following steps store COGO points at the deck elevations locations. These are created from the XYZ file, which is created when the deck elevations are calculated.

6. Launch the Store ASCII XYZ DAT File to COGO 3PC application from the **Design and Computation Manager** by double clicking on the following path:

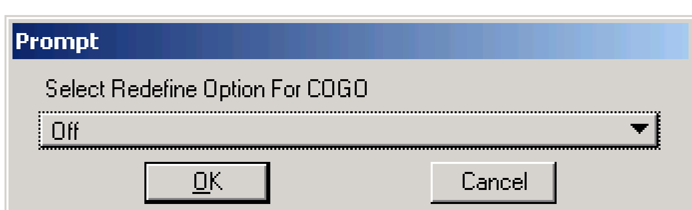
   3PC\Store ASCII XYZ DAT File to COGO.

   It is the entry highlighted in the following dialog:

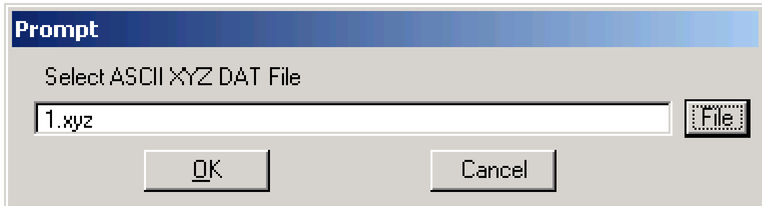


7. **Enter** the GPK Job Number **300** for (job300.gpk) and click **OK**. The points are added to this GPK file.

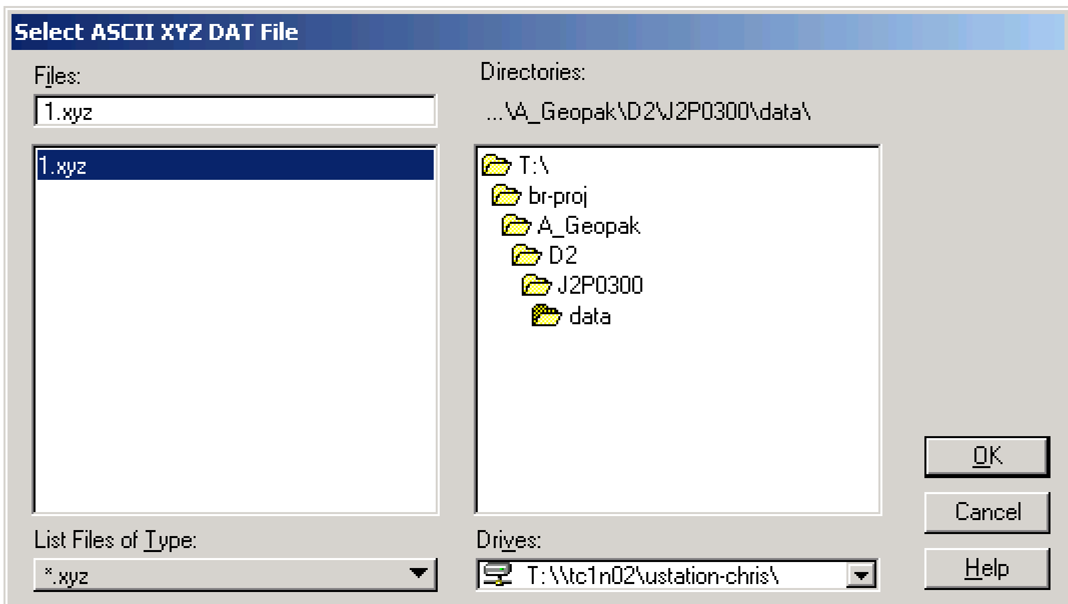
8. Set **Redefine** to **Off** and click **OK**. This prevents the points stored from overwriting any previously stored COGO points.



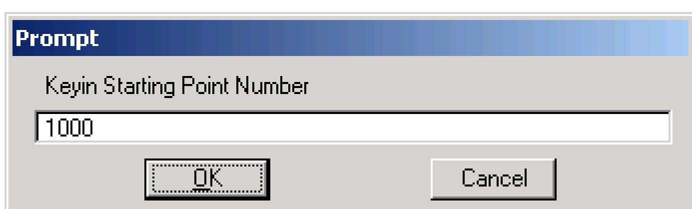
9. Specify the file containing the XYZ data by clicking on **File** button in the following prompt.



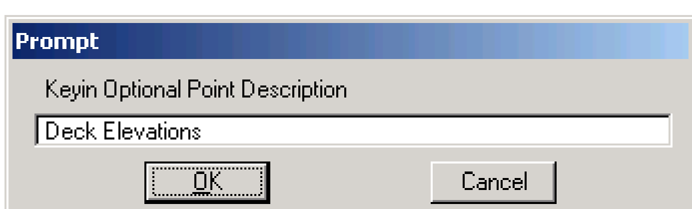
Select the file **1.xyz**, which is highlighted in the dialog below, and click **OK** for both dialogs.



10. Enter **1000** as the name for the first COGO point stored and click **OK**.



11. To identify the points stored as being deck elevation points enter "**Deck Elevations**" as the point description and click **OK**. View the points stored using the COGO Navigator.



Chapter 12

Plan & Profile Sheets

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12.1 Objectives

- Understand and be able to use the GEOPAK Plan & Profile Sheet Generator

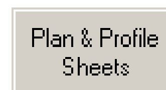
12.2 Definitions

Based on user-defined parameters and sheet size, sheet borders will be placed into a design file relative to a specific alignment. Modifications may be made to sheet size and location. Once the sheet boundaries are in the proper location, the designer may then place the sheet(s) into a design file(s) with the appropriate reference files and sheet cell.

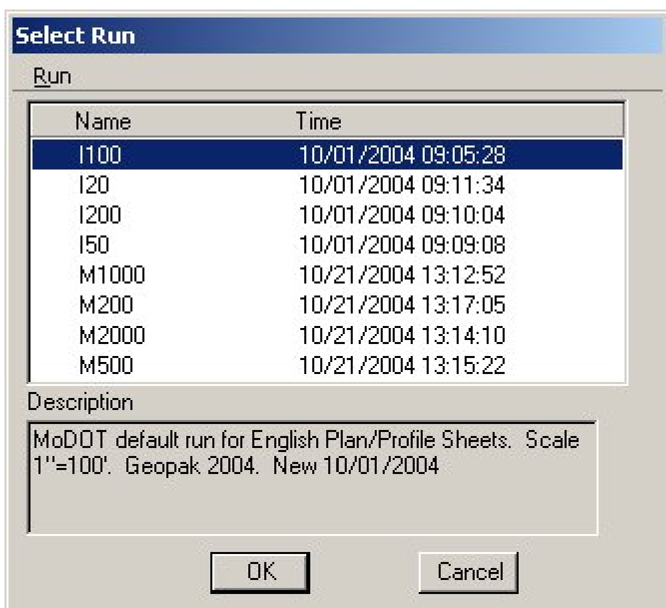
The CADD Support Center has set up a plan sheet library as a basis for generating typical plan and profile sheets. These plan sheet library includes all of the settings, which include General Settings, Plan Drawing Area, Profile Drawing Area, Grid Settings, Tabular Data, etc.

12.3 Accessing

The Plan and Profile Sheets Generator must be invoked via the **Road Project** flow chart button **Plan & Profile Sheets** shown to the right.



When the button is pushed the **Plan & Profile Sheets Run Picker** dialog appears.



The user will copy the run that represents the scale in which he/she is interested. Each run is configured to minimize user input.

RUN NAME	DESCRIPTION
I100	English Sheet for a 1”=100’ scale
I200	English Sheet for a 1”=200’ scale
I50	English Sheet for a 1”=50’ scale
I20	English Sheet for a 1”=20’ scale
M1000	Metric Sheet for a 1:1000 scale
M2000	Metric Sheet for a 1:2000 scale
M500	Metric Sheet for a 1:500 scale
M200	Metric Sheet for a 1:200 scale

Upon entering a run, the Sheet Layout dialog appears. The sheet scale part of the dialog is automatically set for each default run.

12.4 Sheet Library

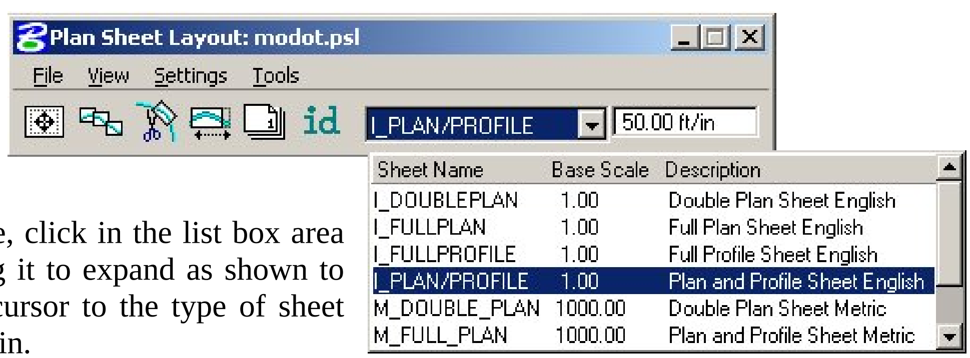
A sheet library must be attached to the current session. CADD Support has set up the tool so the MoDOT sheet library (modot.psl) is automatically attached.

The sheet library contains all the parameters required to layout and to clip the sheets. Only CADD Support is authorized to edit the MoDOT sheet library. Any other sheet libraries will not be supported.

12.5 Sheet Types

The sheet library contains four types of sheets both for English and Metric projects. They are:

- Double Plan
- Full Plan
- Plan/Profile
- Full Profile

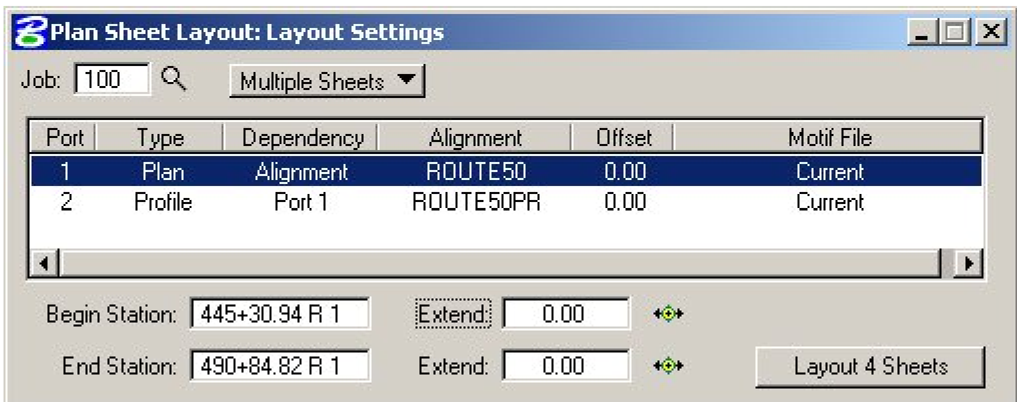


To select a sheet type, click in the list box area of the dialog, causing it to expand as shown to the right; move the cursor to the type of sheet desired; and click again.

12.6 Sheet Layout

Once the type of sheet has been selected, the user is ready to layout the sheets. To access the layout process, select the layout icon from the dialog box or by selecting **Tools>>Sheet Layout.**

The **Layout Sheets** dialog appears.



12.6.1 Job Number

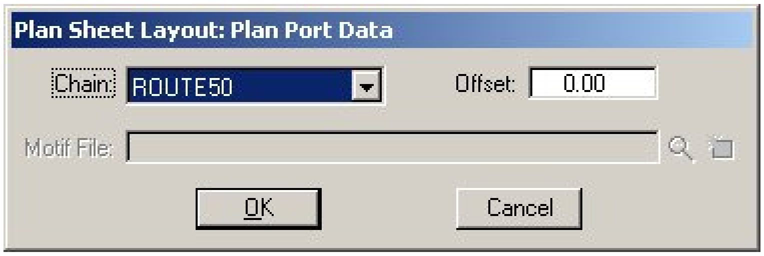
The job number is populated based on the .gpk file selected through Project Manager. With the job number selected, the user is ready to set up each port.

12.6.2 Ports

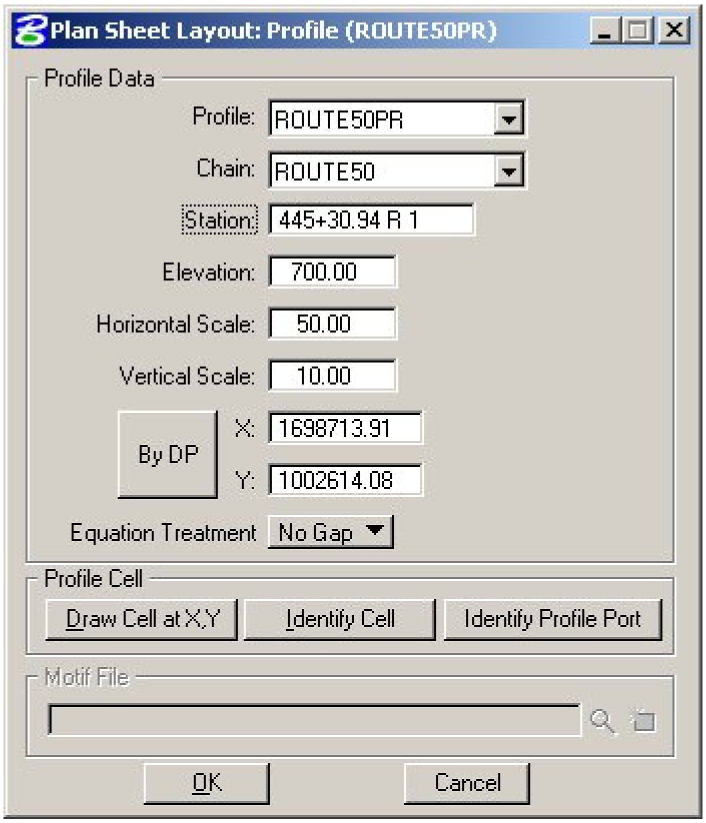
Depending on what type of sheet is selected, the user may have one or two ports. A port is typically a rectangular area that shows a particular section in a sheet, for instance, a standard plan and profile sheet contains two ports, one plan port and one profile port.

The job specific data for each port must be set. If there are two ports, it is important to enter the data for Port 1 first. Double click on a port to enter the data for the port.

If it is a plan type port the next dialog box appears. Select the chain via the pull down list box. Once the chain is selected, click the **OK** button.



If it is a profile port, the following dialog appears. The profile must be selected from the Profile list box.



The rest of the fields in the **Profile Data** area of the dialog can be filled in two ways. One way is to manual fill each of the field with the proper information. However, if a profile cell has been plotted for the alignment, the user can automatically populate the fields by clicking on the **Identify Cell** button and data pointing on the plotted cell. If a profile cell does not exist, the **Draw Cell at X, Y** can be used to place a profile cell once the information has been manually entered into the dialog.

The Profile Data fields contain the following information:

Station: station value of the data point used to define the location of the profile;
Elevation: elevation value of the data point used to define the location of the profile;
Horizontal Scale: horizontal scale of the plotted profile;
Vertical Scale: vertical scale of the plotted profile;

DP X: the X coordinate of the profile location; and
DP Y: the Y coordinate of the profile location.

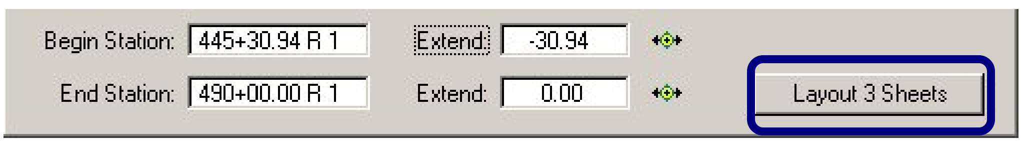
The X and Y coordinates can be typed in or set by choosing the **By DP** button and data pointing in the MicroStation drawing to set the origin point. If the profile has a station equation, the profile can be plotted with gaps or with no gaps.

Once the profile information populated, click on the **OK** button.

12.6.3 Station Range

The **Beginning Station** and **Ending Station** fields are automatically filled in with the station limits of the chain identified in the upper portion of this dialog box. Should the user want to begin or end at a different location the user has the option to type in the station limits for sheet processing or click the **DP** button and data point a location on the screen along the center line.

In addition, the user has the option to start the sheet layout before or after the beginning or end of the alignment by setting the appropriate values in the **Extend** field. A positive number moves in the direction of increased stationing, while a negative number moves in the direction of decreased stationing. For example, the values for the Begin Station shown below will cause the first sheet to start at station 445+00, 30.94 feet before the beginning of the chain.

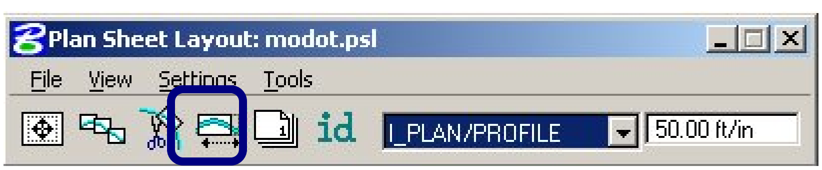


Based upon the begin and end station information the dialog will indicate how many sheets will be laid out as shown above. The user then selects the **Layout Sheets** button to layout the sheets.

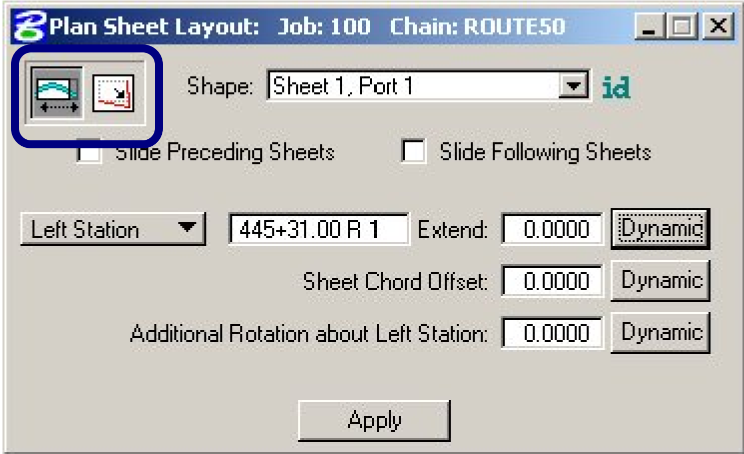
12.7 Modify

Once the above process is complete, the user should review the location of all the sheets to see if any modifications are needed.

To access the Modify mode, select the **Modify Sheets** icon or the menu path **Tools>>Sheet Modify**.

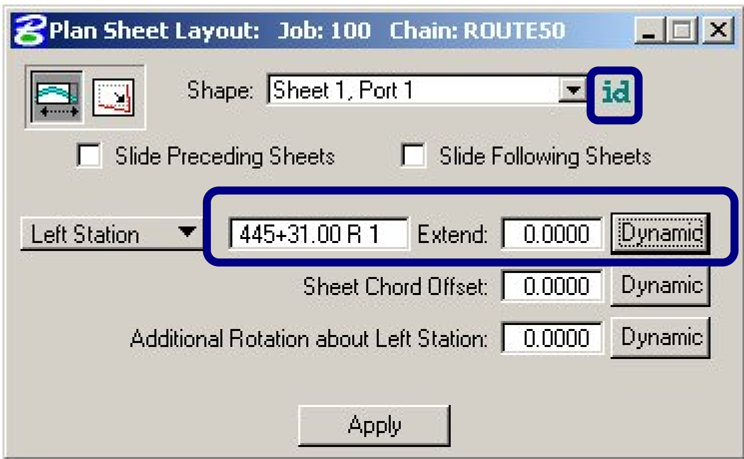


Two major modifications are supported and are selected via icon in the upper left corner of the dialog box shown below. The user has the options of **Slide Sheets** or **Modify Drawing Area.** As the modification type is selected, the dialog changes to reflect the selection.



Slide Sheets - slides previously placed sheets along the alignment; adjacent sheets can remain in their original location or be moved along.

First, the user needs to identify the port to be modified by either selecting it from the list of all shapes in the current set or by pressing the **Id** button and graphically selecting the clipping shape for the port, which will automatically fill the **Shape**.



Next, determine whether only one sheet is to be modified or if the modification should be carried over to adjoining sheets. If the sheets preceding the current sheet are also to be moved, then activate the **Slide Preceding Sheets** toggle. If the sheets after the current sheet are to be moved a corresponding amount as the original shape, activate the **Slide Following Sheets**. If all sheets should be adjusted the same as the original sheet, activate both the **Slide Preceding Sheets and Slide Following Sheets.**

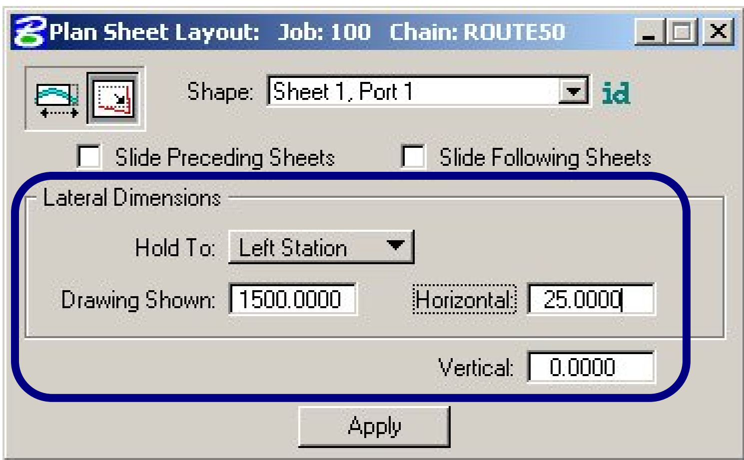
The sheets can be moved dynamically or by value. The station of the sheet is populated when the sheet was selected. To move the sheet along the alignment, enter the value (in terms of master units) in the **Extend** field or just enter the new station value. If entering a value in the **Extend** field, a positive number moves in the direction of increased stationing, while a negative number moves in the direction of decreased stationing.

To move dynamically, press the **Dynamic** button to the right of Extend, which attaches the sheet to the cursor. Then place a data point to initiate moving the cursor, noting the station and Extend values changing as you move. To stop the dynamics, place a final data point to identify the location and commence sliding.

To move the sheet further away (or closer to the alignment) without changing the stationing, use the **Sheet Chord Offset** using a value or dynamically

The **Rotation** can be entered as an angle or dynamically. Rotation always pivots about the left edge of the clipping shape. Rotation alone does not cause Preceding or Following sheets to slide.

Modify Drawing Area - modifies the Clip borders.



The sheet must be identified using the same procedure as the **Slide Sheets tool**. The **Slide Preceding** and **Following Sheets** is also supported.

When the sheet is identified, the fields in the **Lateral Dimensions** are automatically populated. The user has the option to hold the **Left Station**, the **Right Station** or the **Center Station**. Only one station can be held while the other two are adjusted to the revised drawing parameters. Set the desired values and press the **Apply** button to commence redrawing.

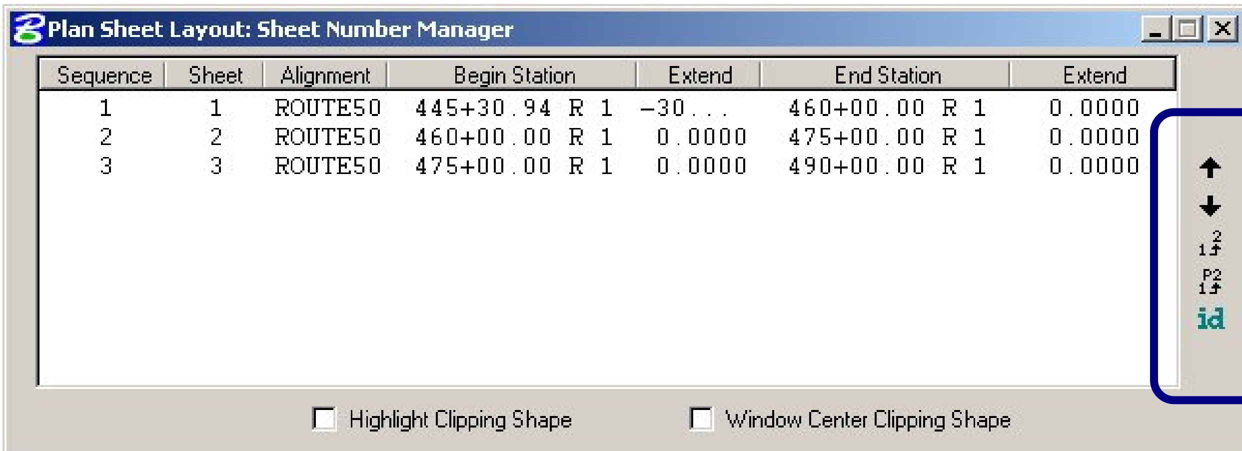
Note: There are no dynamic options when changing the drawing area.

12.8 Sheet Number Manager

Once the clipping shapes have been placed in the MicroStation drawing, the user can adjust the sequence of the sheets by using the **Sheet Number Manager**.

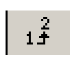
The Sheet Number Manager can be accessed via pull down **Tools >> Sheet Number Manager** or by selecting the icon on the dialog box.

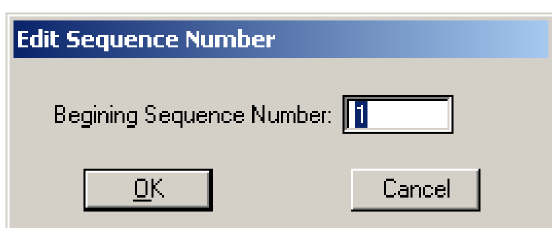
Once the tool is selected the dialog below appears.

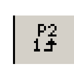


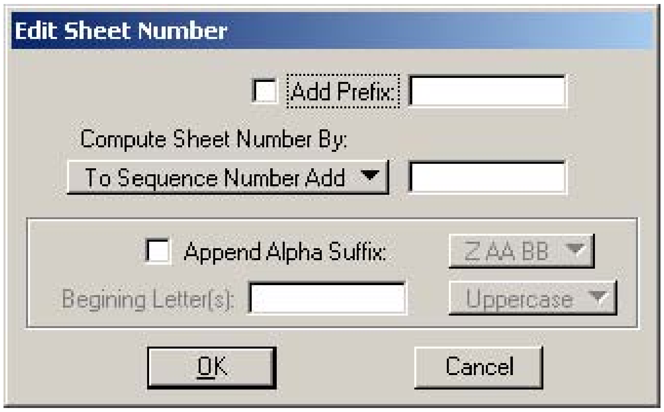
The dialog lists all the sheets in the order they will be drawn. By default the sequence of the sheets matches the sheet number. If the sequence of the sheets needs to be adjusted, the user can highlight the sheet and use the **up and down arrows** on the right hand side of the dialog.

The **id** icon allows the user to select a clip shape from the MicroStation file. The associated line in the list box is highlighted.

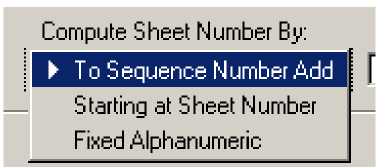
The **Edit Sequence** tool  may be used in the case that there are too many sheets to move with the arrows. Highlight the sheet to be moved and press the icon. **The Edit Sequence Number** dialog opens.



If for any reason the user needs to change the sheet numbers, the **Edit Sheet Numbers**  tool can be used. The user needs to highlight the sheets to be changed and press the **Edit Sheet Number** icon, which opens the dialog shown below.



The user has the option to add a prefix, append an alpha suffix, or do both. The sheet numbers can be edited by the options shown below:



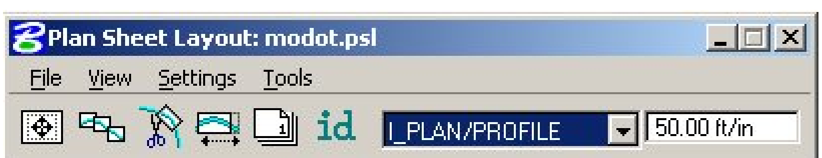
To Sequence Number Add – It renumbers the sheet by adding a value to the original sheet number. For example, if the original sheet number was 1 and sequence add number is 100; the new sheet number becomes 101.

Starting at Sheet Number – The user specifies a given number from where to start.

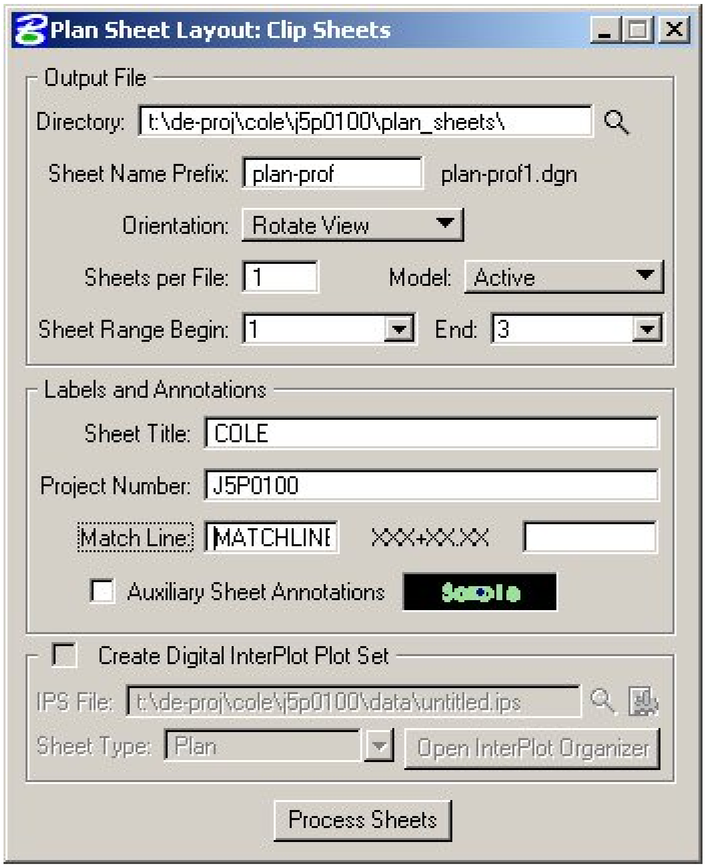
Fixed Alphanumeric - This field is used in combination with the bottom entries in the dialog. The user specifies to hold a fixed alphanumeric value and toggles the **Append Alpha Suffix.**

12.9 Clip Sheets

The **Clip Sheets** process can be accessed via pull down **Tools>> Sheet Clip** or by selecting the icon on the dialog box.



The following dialog appears.



12.9.1 Output File

Directory – Path to folder where the design file containing the sheet(s) will be placed.

Sheet Name Prefix – Name of the design file containing the sheet (s). GEOPAK will add a 1, 2, etc. to the end of each file name.

Orientation - The tool supports two types of orientation, Rotate View and Rotate Reference. **Rotate View -** will attach all reference files and rotate the view to conform to the orientation of the sheet. This option allows true coordinates for the file. (Note: If **Rotate View** is used, tools such as Plan View Labeler, and DP Station and Offset can still be used). **Rotate Reference -** Will rotate each reference file to orient itself with the sheet. (Note: It is suggested to use the **Rotate View** mode.)

Sheets per File - Indicates how many sheets are drawn per design file. (Note: for **Rotate Reference** only)

Model – The *Clip Sheet Tool* supports the use of models. User can select the *Active* model or *By Sheet Name.*

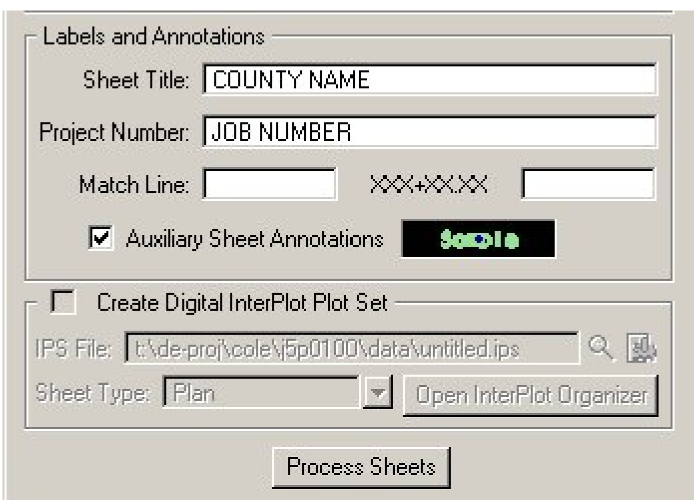
Sheet Range – Allows the user to choose which sheets to clip by selecting a **Begin** and **End** range.

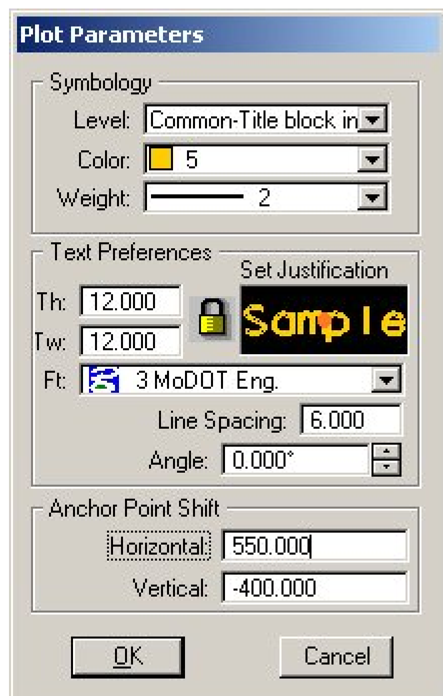
12.9.2 Labels & Annotations

Sheet Title- CADD Support has set this field to be the name of the project county for a standard MoDOT sheet title block.

Match Lines – Will place a match line station.

Auxiliary Sheet Annotations – Will allow the user to add any other notes not already set in the default settings. Once the **Auxiliary Sheet Annotations** toggle is turned on, the **Sample** graphics button will become available, and the user can define the plot parameters accordingly. These Auxiliary Sheet Annotation will provide an additional label with the *name of the chain, the rotation angle and the sheet number*.





Process Sheets - Once all the fields in the dialog box are entered, selecting the **Process Sheets**, initiates the sheet(s) creation.

12.10 File Pulldown Menu

Sheet Library – This menu option has options for creating, attaching, or editing a library. CADD Support maintains the MoDOT plan sheet library. Other sheet libraries will not be supported.

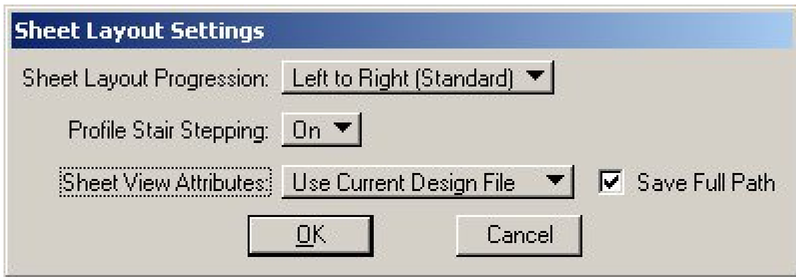
Exit – Exits the Plan/Profile Sheets application.

12.11 View Pulldown Menu

When different types or scales of plan sheet shapes are placed within one plan view drawing, the view menu options allow the user to filter sheets by names or by scale to display the shapes accordingly.

12.12 Settings Pulldown Menu

Only one option is available in this pulldown menu. The Sheet Layout settings option allows the user to set a Sheet Layout Progression, Profile Stair Stepping, and Sheet View Attributes.



12.13 Tools Pulldown Menu

Identify Sheet –

Sheet Composition - Opens the sheet composition dialog box. It allows the user to define the drawing area. CADD Support has set up default settings for MoDOT users.

Sheet Layout – Opens the layout sheet dialog.

Sheet Clip – Opens the clip sheet dialog.

Sheet Modify – Opens the modify sheet dialog

Sheet Number Manager – Opens the sheet number manager.

Draw Tabular Annotation (Sheet Clip Mode) – When the ports are set up in a tabular manner, this tool allows the user to define the tabular data to be included within the plan/profile sheets.

Process Classic Plan & Profile Runs – This will import certain information from the *Classic Plan & Profile* runs to create a sheet library. MoDOT has developed the modot.psl as the library to be used with the MoDOT default runs.

Exercise 12-1

This is a group exercise to show how to use the GEOPAK Plan and Profile Sheets tool to create a single plan sheet rotated to the alignment in the area of a stream crossing.

1. Open the MicroStation file **t:\br-proj\a_geopak\d2\j2p0300\data\plan_j2p0300.dgn**. Attach **t:\br-proj\a_geopak_\d2\j2p0300\data\topo_j2p0300.dgn** as a reference file.

2. Open the project **j2p0300.prj** and enter **Road** as user **userc**. Use the **Rte6** working alignment.

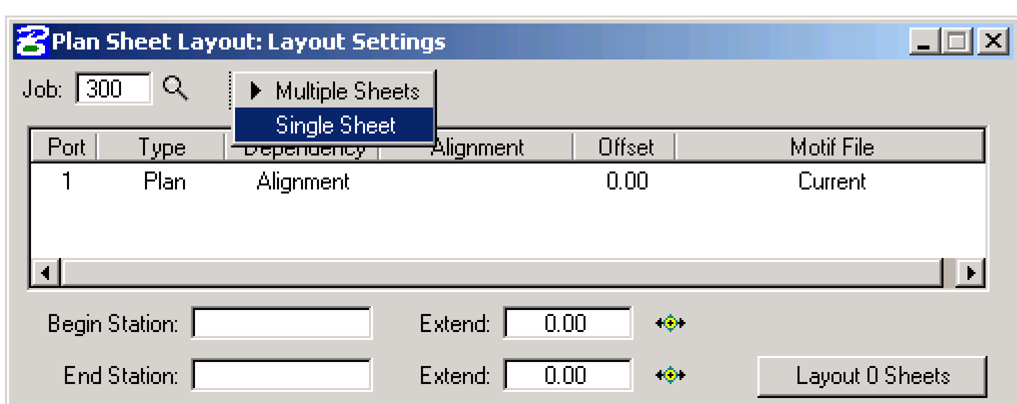
3. Choose **Plan & Profile Sheets** from the **Road Project** flow chart.

Copy the **I20** run, name the new run **Rte6** and enter the new run.

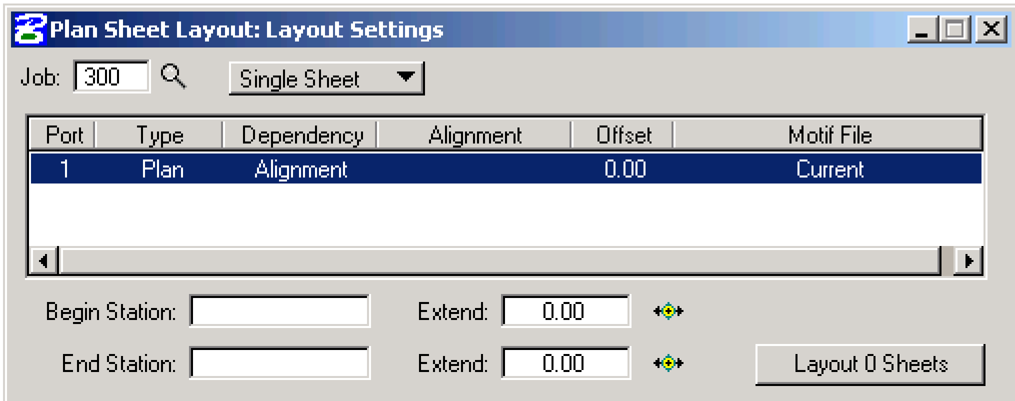
4. Select the **I_FULLPLAN** from the pull down outlined blow.

5. Click on the **Layout Sheets** icon, which is outlined below.

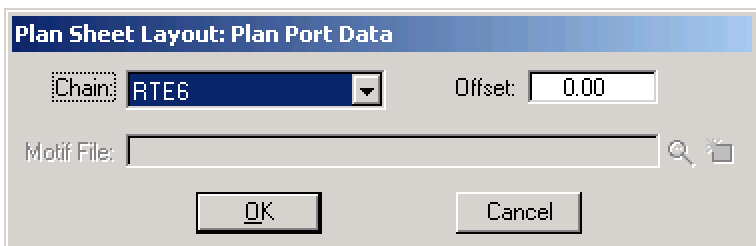
6. This brings up the **Layout Settings** dialog shown below. Switch to the Single Sheet option



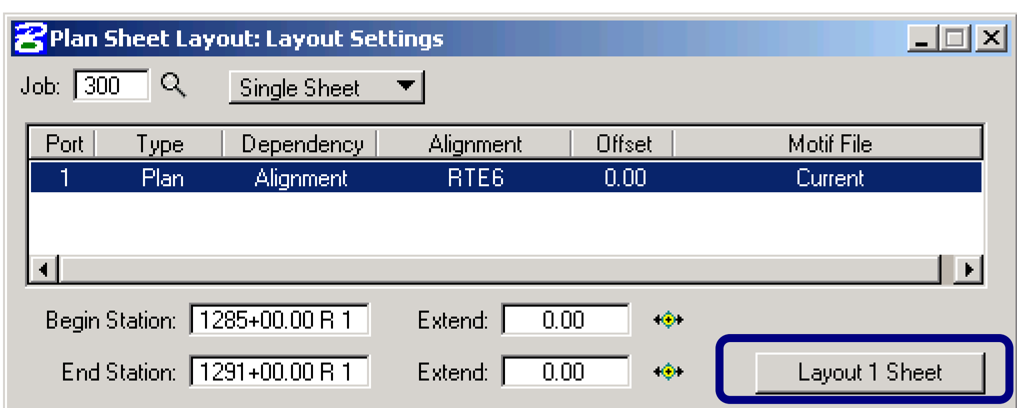
7. To edit the information for sheet Port 1, double click on the entry for that port, which is the highlighted line in the following figure.



Select **RTE6** as the **Chain** for the Plan Port, as shown below.

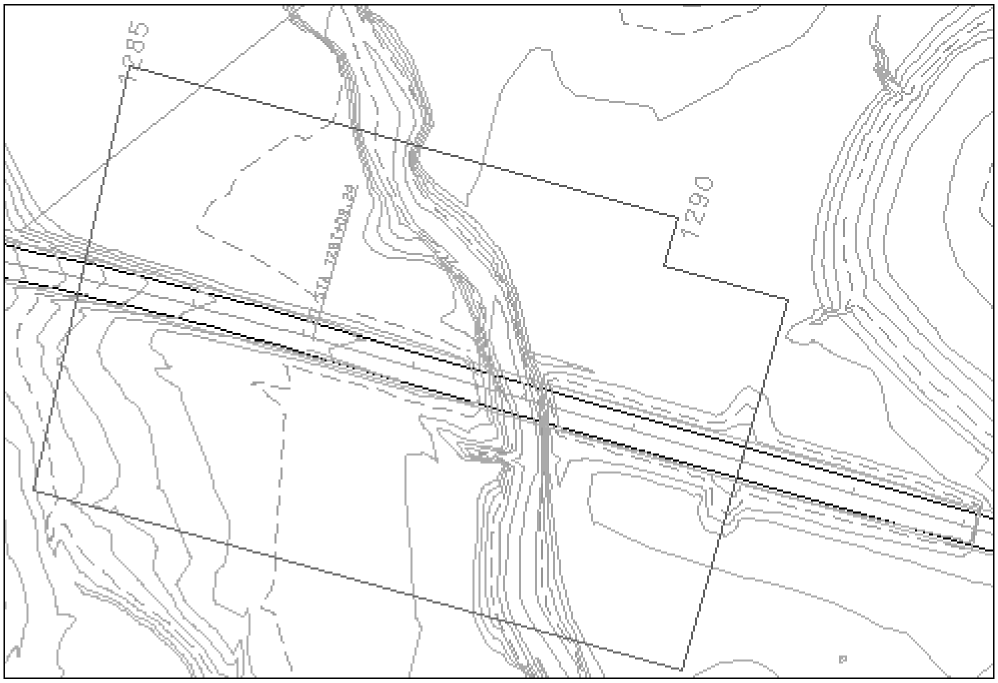


Click **OK** to save the Plan Port Data settings. This will update the settings for the plan port. Change the **Begin Station** value to **1285+00**, as shown below. The End Station will automatically be adjusted for the size of the sheet.



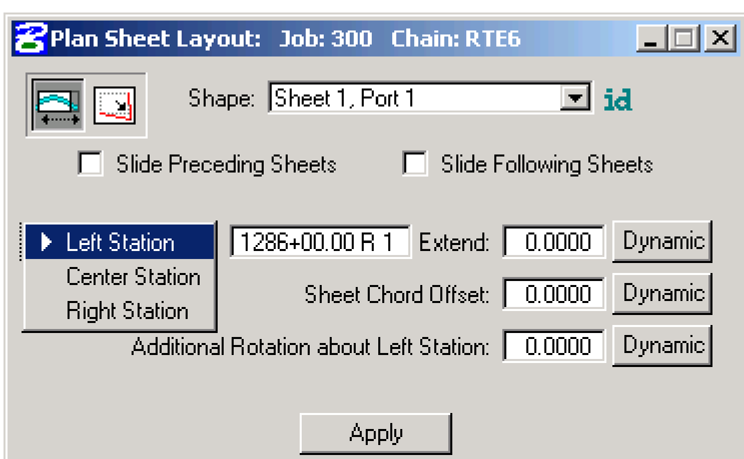
To place the sheet, click on **Layout 1 Sheet**, which is outlined above. This will place the clip boundary for the sheet.

8. As can be noted in the following screen capture, the sheet is not centered on the stream crossing.



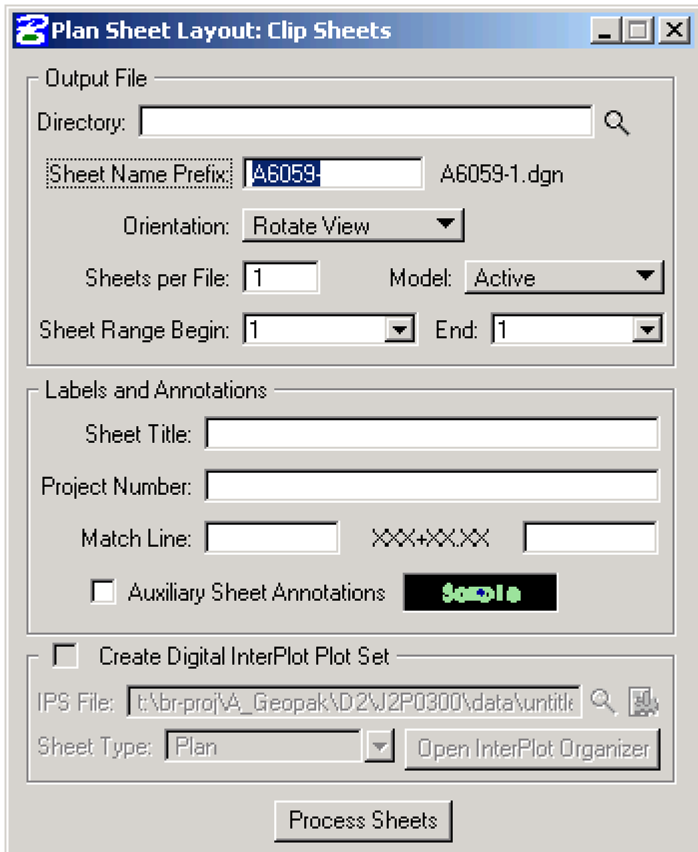
To adjust the location of the sheet, select the **Modify Sheet** tool, which is outlined in the following figure.

This brings up the following dialog. The position of the sheet can be adjusted either dynamically (by using the Dynamic button and sliding the sheet) or by entering a station value, which can be used to set the Left, Center, or Right Station for the clip boundary. Adjust the **Left Station to 1286+00** and click **Apply**.



9. Save the changes to the MicroStation file. Return to the Plan Sheet Layout dialog and click on Clip Sheets icon, which outlined below.

This will bring up the following **Clip Sheets** dialog.



If the **Directory** field is left blank, the sheet file is placed in the current working directory, which is where we want it.

The **Sheet Name Prefix** field lets the user specify the first part of the DGN to be created. Enter A6059- or another suitable name in the filed and hit the Tab key to update the file name preview to the right of the field.

Click on **Process Sheets** to generate the sheet file. Several MicroStation files need to be opened as part of the process. Click OK to save the changes to each of the files that are opened. An alternative to this is to toggle on Automatically Save Design Changes in the Operation tab of the **Workspace** > **Preferences** dialog. If you do toggle it on prior to clipping the sheets, be sure to toggle if off when the process is complete.

Exit the Plan Sheet Layout tool and save the changes to the run.

Chapter 13

Original Ground

Cross Sections

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13.1 Objectives

To generate original ground cross-sections based on a DTM, and to use the **Cross-section Navigator** tools.

13.2 Definitions

Geopak uses topographic elements to generate original cross sections. These include breaklines and spot elevations. GEOPAK can access and read this data from several basic data formats:

- Field Notes
- RDS cross sections
- DTMs based on Photogrammetric Mapping
- DTMs based on survey information

Of these basic formats, MoDOT primarily uses data from DTM's for generating existing ground cross sections.

13.3 Accessing

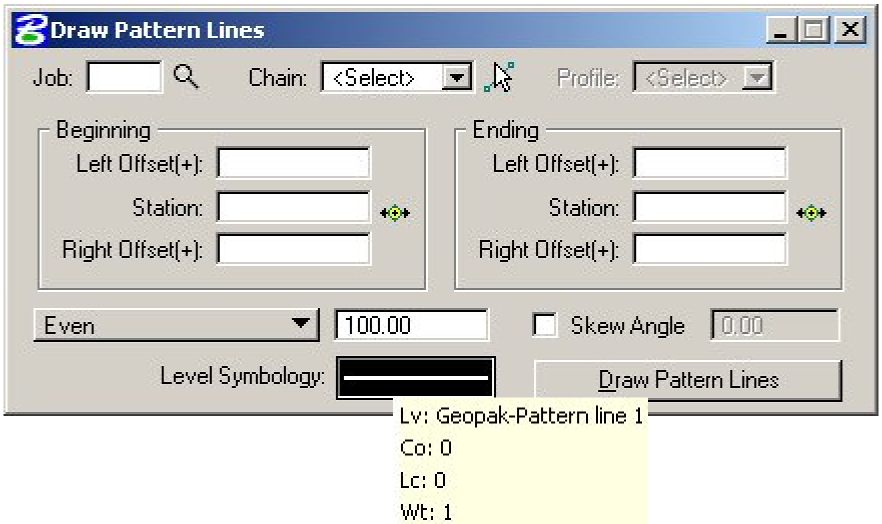
To access the **Draw Pattern Lines** dialog box, go to **Project Manager >> Draw Pattern** or choose the **Draw Pattern** icon.

To access the **Existing Ground Cross Sections** dialog box, go to **Project Manager >> Existing Ground Cross Sections**, or choose the **Existing Ground Cross Sections** icon.

13.4 Pattern Lines

Pattern Lines identify the location of the cross sections. Pattern lines are either a line or a line string drawn into a Microstation drawing. The lines are most commonly drawn using the Microstation Place Line or Place Smartline tools, or by the Geopak **Draw Pattern Line** dialog. The **Draw Pattern Line** dialog allows the user to easily place pattern lines at even intervals, and key alignment locations. The Microstation tools are generally used for specialty sections, such as an existing culvert location, or kinked sections.

From the **Project Manager** select **Draw Pattern**, and choose the run. The following dialog box will appear.



The user selects the **Job Number** and the **Chain** along which to draw the pattern lines. The **Left Offset (+)** and **Right Offset (+)** determine how far from the chain the pattern line is to be drawn, and the **Beginning** and **Ending Stations** determine the station range for which to plot the pattern lines.

Six methods are allowed for drawing the pattern lines.

Increment – starts at the beginning station, and draws a pattern line at the given increment (i.e. for a 100 foot increment on a chain starting at 10+17, pattern lines will be drawn at 10+17, 11+17, 12+17, …)

Even – draws pattern lines at stations divisible by the given value (i.e. for a 100 foot even interval on a chain starting at 10+17, pattern lines will be drawn at 11+00, 12+00, 13+00, …)

Once – draws a pattern line at a given station. (Only the beginning station is active.)

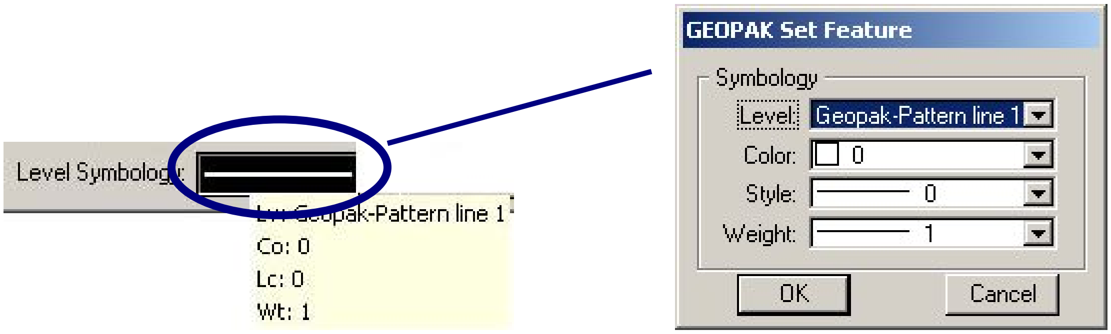
Critical Points - Horizontal – draws a pattern line at each of the critical points (i.e. POT, PC, PT, etc.) within a chain.

Critical Points - Vertical – draws a pattern line at each of the critical points (i.e. VPC, VPT, and high or low point) within a profile.

Superelevation Transitions – draws pattern lines at the beginning and ending of each superelevation shape drawn in the current Microstation file, and any attached reference files. (Locations that are coincident with the horizontal control points are not drawn.)

The cross section **skew** can be set using the **skew** toggle. The pattern line is skewed by the specified angle from the standard pattern line (perpendicular to the baseline). A positive skew angle will rotate the pattern line clockwise, and a negative skew angle will rotate the pattern line counter-clockwise.

The **Level Symbology** can be read from the working alignment definition. The user can change the level symbology by double clicking on the **Level Symbology** element.

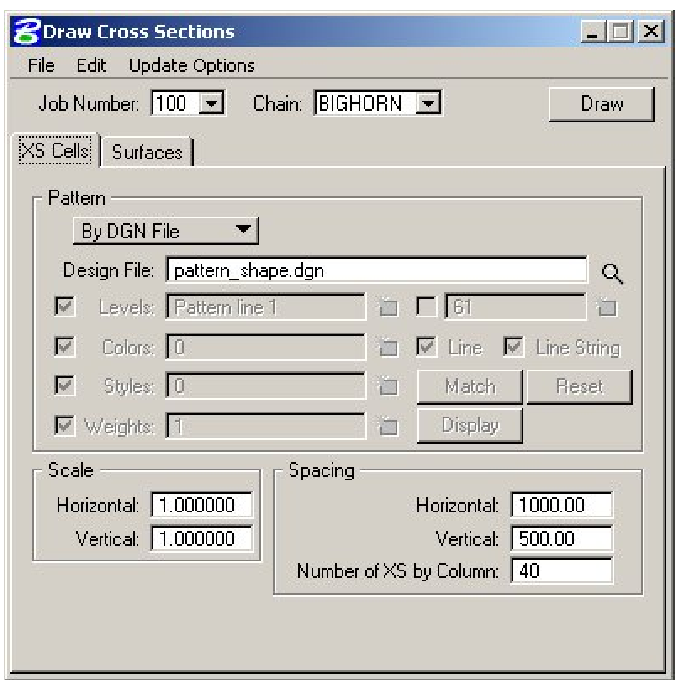


Once all the key-in fields have been completed and the **Draw Pattern Lines** button is selected the pattern lines are drawn along the chain into the open Microstation design file (on the specified level, color and style). This is a visual representation of the location of the cross sections to be generated.

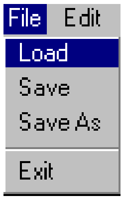
The user can use the Microstation **Place Smartline**, or **Place Line** command to draw additional pattern lines as needed.

13.5 Processing the Existing Ground Sections

Once the pattern lines have been drawn the cross-sections can be processed. To process the cross-sections, go to **Project Manager >> Existing Ground Cross Sections**, or choose the **Existing Ground Cross Sections** icon. After the run is chosen, the dialog box below will appear.

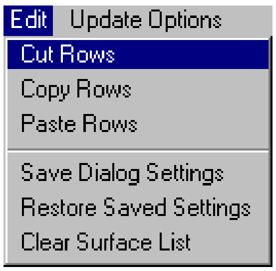


13.5.1 File Menu



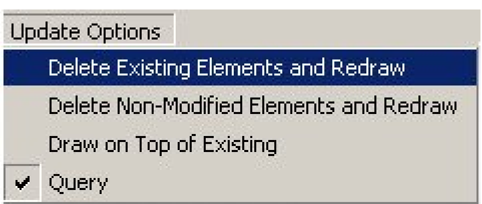
The **File** menu allows the user to save the dialog settings for each chain. The user sets the parameters for each chain, and then selects **File>>Save**. The next time the user accesses this dialog, the current information is completed from the resource files. The user can select **File>>Load** to access the previously saved settings. As the user switches between chains, the dialog settings will change according to how the user saved them. The Project Manager run also performs the same functionality.

13.5.2 Edit Menu



The **Edit** menu allows the user to **Cut**, **Copy**, and **Paste** rows from the **Surfaces** tab. **Save Dialog Settings** will save the information in the dialog box to the resource file. **Restore Saved Settings** will restore the dialog settings from the resource file. (If the resource file is deleted, these settings will be lost and cannot be restored.) The **Clear Surface List** option will clear all surface options from the current list.

13.5.3 Update Options Menu



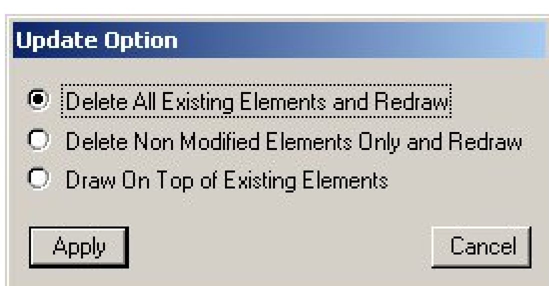
The **Update Options** dialog determines how previously cut original ground section elements will be handled when drawing new original ground section elements on the same cross section cells.

Delete Existing Elements and Redraw – any existing ground lines previously drawn with this tool are deleted and new ground lines are drawn.

Delete Non-Modified Elements and Redraw – only the existing ground lines previously drawn with this tool that have not been modified are deleted and new ground lines are redrawn. Lines that have been modified are left intact.

Draw on Top of Existing – the previously drawn existing ground lines are ignored, and new lines are drawn. This will result in two sets of lines.

Query – brings up the following dialog when the **Draw** button is pressed. The user can choose which option to use.



13.5.4 Job Number

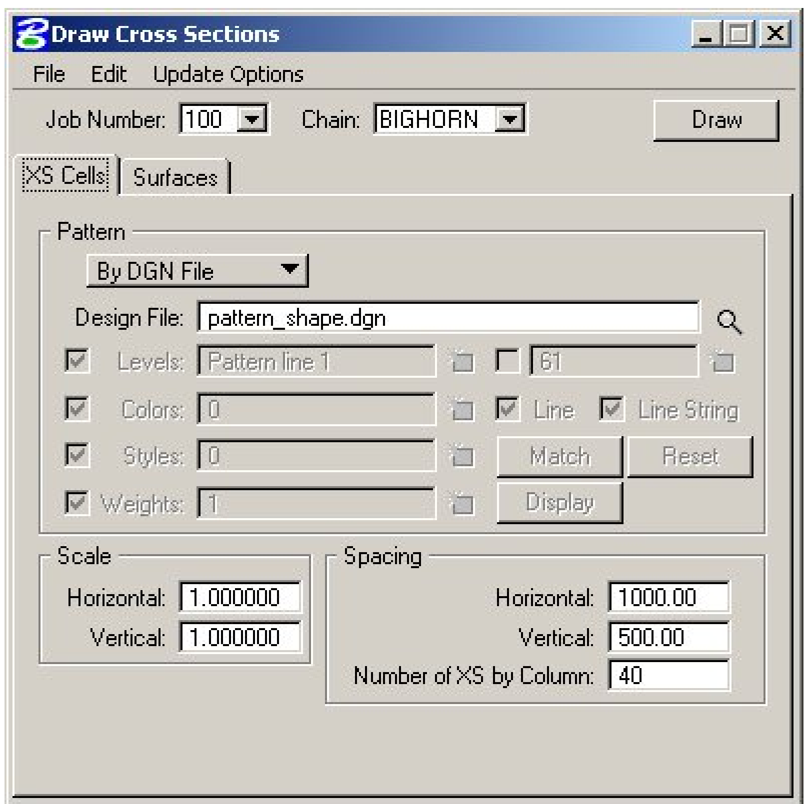
The user must specify the job number that contains the chain on which to base the cross sections. The drop-down arrow will display the .gpk files available in the working directory.

13.5.5 Chain

The user must specify the baseline to be used for the cross sections. The drop-down chain will display the chains available in the specified job number.

13.5.6 XS Cells

The **XS Cells** tab allows the user to determine where each cross section is to be drawn.



Three options are available in the **Pattern** section to determine the location of the cross sections.

By Station – allows the user to specify the **Beginning** and **Ending Stations**, the **Left** and **Right Offsets** and whether the stations should be cut at specified **Even** stations or at a specified **Increment** along the baseline.

By DGN File – uses the pattern lines drawn as discussed in section 13.4. The user needs to specify the Microstation design file in which the pattern lines are drawn, and the symbology of the pattern lines. The **Match** button can be used to select a pattern line with the desired symbology. When accepted, the symbology of the selected element will populate the fields that are turned on. The **Display** button will display all of the elements that match the specified symbology. The **Reset** button will clear all of the symbology fields.

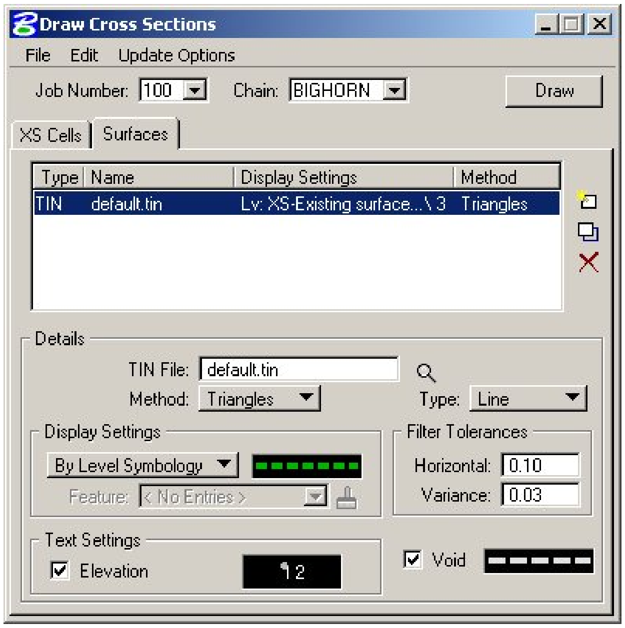
In Existing Only – this option uses the only the cross section cells drawn in the current Microstation Design File.

The **Scale** section can be used to adjust the scale of the cross sections. For MoDOT, the **Horizontal** and **Vertical** scale should always be set to 1.0. MoDOT controls the scaling of the cross sections when the cross section sheets are plotted.

The distance between the cross sections and the maximum number of cross sections in each column can be set using the **Horizontal**, **Vertical**, and **Number of XS by Column** option in the **Spacing** section. It is suggested to leave the **Vertical** and **Number of XS by Column** settings at the default values. The **Horizontal** setting may need to be changed depending on the width of the cross sections. The **Horizontal** setting should be set to a value greater than the total width of the cross section. This will prevent the cross sections from overlapping each other.

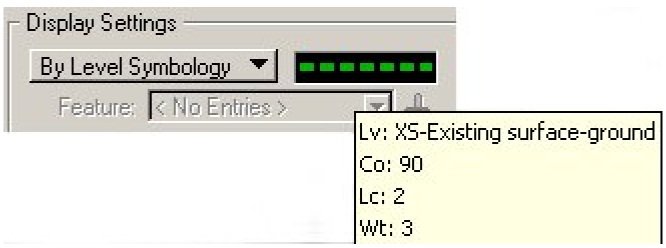
13.5.7 Surfaces

The **Surfaces** tab allows the user to specify the surfaces from which to cut the original ground cross sections.



The top portion of the dialog lists the surfaces to be cut, and the symbology to be used when drawing the cross sections for the given surface. The icons on the right allow surfaces to be added, modified, or deleted.

The **Details** portion of the dialog allows the user to specify the TIN file to be used as the cutting surface, select the **Method** of interpolation, and select the **Type** of element to be drawn. When **Breaklines** is selected as the **Method**, the cross section is interpolated between the breaklines, and the triangles are ignored. This is mainly used in a site design application. The method should always be set to **Triangles**, which will include the triangles in the interpolation of the cross section surface. The **Type** allows the cross section to be drawn a **Line**, or a **Line String**.

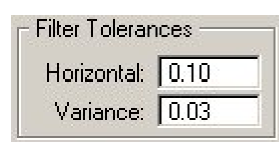


The **Display Settings** section allows the user to determine how the cross section surface will be drawn. The user can choose **By Level Symbology** or **By Feature**. When using **By Level Symbology**, the user can choose the level, weight, color, and line style for the cross section elements by double clicking on the symbology box next to the **By Level Symbology / By Feature** toggle. **By Feature** allows the user to choose an item from the current D&C Manager database. Selecting the paintbrush icon will open the current D&C Manager. The user can select the item to use, which will then be displayed in the **Feature** field. Previously selected items can be viewed by using the pull down in the **Feature** field. Currently, MoDOT does not have any D&C Manager items set up for the cross section view. Therefore, it is suggested to us the **By Level Symbology** option.

The **Void** symbology can be set using the **Void** toggle. This will draw any areas that cross a void, or the tin hull using the specified symbology. The following table shows the level symbology currently used in MoDOT.

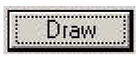
Surface Name	Level	Color	Weight	Line Style
Existing Ground	XS-Existing surface-ground	90	3	2
Void Areas	XS-Existing surface-ground	40	3	2
Top of Rock	XS-Existing subsurface-rock	8	3	2
Bottom of Rock (for rock seam)	XS-Existing subsurface-rock bottom	9	3	2

The **Filter Tolerances** section allows for the elimination of short segments that may be created but are less than the tolerance distance in length. The default values are good values to be used for these options.



The existing ground elevation at the baseline can be plotted using the **Text Settings** portion of the dialog. To use the text settings option, turn on the **Elevation** toggle. Choosing the symbology box located next to the elevation toggle can set the text symbology.

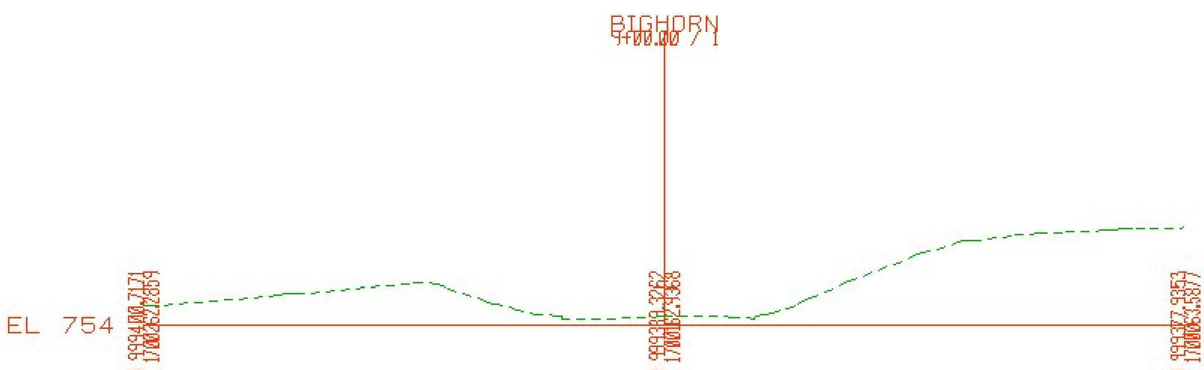
13.5.8 Draw



Once the cross section location is set up, and the surface and surface symbology is determined, the **Draw** button can be used to draw the cross sections into the active Microstation design file.

13.6 Cross Section

The cross sections consist of mostly Microstation elements. These elements can be modified using Microstation tools. New elements can also be added using Microstation or Geopak drawing tools.

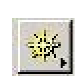


The intelligence of the cross section is built into the cross section cell. This cell is located on level 63. The cell consists of the baseline name, the station and region, the end coordinates for the cross section location, and the coordinates for the location at which the cross section intersects the baseline.

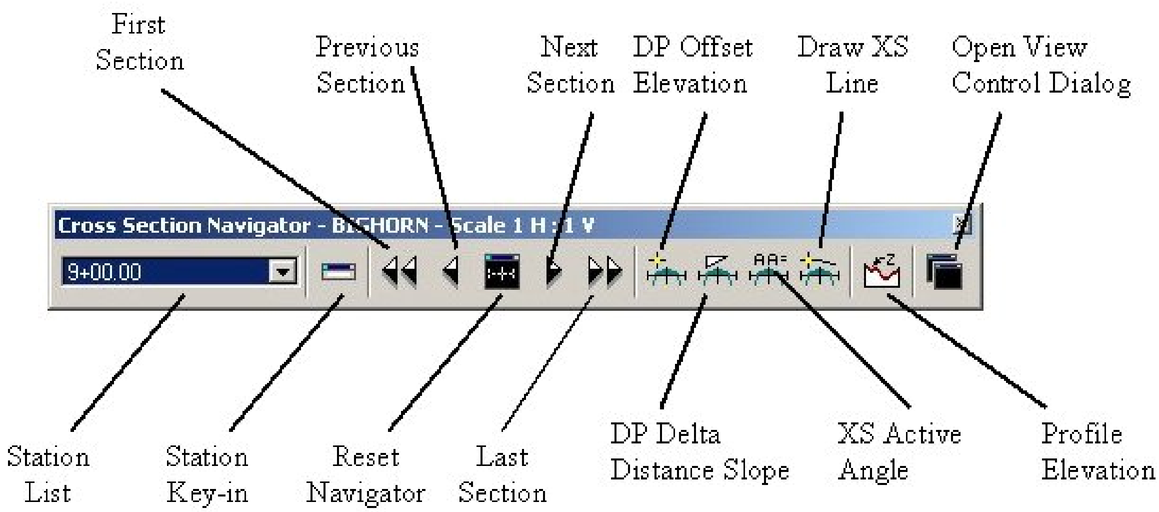
Warning: Do not delete or modify the cross section cells. If the cell is deleted or modified, the intelligence for this cross section will be lost.

13.7 Cross Section Navigator

The **Cross Section Navigator** is a tool used to view and move between cross-sections. It can also be used to draw cross-section information.



The user can access **Cross Section Navigator** by the **Cross Section Navigator** icon. When the icon is chosen, the following dialog appears.



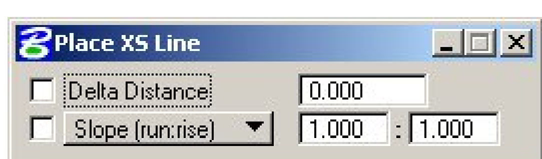
The user can move through the cross-sections by either choosing the station from the pull-down list, by typing the station value into the **Station Key-in** dialog, or by using the **First Section**, **Previous Section, Next Section,** or **Last Section** icons. The **Reset Navigator** icon will center the first station to the view, and reset the navigator to the first station value. Cross-section elements can be added or modified using Microstation tools, and/or the cross-section drawing tools.

DP Offset Elevation – data points at a given offset/elevation, or find the offset/elevation of the cursor location.

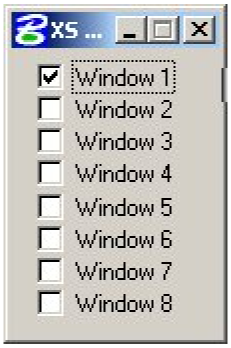
DP Delta Distance Slope – draws a line at a given horizontal distance and slope.

XS Active Angle Tool – sets the active angle to the given value. If a Microstation tool is used with the active angle option, this value will be used.

Draw XS Line – draws a cross-section line. An offset or a slope can be specified.



Profile Elevation – issues a data point at the elevation of a specified profile. An alternate chain location can also be specified.



Open View Control Dialog – allows the user to open and navigate through several windows to view different portions of the cross-section at the same time. (I.e. The user can view the whole cross-section in view 1, the left side in view 2, and the right side in view 3.)

13.8 Summary

Basic Steps to Creating Original Ground Cross Sections from a DTM

1. Have an existing triangle file (.tin).
2. Open a 2D Microstation design file for the pattern lines.
3. Draw the pattern lines.
4. Open a 2D Microstation design file for the cross sections.
5. Draw cross sections through GEOPAK.
6. Review and modify (if necessary).

Exercise 13-1

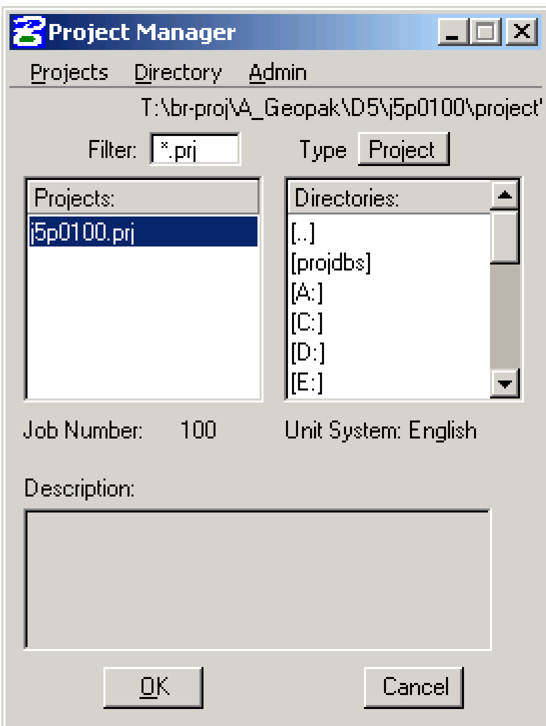
This is a group exercise to demonstrate the process for specifying the location of cross sections using pattern lines and creating existing ground at those locations.

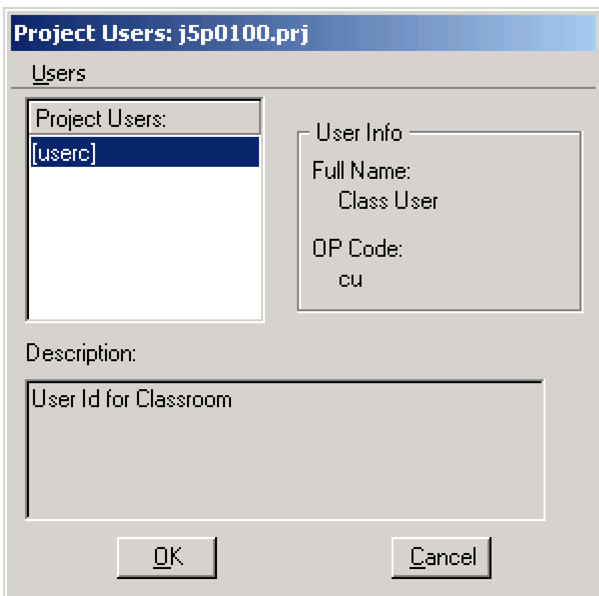
1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\pattern_shape_j5p0100.dgn**.

   Attach the following files as references: **t:\br-proj\a_geopak\d5\j5p0100\data\plan_50_j5p0100.dgn** and **t:\br-proj\a_geopak\d5\j5p0100\data\plan_bh_j5p0100.dgn**.

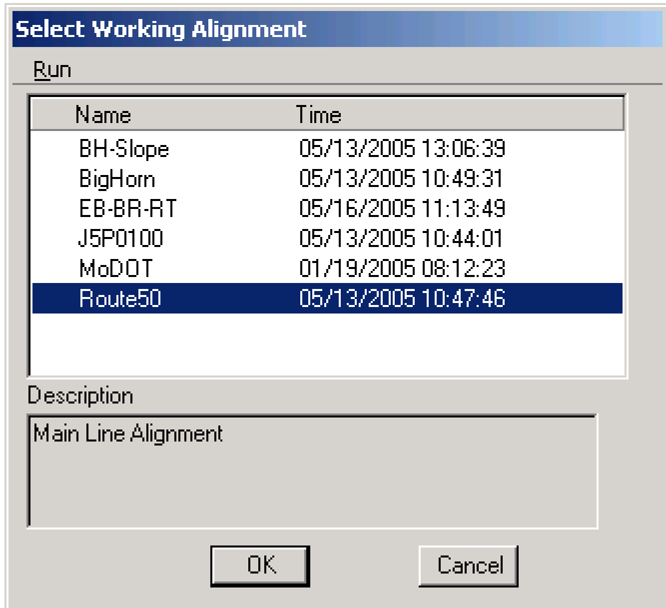
   Save changes to the MicroStation file **pattern_shape_j5p0100.dgn**.

2. Open the project **t:\br-proj\a_geopak\d5\j5p0100\project\j5p0100.prj**. Select user **userc**.

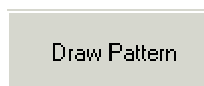




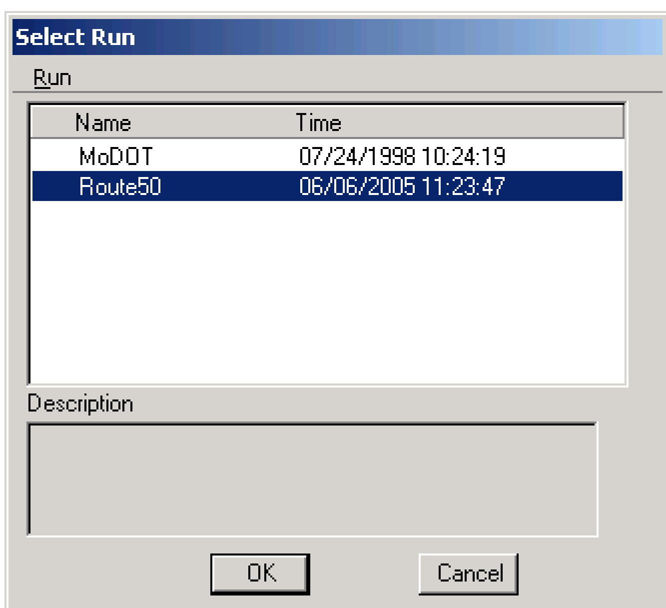
3. Select the **Route50** working alignment.



4. Choose **Draw Pattern** from the **Road Project** dialog.



Copy the **MoDOT** run and name the new run **Route50**.

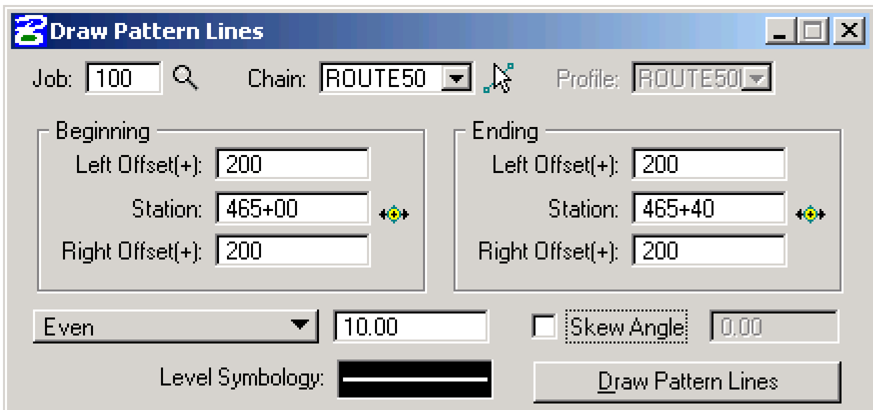


5. Create the pattern lines for the Route50 alignment in the vicinity of Big Horn Dr. but away from the proposed bridge ends by using the following settings.

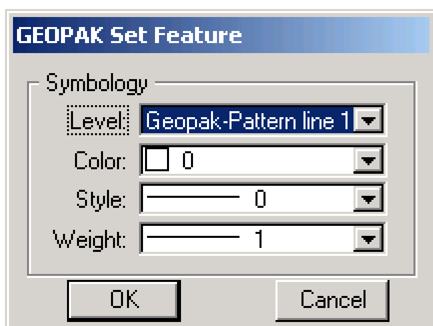
Job: **100** Chain: **Route50**

Beginning		Ending	
Left Offset (+):	**200**	Left Offset (+):	**200**
Station:	**465+00**	Station:	**465+40**
Right Offset (+):	**200**	Right Offset (+):	**200**

Even: **10**

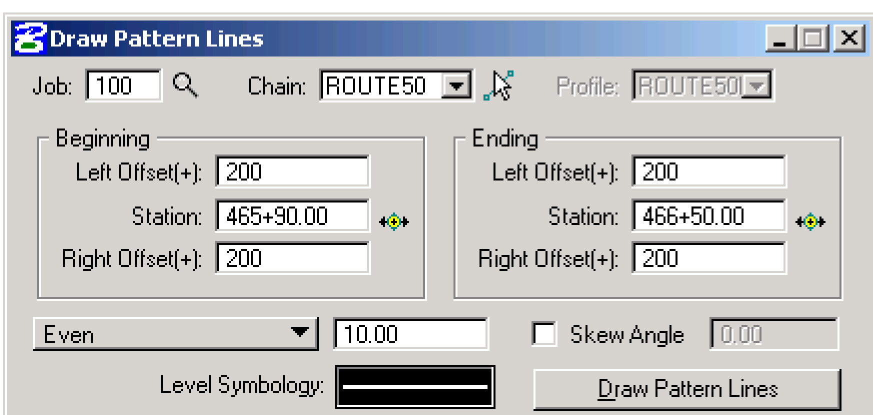


Make sure the Level Symbology is set to that shown below.



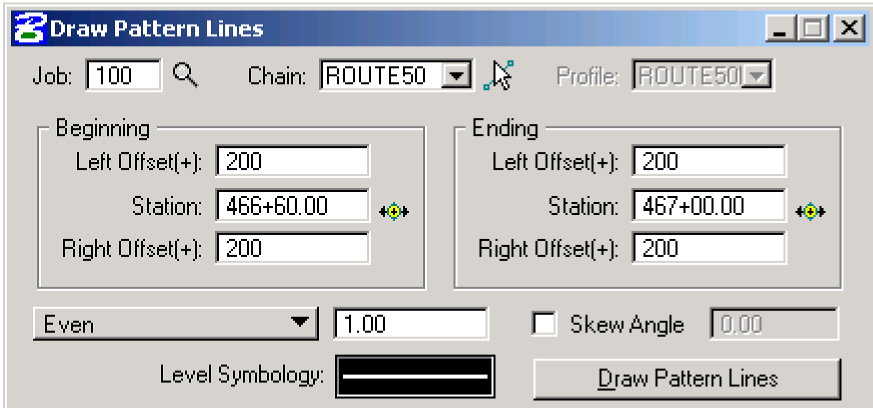
After enter this information in the Draw Pattern Lines dialog, plot the pattern lines by clicking on **Apply**.

Repeat the process with a beginning station of **465+90** and ending station of **466+50**.



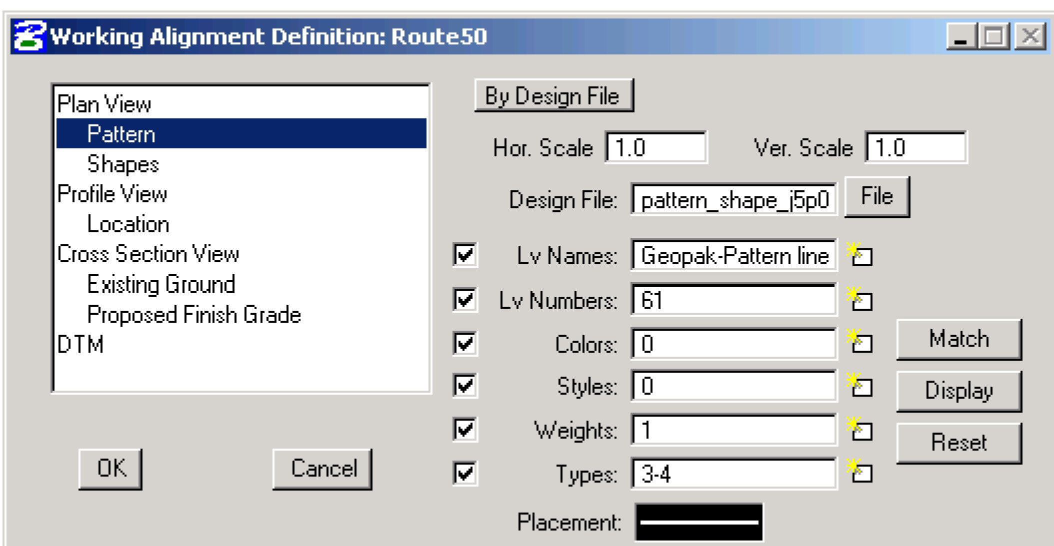
6. Add pattern lines at 1' increments in the vicinity of the proposed bridge ends. To do this, change the **Even** value to **1** and add the following two ranges of pattern lines as follows. **Make sure you do not add pattern lines on top of any already plotted lines**.

Beginning Station	**465+50**	Ending Station:	**465+80**
Beginning Station	**466+60**	Ending Station:	**467+00**



7. Exit Draw Pattern and save the changes to the MicroStation file.

8. In the **Pattern** section of the Route 50 **Working Alignment Definition** note that the Design file is **pattern_shape_j5p0100.dgn** and the symbology for the pattern lines.



9. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\xs_j5p0100.dgn**.

   Save the file as **xs_50_j5p0100.dgn** so xs_j5p0100.dgn remains a blank file.

10. Choose **Existing Ground Cross Sections** from the **Road Project** dialog.

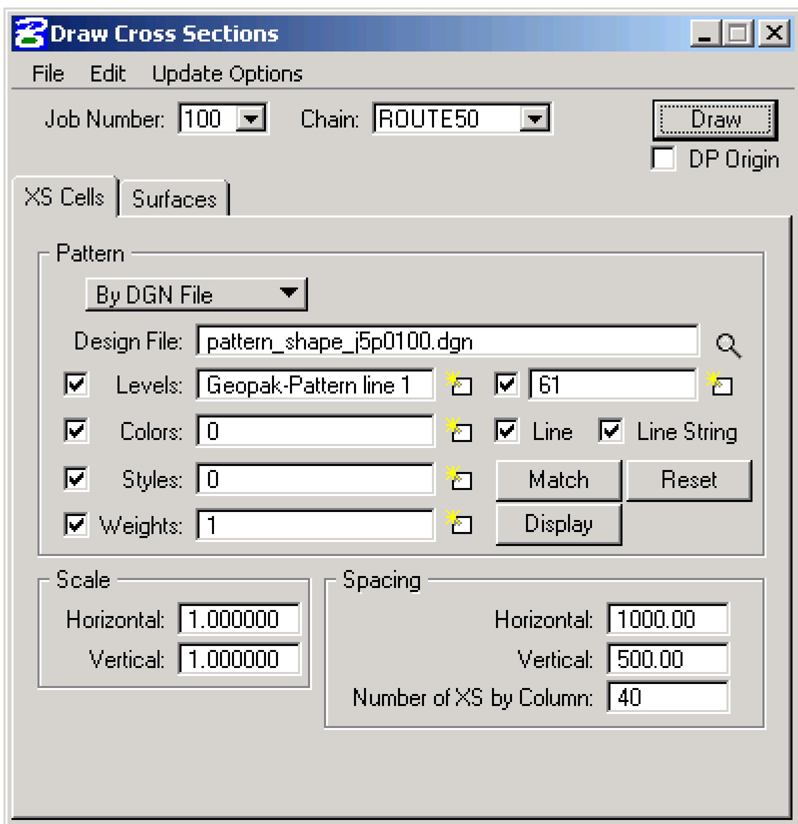
Copy the MoDOT run to **Route50** and enter that run.

11. Cut the existing ground cross sections with the following parameters in the top portion of the dialog:

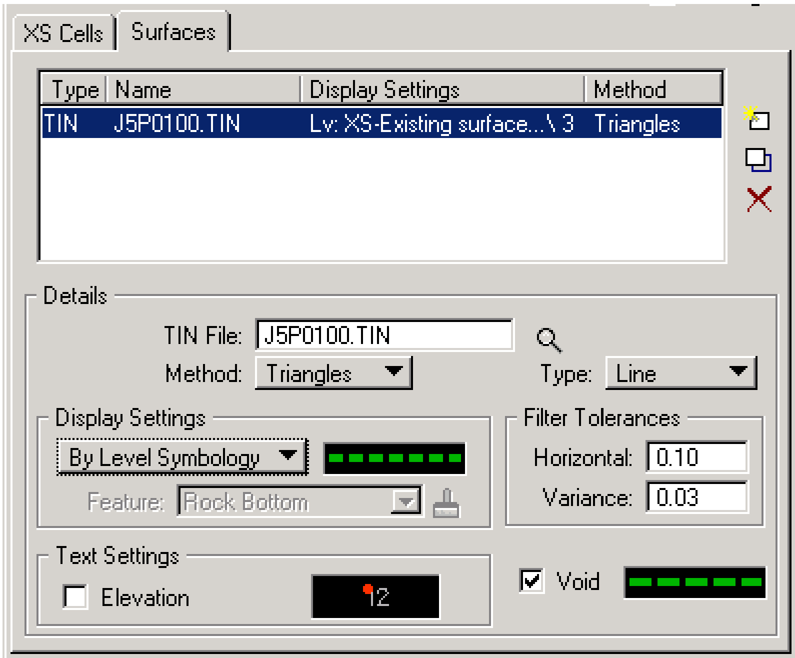
Job Number:	**100**
Chain:	**Route50**

In the **XS Cells** tab, set the following:

Pattern:	**By DGN File**
Design File:	**pattern_shape_50_j5p0100.dgn**



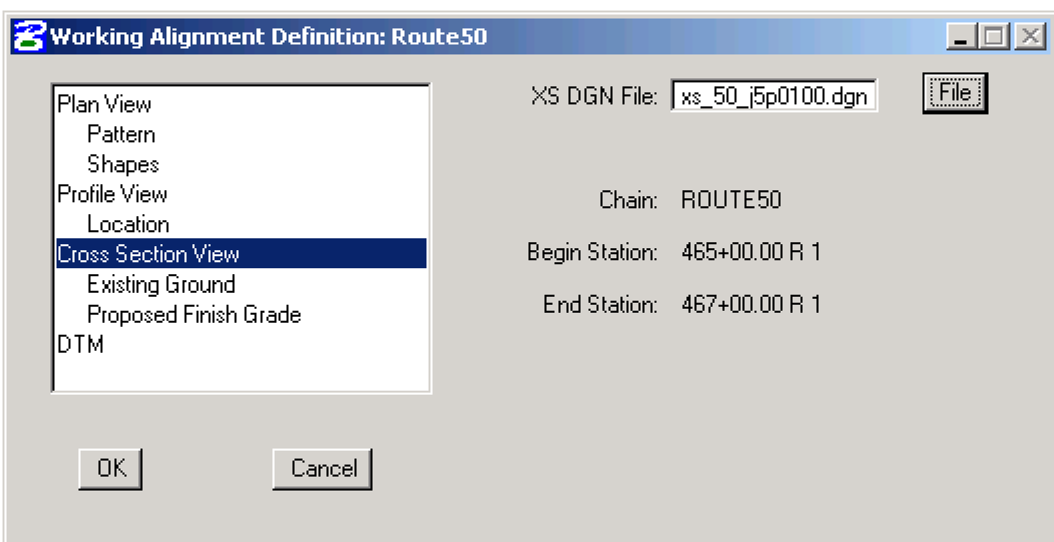
11. Continued
In the **Surfaces** tab, set the **TIN File** to **j5p0100.tin**.



Click on **Draw** to cut the cross sections.

12. Exist Draw Cross Sections and save the changes to the run and the MicroStation drawing **xs_50_j5p0100.dgn**.

13. In the **Cross Section View** section of the **Route50 Working Alignment Definition** set the **XS DGN File** to **xs_50_j5p0100.dgn**.



Exercise 13-2

This is a group exercise to demonstrate how stream cross sections can be plotted from both a digital terrain model (DTM) and the field surveyed survey chains. A previous exercise demonstrated how survey points are used to create a chain and a profile. This exercise plots the chains to indicate the location of the cross sections, creates cross sections at those locations from the DTM, and adds the surveyed profiles so a comparison can be made between the DTM and the field-surveyed data. A later exercise demonstrates how a report can be generated from this geometric information for import into HEC-RAS.

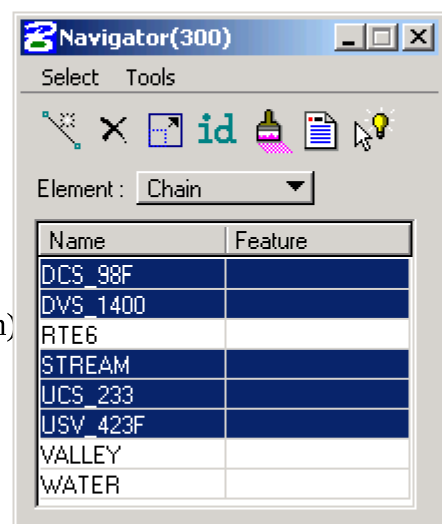
1. Open the MicroStation file:
   t:\br-proj\a_geopak\d2\j2p0300\data\pattern_shape_j2p0300.dgn.

   If it has not already been done, attach the following files as references:
   t:\br-proj\a_geopak\d2\j2p0300\data\plan_j2p0300.dgn.
   t:\br-proj\a_geopak\d2\j2p0300\data\topo_j2p0300.dgn.

2. Open the project **t:\br-proj\a_geopak\d2\j2p0300\project\j2p0300.prj** and enter it as **userc**.

3. Copy the J2P0300 working alignment to **Stream** and enter that working alignment.

4. **Enter Coordinate Geometry** (COGO). Set Visualization to and use the Permanent and use the COGO Navigator to **visualize the following chains**, which are highlighted in the figure to the right. To do this, set Element to Chain, highlight the desire elements, and click on the paintbrush (Visualize Element) icon.



   DCS_98F (Typical Channel Section 98' Downstream)
   DVS_1400 (Narrow Valley Section 1400' Downstream)
   STREAM (The Streambed)
   UCS_223 (Typical Channel Section 233' Upstream)
   USV_423F (Narrow Valley Section 423' Upstream)

   Close the navigator and COGO.

   The section of the RTE6 chain that corresponds to the Existing Channel section will be plotted later.

5. To make it easier to complete the rest of this exercise, turn off the display for the reference files.

6. A close inspection of the plots of the chains shows that lines are not straight, which means that locations surveyed weave back and forth. In fact, the upstream channel section actually doubles back in two placed near where it crosses the stream. Engineering judgment is needed to determine whether the chains and profiles should be used as submitted or recreated by eliminated some of the points. To do this, the chain and profile need to be restored using only the desired points. Exercise 5-4 gives information on how to store a chain and a profile from a set of points.

   For this exercise we will use the chains and profiles used as submitted with the Bridge Survey Report for the project. Great care must be used before modifying the survey information provided. If you question the data, the best option is to direct them to the District Contact, who can verify the information with the surveyor.

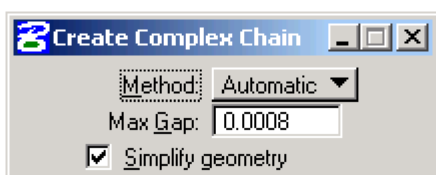
7. The pattern lines that are used to indicate the location of cross-sections need to be a single line or a line string running from the left to the right side of the alignment that connects the cross-sections together. For this case, the alignment chain is STREAM, which is the streambed as surveyed.

   Set the active MicroStation symbology to the following:

Lv Names	**Geopak-Pattern line 2**
Color	**0**
Line Style	**0**
Weight	**1**

   The lines visualized using COGO are just a series of lines. Use the MicroStation Create Complex Chain to covert the lines in to line strings. It is the highlighted tool in the Main MicroStation toolbox shown to the right.

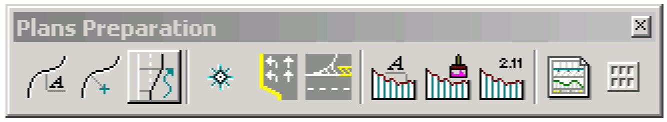
   In the **Create Complex Chain** tool, set the Method to **Automatic** and toggle on **Simplify geometry**, as shown below.

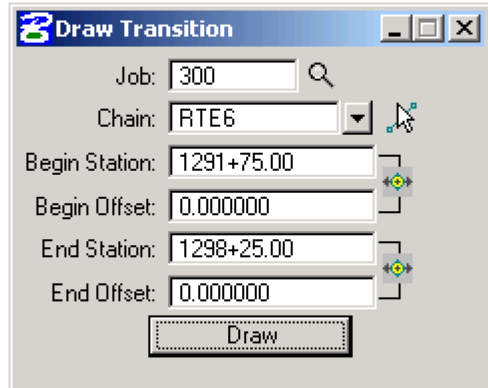


   With this tool active click on the left end of each of the section chain lines and data point twice to accept.

8. 

Since only a portion of the RTE6 chain needs to be plotted, use Draw Transition to plot the portion needed. It is the third icon in the raised tool pallet in the Road toolbox shown to the left. The expanded tool pallet is shown above an to the right:





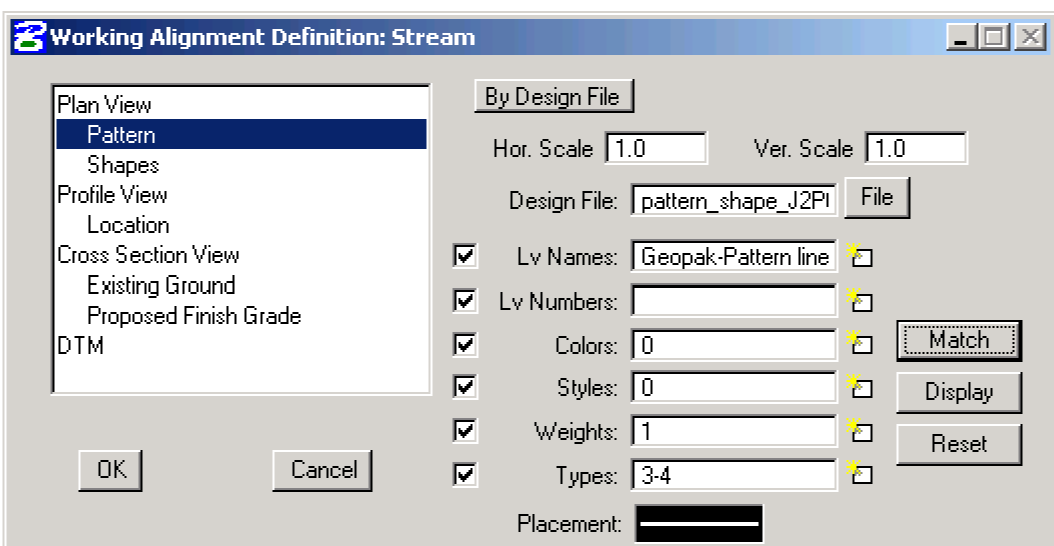
The existing channel section is plotted from RTE6 **Station 1291+75.00 to 12+98.25**. Use the same range when drawing the chain with a **beginning and ending offset of zero**, which indicates the location of the existing channel section in the drawing.

Set up the Draw Transition tool as shown to the right and click **Draw**.

9. Enter the Working Alignment Definition for **Stream** and change the following:

Section	Item	Value
Plan View	**Chain:**	**STREAM**
Pattern	**Design File:**	**pattern_shape_j2p0300.dgn**
	Lv Names	**Geopak-Pattern line 2**
	Weights	**1**
	Colors	**0**

The easiest way to set Pattern search symbology is to use the Match feature. To use it, click on the **Reset** button to clear the symbology settings, click on the **Match** button, **data point on one of the pattern lines** (the line is highlighted), and **data point again to accept** the line. The completed dialog of the Pattern section is shown below.

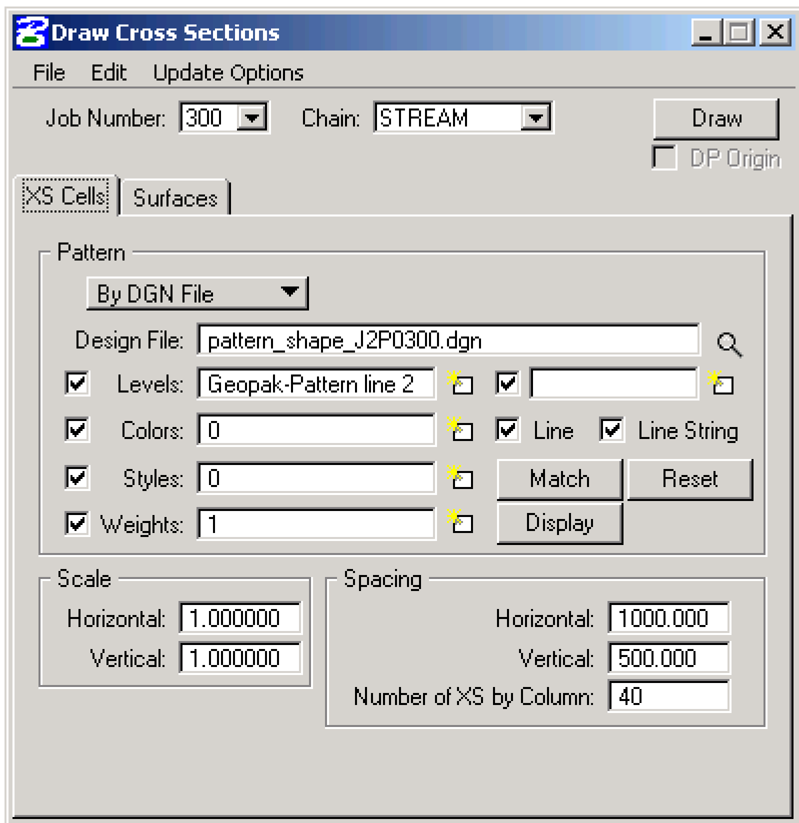


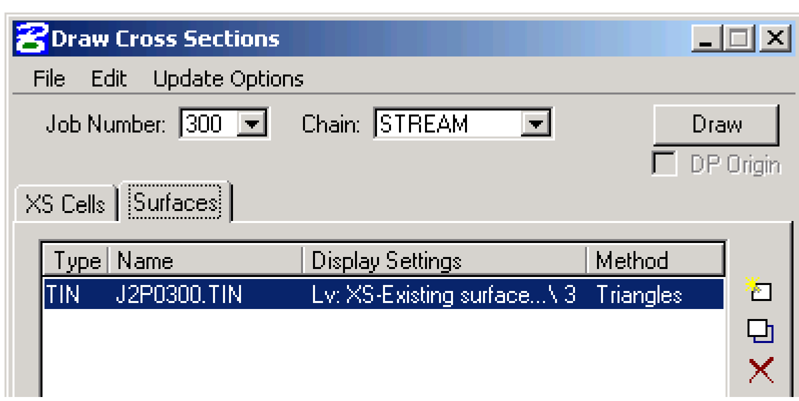
Make sure you get **line types 3-4**. Click **OK** to accept the changes.

10. Save changes to the current MicroStation file and open the following drawing:
t:\br-proj\a_geopak\d2\j2p0300\data\xs_stream_j2p0300.dgn.

11. Choose **Existing Ground Cross Sections** from the **Project Manager** dialog.

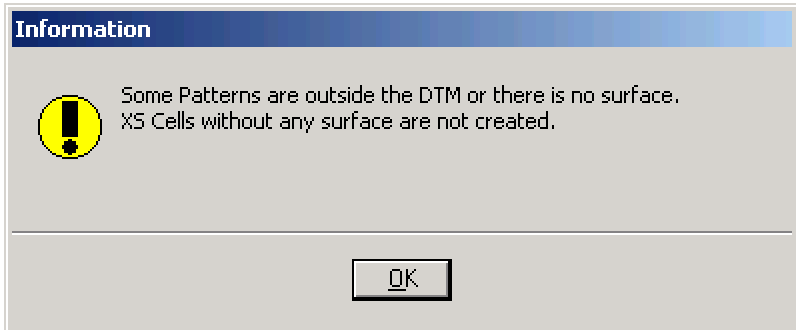
Copy the **MoDOT** run to **Stream** and enter that run. Set the **XS Cells tab** as shown below and have the **J2P0300.TIN** as the only one listed under the **Surfaces tab**.





Select **Draw** to generate the sections. **Save** the MicroStation file. Exit the run and save settings

12. When you click on Draw you should have gotten the following dialog:



This dialog appears because the downstream narrow valley section is outside of the TIN model. Before plotting this profile, a cell needs to be drawn to for that pattern line.

Open the Draw Cross Section Cells tool. It is fifth (5th) icon from the right in the Cross Section tool pallet, which is shown below. The Cross Section tool are located in the lower left hand corner of the Road tools.

Enter the following settings in the Draw XS Cell tool, as shown to the right:

Top Section

Method **Semi_Auto**
Job Number **300**
Chain **STREAM**
Horizontal Scale **1.00** LT **1283.362**
Vertical Scale **1.00** RT **1185.859**

Station Section

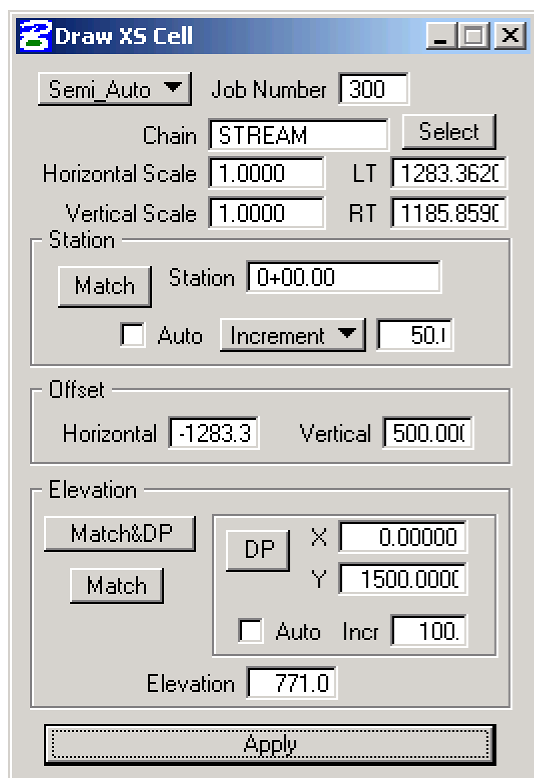
Station **0+00.00**
Auto **Off**

Offset Section

Offset Horizontal **-1283.362**
Offset Vertical **500**

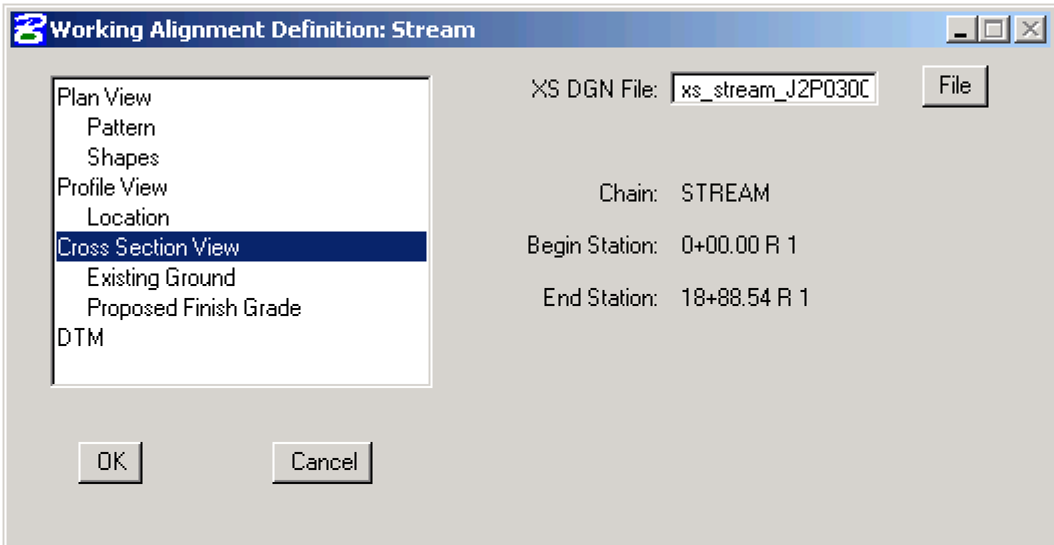
Elevation Section (DP is left end of top cell)

DP X **0.00**
DP Y **1500**
Auto **Off**
Elevation **771**



Click **Apply** to draw the cell.

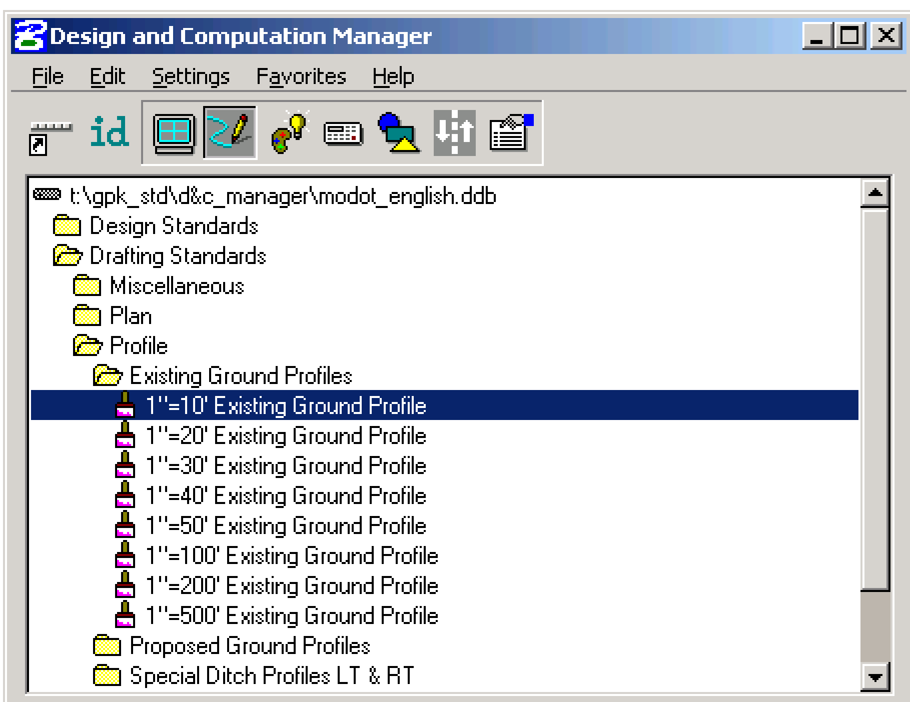
13. Set **xs_stream_j2p0300.dgn** as the **XS DGN** in the Cross Section View section of the Water **Working Alignment Definition** as shown below.



14. The final step is to draw the survey profiles for each of the sections.

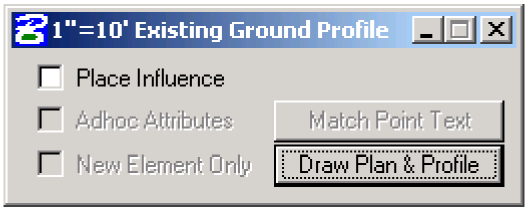
Open **D & C Manager** and navigate to the following item:

Drafting Standard \ Profile \ 1"=10' Existing Ground Profile as shown below.



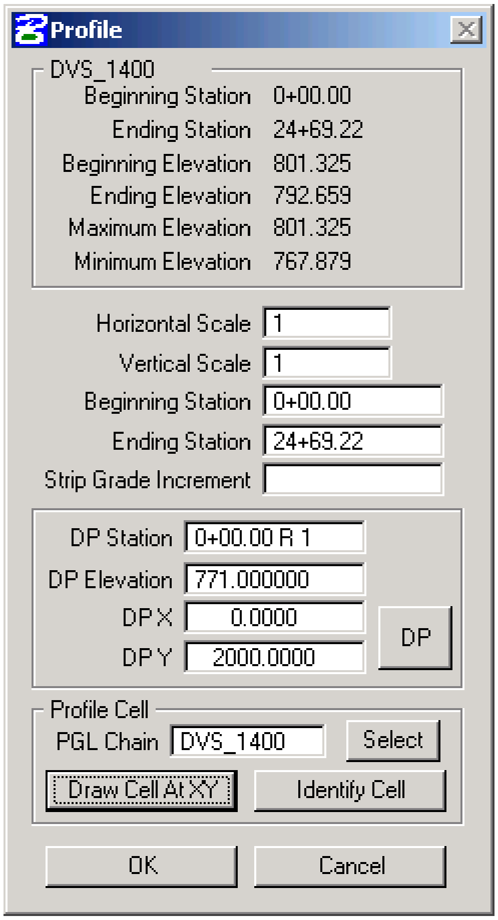
(Step 14 continued)

Click on **Draw Plan & Profile** in the operations box shown below.



This will bring up the following dialog. Since only the line and no text is being plotted the setting of the label scale does not matter.

Since the sections will be plotted from top to bottom, select the profile **DVS_1400**. Set up the Profile dialog as shown below.



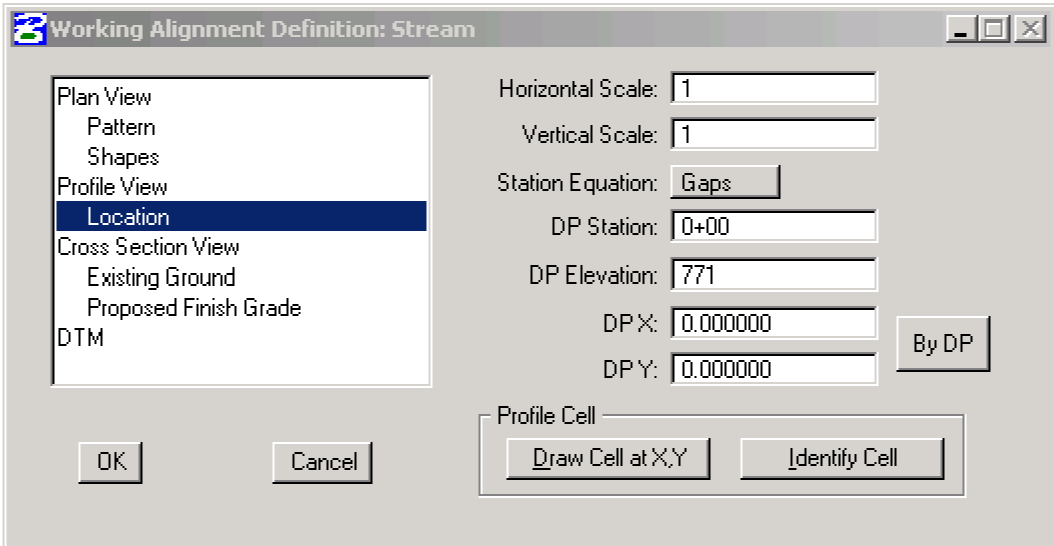
The **DP** point is the left edge of the top most cross section cell (Station 0+00).

Click on **Draw Cell At XY** to place a profile cell.

Click on **OK** to draw the profile.

(Step 14 continued)

To make the placement of the rest of the profiles easier, open the Working Alignment Definition dialog and go to the Profile View / Location section. Set it up as shown below

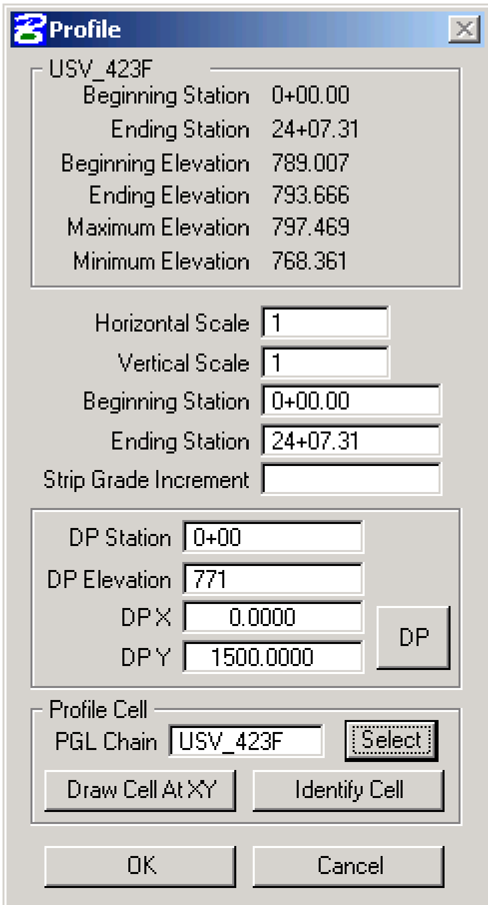


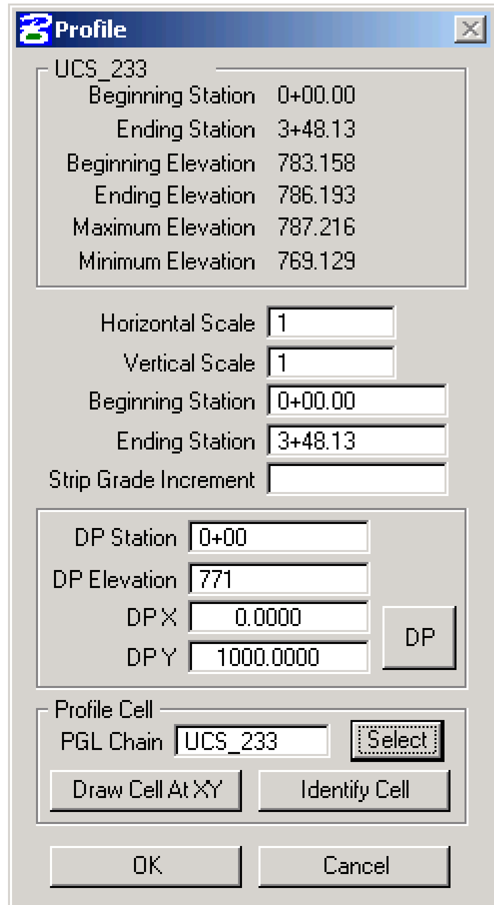
Click **OK** to save the changes.

(Step 14 continued)

The second from the top XS cell (Station 18+88.54) is for the upstream narrow valley section.

Select the profile **USV_423F**. Set up the Profile dialog as shown below on the left.





Click on **Draw Cell At XY** to place a profile cell.

Click on **OK** to draw the profile.

Repeat the process for the third XS cell (Station 16+68.42), which is for the upstream channel section.

Select the profile **UCS_233**. Set up the Profile dialog as shown above and on the right.

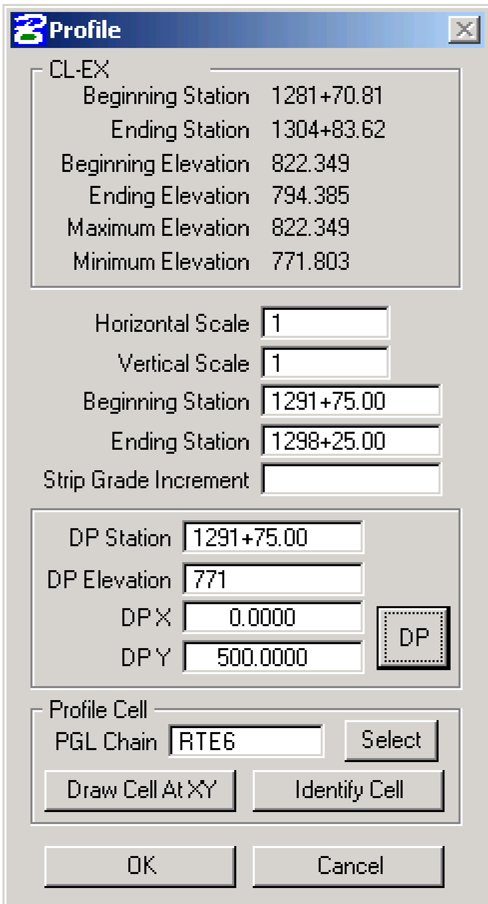
Click on **Draw Cell At XY** to place a profile cell.

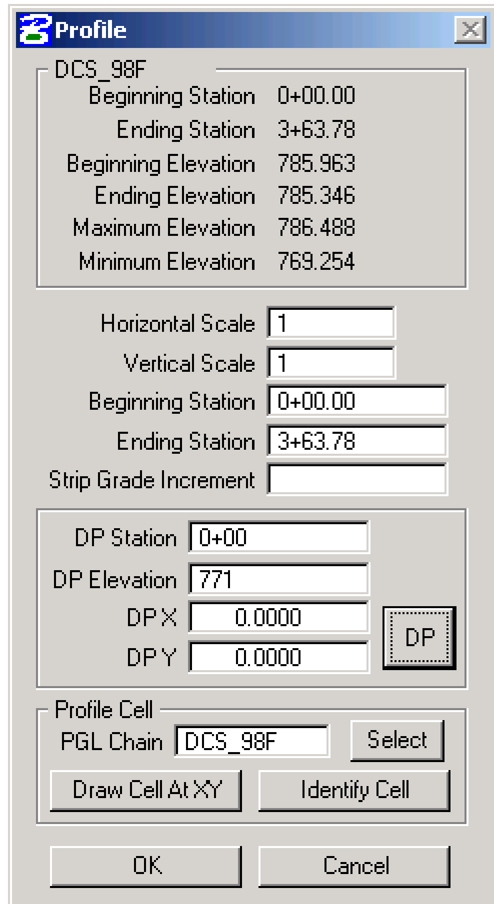
Click on **OK** to draw the profile.

(Step 14 continued)

The forth XS cell (Station 14+36.88) is for the existing channel section.

Select the profile **CL-EX**. Since the pattern line was not created for the whole profile, limit the plot of profile to **Stations 1291+75 to 1298+25** set the rest of the Profile dialog as shown below on the left.





Click on **Draw Cell At XY** to place a profile cell.

Click on **OK** to draw the profile.

Repeat the process for the bottom XS cell (Station 13+41.50), which is for the downstream channel section.

Select the profile **DCS_98F**. Set up the Profile dialog as shown above and on the right.

Click on **Draw Cell At XY** to place a profile cell.

Click on **OK** to draw the profile.

Close D&C Manager and **save** the changes to the MicroStation drawing.

Chapter 14

Superelevation

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14.1 Objectives

- Learn how GEOPAK defines a roadway slope.
- Learn to use GEOPAK **Auto Shape Maker** and **Graphics Shape Maker** to apply superelevation to a roadway.

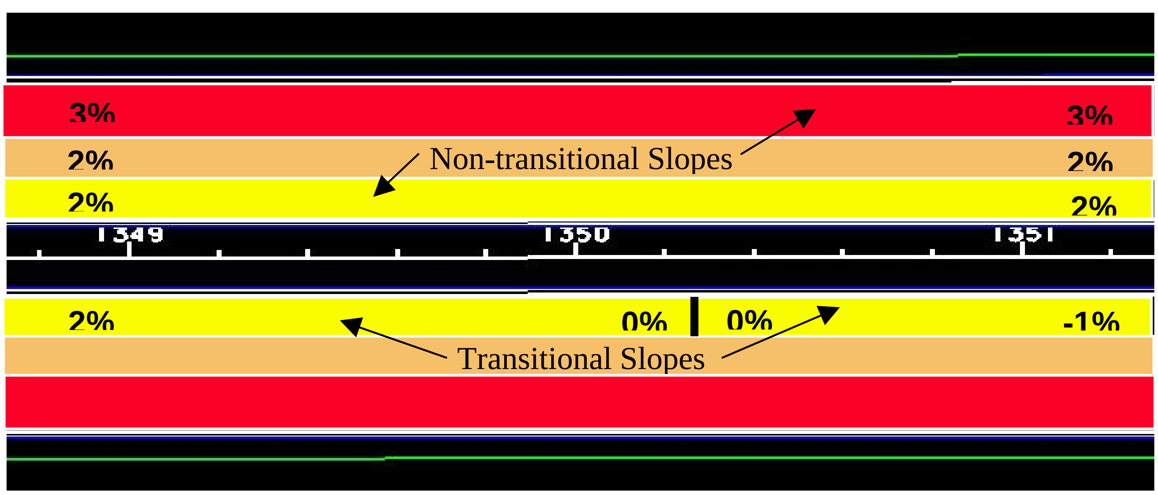
14.2 Definitions

GEOPAK uses two tools to calculate superelevation transition locations for any chain stored in the coordinate geometry database. One tool results in an ASCII file that lists the stations and slopes for each superelevation transition break. Microstation shapes represent the roadway crown and depict the superelevation transition breaks. GEOPAK Superelevation uses the following tools for shape creation.

- **Auto Shape Maker -** is a tool used to create an input file for applying superelevation transition locations along a specified alignment. Using this tool will result in an ASCII file that lists the stations and slopes for each superelevation transition break. This file is then processed to draw the shapes into the Microstation drawing.
- **Graphics Shape Maker** permits interactive creation of superelevation shapes defined by graphic elements drawn in a Microstation file.

14.2.1 Shapes

Shapes are Microstation complex shapes that are placed into a design file to represent an area of pavement slope. **Non-transitional** shapes have a constant slope for the entire length of the shape. **Transitional** shapes have a different slope at each end of the shape, and will either linearly or parabolically interpolate between the slopes.



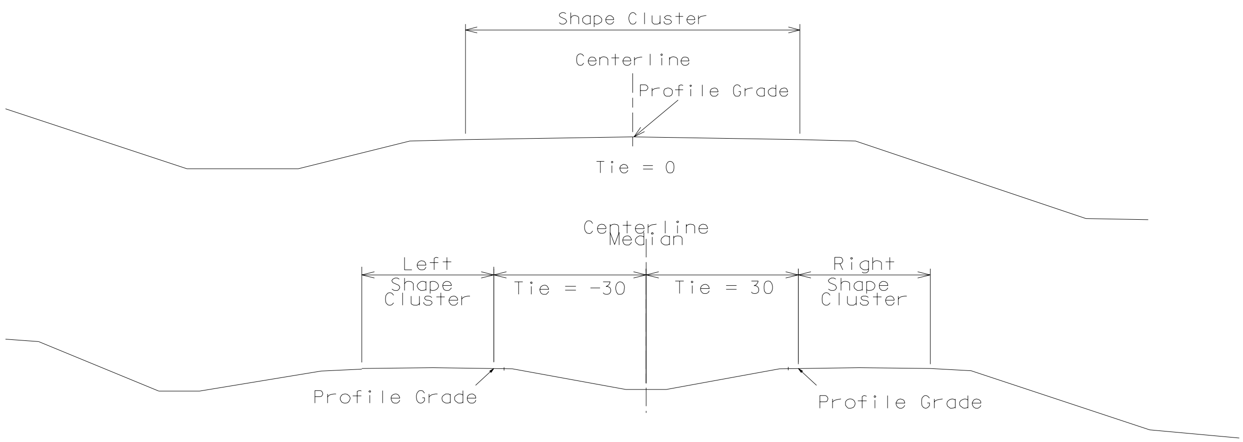
14.2.2 Shape Clusters

Four attributes are associated with each shape depending on the definition of the profile grade line.

Baseline – roadway baseline

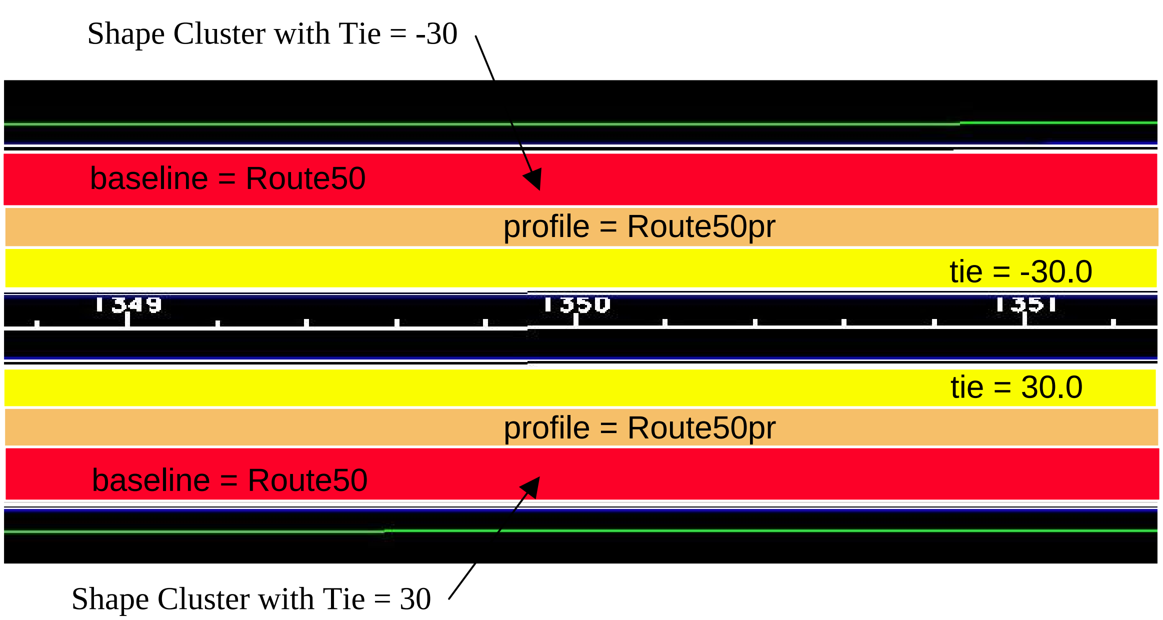
Profile – roadway profile

Tie – distance between the roadway baseline and roadway profile



PGL-Chain – (optional) defines the location of the profile if the distance between the baseline and profile is not constant. (If the distance is constant the tie distance can be used.)

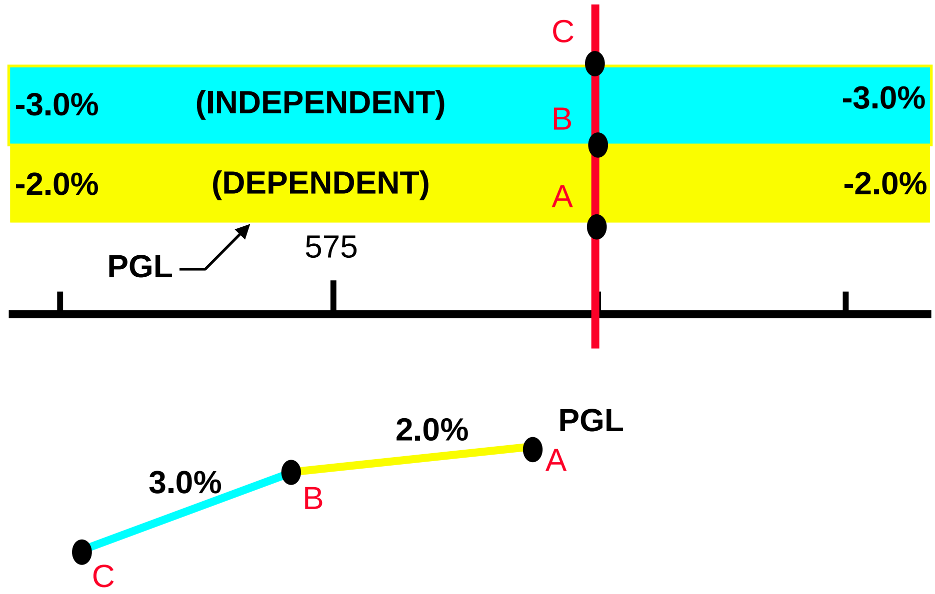
A group of shapes with the same shape attributes is called a "Shape Cluster".



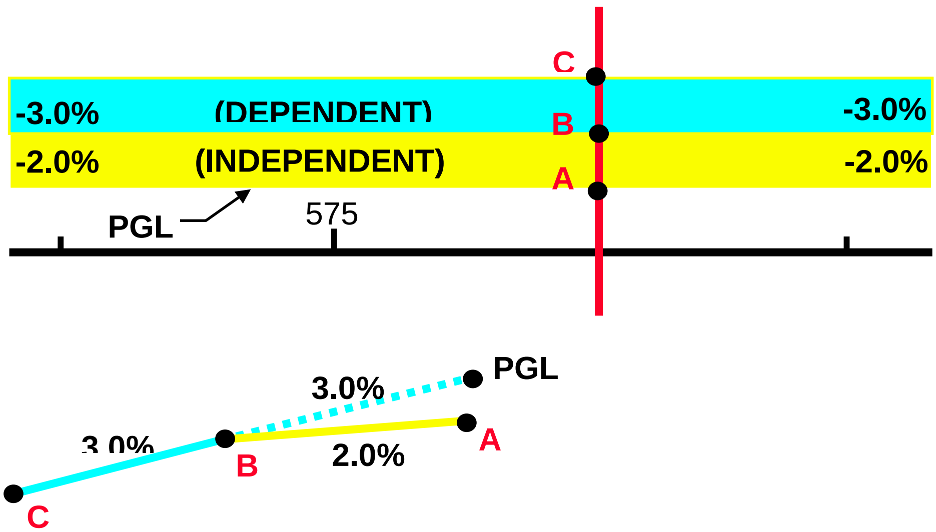
14.2.3 Shape Class

There are two classifications of shapes, **Dependent** and **Independent,** which determine how the pavement elevations are computed. **Dependent** shape pavement elevations are determined directly from the profile. **Independent** shape pavement elevations are determined from adjacent shapes.

The figure below shows the dependent shape adjacent to the profile grade line (PGL). Therefore, the elevation of the shape at point A will be the elevation of the profile at point A. The elevation of the shape at point B will be calculated based on the width and slope of the dependent shape. This will be the starting elevation for the independent shape. The elevation of point C will be calculated based on the width and slope of the independent shape.



The figure below shows the independent and dependent shape reversed from the figure above. In this case, the independent shape is located next to the PGL. The starting elevation of the dependent shape, point B, is calculated based on the slope of the dependent shape and the



distance between the dependent shape and the profile. The end of the dependent shape, point C, is calculated based on the width and slope of the dependent shape. The end point of the independent shape, point B, is at the same elevation as the dependent shape at that point, and the beginning of the independent shape, point A, is calculated based on the width and the slope of the independent shape.

It is good practice to use one dependent shape for each shape cluster.

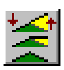
14.2.4 Shape Elements

Shapes consist of a series of connected Microstation elements that form a closed surface. The types of elements can be classified into two types, **longitudinal edges**, and **filler lines**.

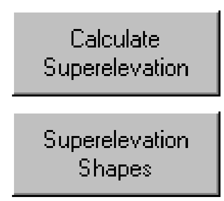
Longitudinal Edges - Typically, these consist of the roadway edges of pavement or lane lines. These lines do not represent slopes.

Filler Lines - These lines represent the beginning and ending slopes of a pavement shape. Each of these lines always represents a slope value.

14.3 Accessing



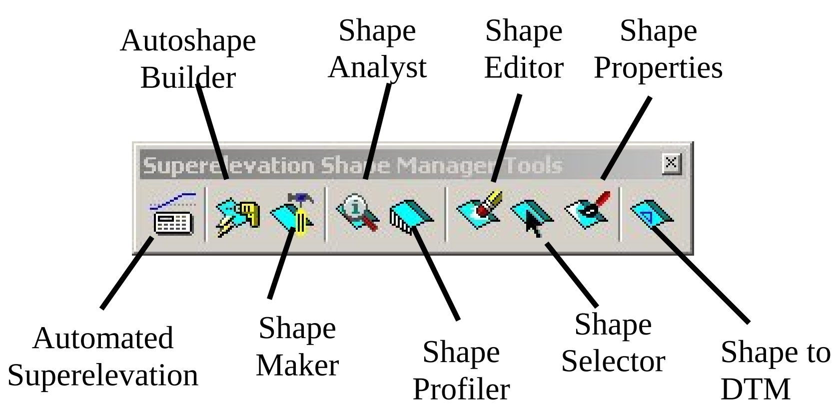
The superelevation tools can be accessed from the cross section toolbox by choosing the **Superelevation Shape Manager** tool. When selected, the superelevation toolbox will be displayed.



The Automated Superelevation can also be accessed from **Project Manager >> Calculate Superelevation**, and the **Shape Maker** can also be accessed from **Project Manager >> Superelevation Shapes**.

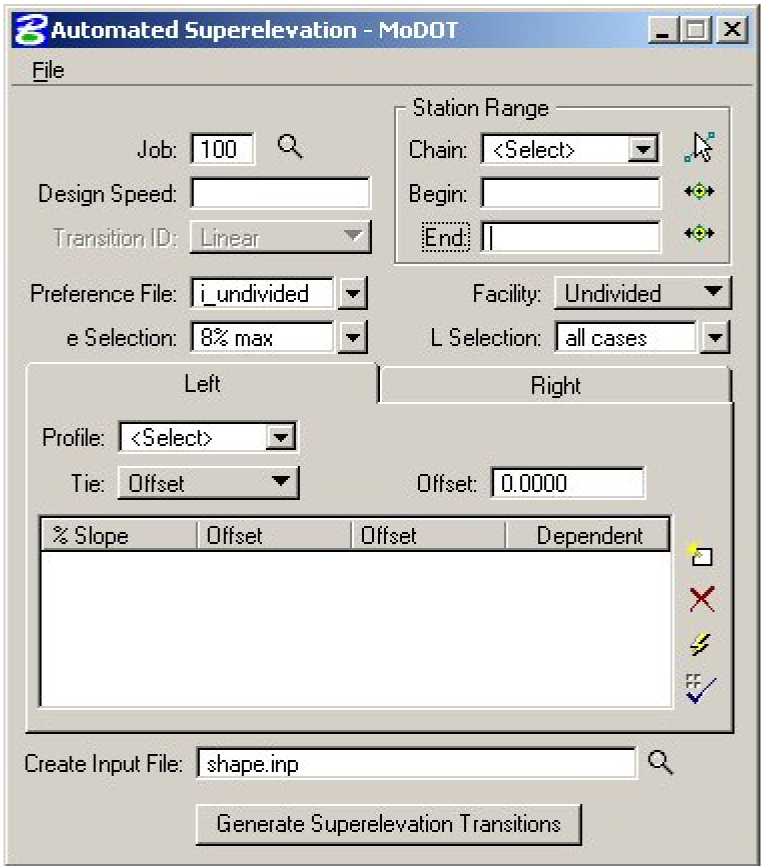
14.4 Dialog

The superelevation toolbox is shown below.



14.4.1 Automated Superelevation

The **Automated Superelevation** dialog is the dialog most commonly used to create superelevation. It allows the user to specify the parameters needed for superelevation, and then creates an input file the user can modify according to the specific design for the project. When the **Automated Superelevation** icon is chosen, the following dialog will appear.



If project manager is used, the **Job Number**, **Chain**, and **Begin** and **End** stations will be filled in using the current **Working Alignment**. The user can specify the design information as follows.

Job – Job number of the .gpk file for the project.

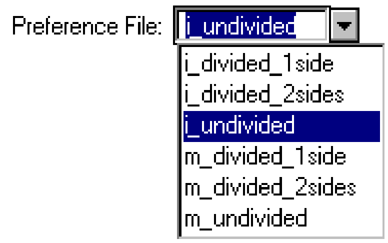
Chain – Baseline chain name for the project. This may be the centerline of roadway for an undivided roadway, the centerline of median for a divided roadway, or the edge of pavement for a ramp.

Begin – station to begin the shapes.

End – station to end shapes.

Design Speed - the design speed for the project that determines the rate of superelevation for curves.

Preference File – the file to use in calculating the superelevation rates and transition stations. The user should choose the preference file according to the standard plan being used for superelevation calculations.



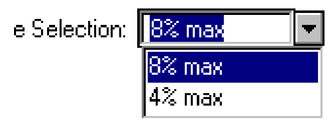
i_divided_1side – imperial, divided roadway, using standard 203.21G, when calculating only 1 side of the median.

i_undivided – imperial, undivided roadway, using standard 203.20E

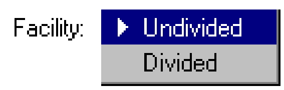
m_divided_1side – metric, divided roadway, using standard M203.21G, when calculating only 1 side of the median

m_undivided – metric, undivided roadway, using standard M203.20E

e Selection – the maximum superelevation value to be used for the alignment. Select **8% max** for rural projects and **4% max** for urban projects.



Facilitiy – set according to if the roadway is Undivided or Divided

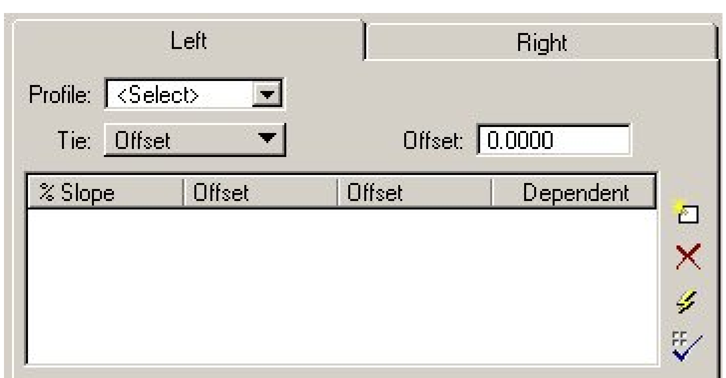


L Selection – this should be set to **All Cases** for all situations.

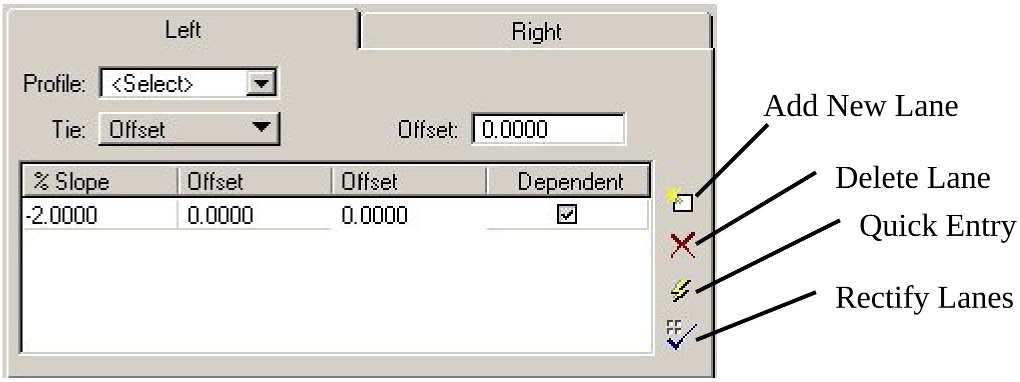
Profile – choose the profile for the left and right sides. For undivided roadways, the left and right profiles should be the same. For divided roadways, the left and right profiles may or may not be the same.

Tie/PGL Chain – set to either **Tie** or **PGL Chain**. The tie distance is the distance between the baseline and the profile. If this distance is variable, a PGL chain can be used to define the location of the profile.

The **% Slope**, **Offset**, and **Dependency** field define the shape characteristics.



Shapes can be added by selecting the **Add New Lane** button . Once the add button has been selected the following dialog appears



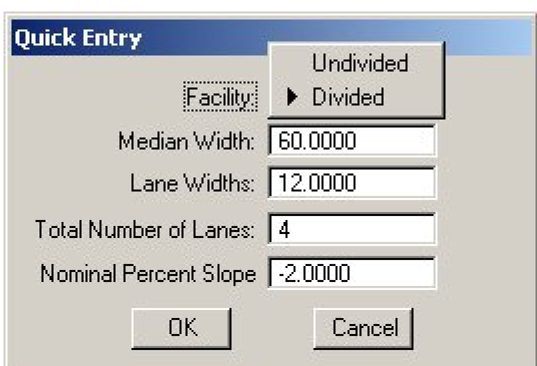
To specify the **% Slope, offsets, and dependency**, double click in the **% Slope, Offset and Dependent cells** for each row and type in the desired value. Once listed, the shapes can be deleted , or modified by re-entering the values in the cells.

% Slope – define as the normal slope for this section of roadway.

Offset – define one **Offset** as the distance between the baseline and the inside edge of the shape, and the other as the distance between the baseline and the outside edge of the shape.

Dependency – defines whether the shapes elevation is determined by the profile, or by the adjacent shapes. **Dependent** shapes obtain the elevation from the profile and the slope of the shape as discussed in section 14.2. **Independent** shapes obtain the elevation from adjacent shapes. Check the toggle to set a **Dependent** shape or leave unchecked for an **Independent** shape.

Create Input File – specifies the name o the shape input file to be created that creates the shape information. This file needs to be run to plot the shapes into the Microstation drawing.



The **Quick Entry** button  will bring up the **Quick Entry** dialog. This dialog can be used to create shapes without calculating the required offsets for multiple lanes. The user chooses the type of **Facility** as divided or undivided. If divided is chosen, the **Median Width** can be specified. The **Lane Widths**, **Total Number of Lanes**, and the **Nominal Percent Slope** are specified. When the dialog has been completed, the **OK** button is pressed, and the number of lanes and their corresponding offsets are automatically entered into the shape cluster list boxes.

When the **Automated Superelevation** dialog has been completed, the user presses the **Generate Superelevation Transitions** button. This will create the input file specified in the **Create Input Field** dialog.

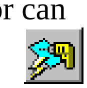
14.4.2 Superelevation Input File

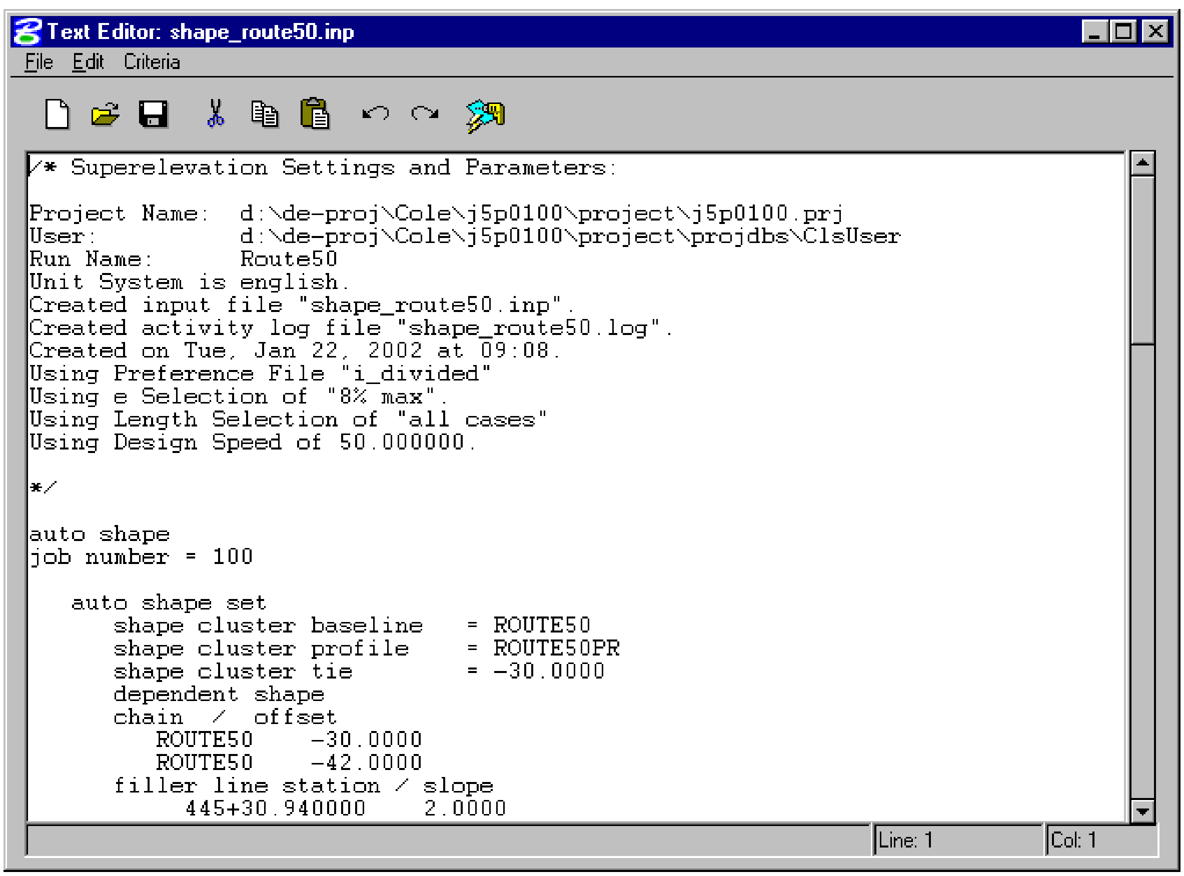
A **Superelevation Input File** with an .inp extension is created and placed in the project directory. This input file shows where the location superelevation critical points by indicating the station and slope along the roadway. This is an ASCII file that may be reviewed and/or edited. A sample input file is provided below.

```
/* Superelevation Settings and Parameters:
Project Name:  T:\de-proj\Cole\j5p0100\project\j5p0100.prj
User:          T:\de-proj\Cole\j5p0100\project\projdbs\ClsUser
Run Name:      BigHorn
Unit System is english.
Created input file "shape_BigHorn.inp".
Created activity log file "shape_BigHorn.log".
Created on Tue, Oct 05, 2004 at 15:19.
Using Preference File "i_undivided"
Using e Selection of "8% max".
Using Length Selection of "all cases"
Using Design Speed of 30.000000.
*/

auto shape
job number = 100

  auto shape set
    shape cluster baseline   = BIGHORN
    shape cluster profile    = BIGHORNPR
    shape cluster tie        = 0.0000
    dependent shape
    chain  /  offset
      BIGHORN    -12.0000
      BIGHORN    0.0000
    filler line station / slope
          0+97.770000   -3.1250
         21+52.700000   -3.1250

  auto shape set
    shape cluster baseline   = BIGHORN
    shape cluster profile    = BIGHORNPR
    shape cluster tie        = 0.0000
    independent shape
    chain  /  offset
      BIGHORN    0.0000
      BIGHORN    12.0000
    filler line station / slope
```

0+97.770000 -3.1250
21+52.700000 -3.1250
Plot Parameters
Dependent Shape
lvname = Geopak-Shapes 2
co = 2
lc = 0
wt = 2
Dependent Text
lvname = Geopak-Shapes 2
co = 2
Independent Shape
lvname = Geopak-Shapes 2
co = 7
lc = 0
wt = 2
Independent Text
lvname = Geopak-Shapes 2
co = 7

Write shapes into dgn = T:\de-proj\Cole\j5p0100\data\BH_pattern_shape_j5p0100.dgn

The input file is also opened into the Geopak text editor. The input file can be edited in the text editor. Once any changes have been made, and the input file has been saved, the text editor can be used to process the input file by clicking on the **Create Superelevation Shapes** button. 



14.4.3 Superelevation Log File

When the **Superelevation Input File** is created, the **Superelevation Log File** is also created. The **Superelevation Log File** contains information pertaining to the creation of the input file. A sample log file is shown below.

Beginning calculation of superelevation for chain ROUTE50 in job 100.

Computing superelevation rates . . .
Curve ROUTE50-1, radius 2864.7890: Superelevation rate computes to be 3.8000.

Computing transition lengths . . .
Note: Because the roadway width consists of 4 lanes,
lengths are to be adjusted after initial calculation.
Curve ROUTE50-1: Super rate of 3.8000 yields
unadjusted runoff length of 150.0000.
Transition Length adjusted to 150.0000 for 4 lanes.

Checking for transition conflicts . . .
No transition conflicts were found.

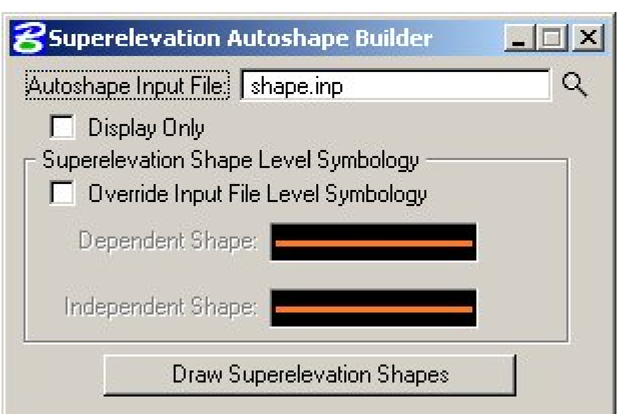
Superelevation Calculation Complete.
Output written to file "shape.inp"

The log file indicates the superelevation rate computed for each curve, the transition length for each curve, and any transition conflicts between curves.

The **Superelevation Log File** should be reviewed prior to the processing of the input file to check for errors, and verify any transition conflict resolutions.

14.4.4 Autoshape Builder

After the input file has been created and edited, it needs to be processed to plot the shapes into the Microstation design file. The input file can be processed by using the **Create Superelevation Shapes** button in the text editor, or by using the **Autoshape Builder**. The **Autoshape Builder** can be accessed from the Superelevation toolbox.  The following dialog will appear.



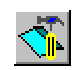
The user selects the **Autoshape Input File** to process and then press the **Draw Superelevation Shapes** button to process. The shapes will be placed with the level symbology that was specified in the input file. However, if the user desires to place the shapes with different level symbology**,** then the **Override Input File Level Symbology** to set the desired parameters. The **Display Only** toggle can be turned on to temporarily plot the shapes into the Microstation design file. When the view is updated, the temporary graphics will be deleted.

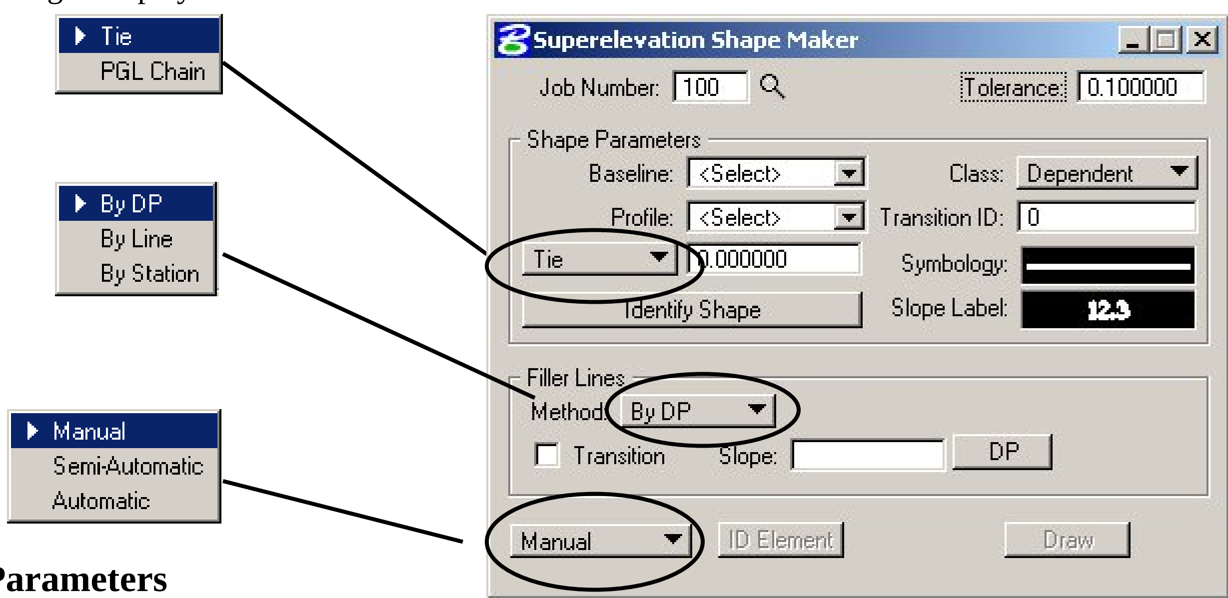
14.5 Shape Maker

Not all superelevation transitions can be defined by station and offset. GEOPAK provides the **Graphical Shape Maker** for situations that involve **left turn lanes**, **merging roadways** and in some cases, **widening**.

The user uses simple Microstation elements to depict the area to which superelevation is applied. Once the area is drawn, the **Graphical Shape Maker** dialog box allows the designer to define the roadway information to apply superelevation. The Microstation elements are then identified and a complex shape representing the superelevation is created.

Access Shape Maker from the GEOPAK Project Manager by selecting **Superelevation Shapes** or from the **Shape Maker** icon in the **Superelevation** toolbox. The following dialog is displayed.





Parameters

Baseline - chain corresponding to the shape.

Profile - profile controlling shape.

Tie - distance between the profile and the baseline.

PGL Chain - chain to define the profile location if the tie distance varies.

Class - dependent or independent, as previously discussed

Transition ID - determines linear or parabolic transition. Use 0 for linear transition.

Symbology - Microstation level symbology used for placing the shape.

Slope Label – Sets level symbology to be used for plotting slope labels.

Identify Shape – Displays the parameters of the selected shape utilizing the sequence of operations listed below:

1. Click **Identify Shape**.
2. Identify and accept a previously defined shape with a data point cursor button.
3. The **Baseline**, **Profile**, **PGL Chain**, **Trans ID**, and **Tie** parameters associated with the shape are displayed on the Shape Maker Window and become active parameters.

Filler Lines

Method: **By DP -** identify filler line by issuing a data point (DP) on each end of the line

By Line - identify filler line by selecting a Microstation line

By Station - identify filler line by keying in station limits

Transition: This option determines whether GEOPAK creates the shapes as a transitional or non-transitional shapes. When the toggle is turned off, a non-transitional shape is drawn. When toggled on, a transitional shape is drawn using the slope specified in the **Slope** field.

Transitional - shape is in a superelevation transition
Non-Transition - shape is not in a superelevation transition (full super or normal crown).

Slope: Cross slope for the filler line at the beginning and end of the shape

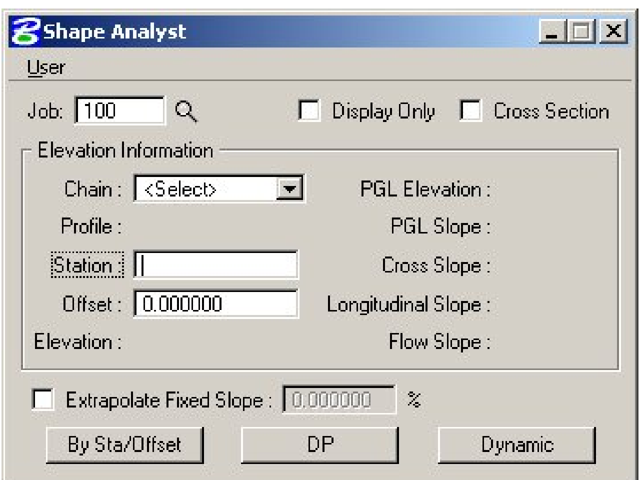
Complete Shape: **Manual -** user identifies each element that makes up the shape.
Semi-Automatic - user *accepts* or *rejects* elements that make up the shape.
Automatic - GEOPAK uses all contiguous elements to create the shape.

Tolerance: User specified acceptable maximum gap between the MicroStation elements that make up the shape.

14.6 Additional Superelevation Tools

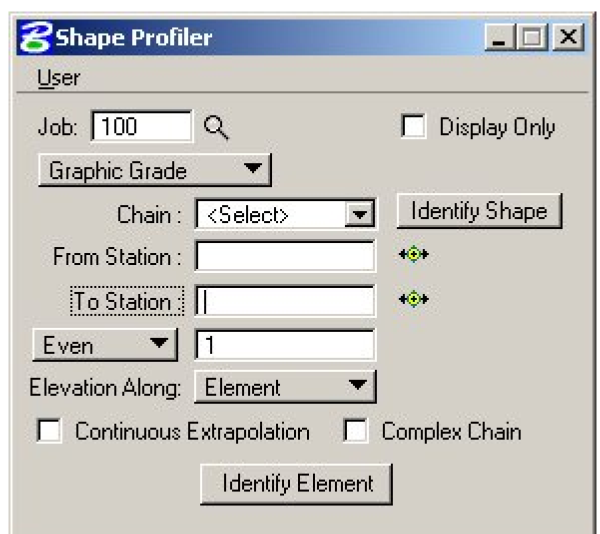
14.6.1 Shape Analyst

The **Shape Analyst** is used to determine the slope of a shape at a particular point. The elevation, profile elevation and slope, cross slope, longitudinal slope, and flow slow are computed and displayed. The elevation can be computed off the shape by using an **Extrapolated Slope** from the edge of the shape. The **Cross Section** option will display the slope of each shape, and the elevation at the edge of each shape.



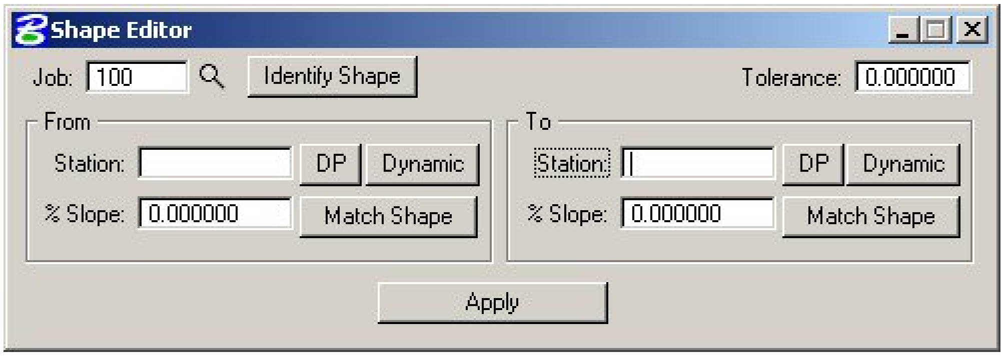
14.6.2 Shape Profiler

The **Shape Profiler** is used to graphically draw the elevations and/or slope arrows into the design file for a specified element or shape. COGO points can also be stored at the given locations.



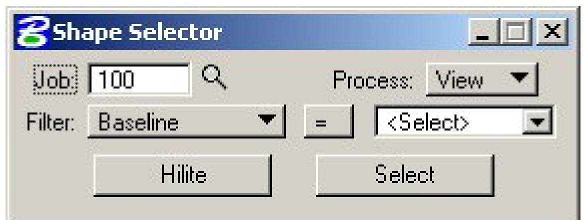
14.6.3 Shape Editor

The user can edit the plotted shapes by using the **Shape Editor**. The Shape Editor allows the user to adjust the slope of the filler lines, or change the location of the filler lines. The filler lines of the adjacent shapes are also adjusted as needed.



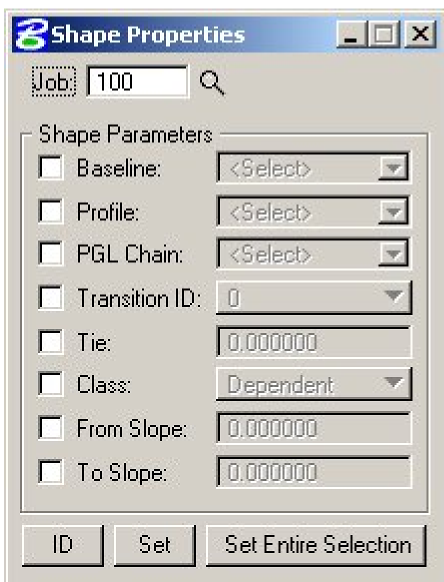
14.6.4 Shape Selector

The **Shape Selector** allows the user to select or highlight shapes based on various attributes of the shape. The attributes include baseline, profile, tie, transition type, class, slope, etc.



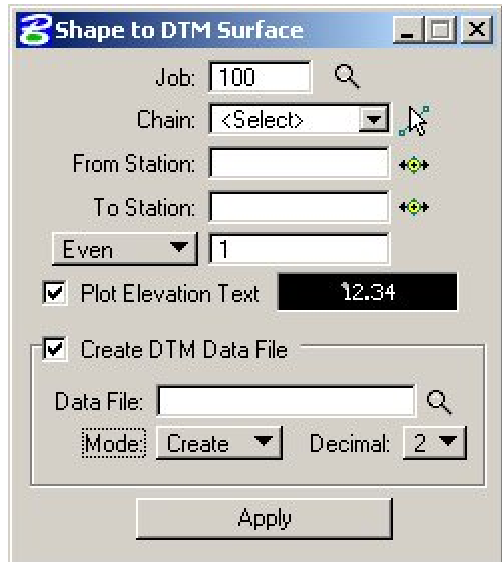
14.6.5 Shape Properties

The properties of a shape can be edited using the **Shape Properties** tool. With **Shape Properties**, a user can change the baseline, profile, tie, etc. of a shape.



14.6.6 Shape to DTM Surface

The **Shape to DTM Surface** tool allows the user to create a data file from the plotted shapes. This data file can then be used to create a TIN model based on the elevations calculated from the plotted shapes. The user has the option to calculate the Digital Terrrain Model (DTM) data file for the entire chain or for a specific station range.

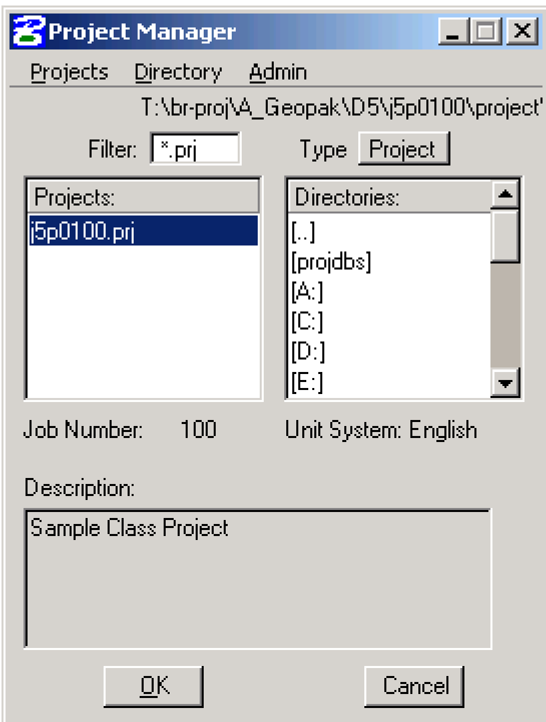


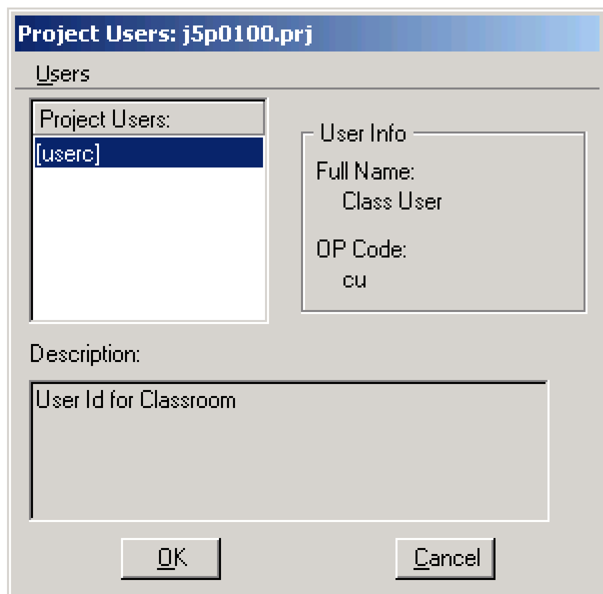
Exercise 14-1

This is a group exercise to create superelevation shapes to be used to determine the layout length of a superelevated curved bridge. These shapes represent 3D surfaces. Sets of shapes are created to model (1) the bridge deck surface; (2) the surface of the road under the bridge; (3) the bridge fill slopes; and (4) a plan below the bridge to define the top limit of the fill slopes.

1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\pattern_shape_j5p0100.dgn**.

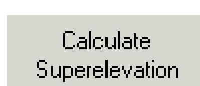
2. Open the project **t:\br-proj\a_geopak\d5\j5p0100\project\j5p0100.prj** as user **userc**.





3. Select the **Route50** working alignment.

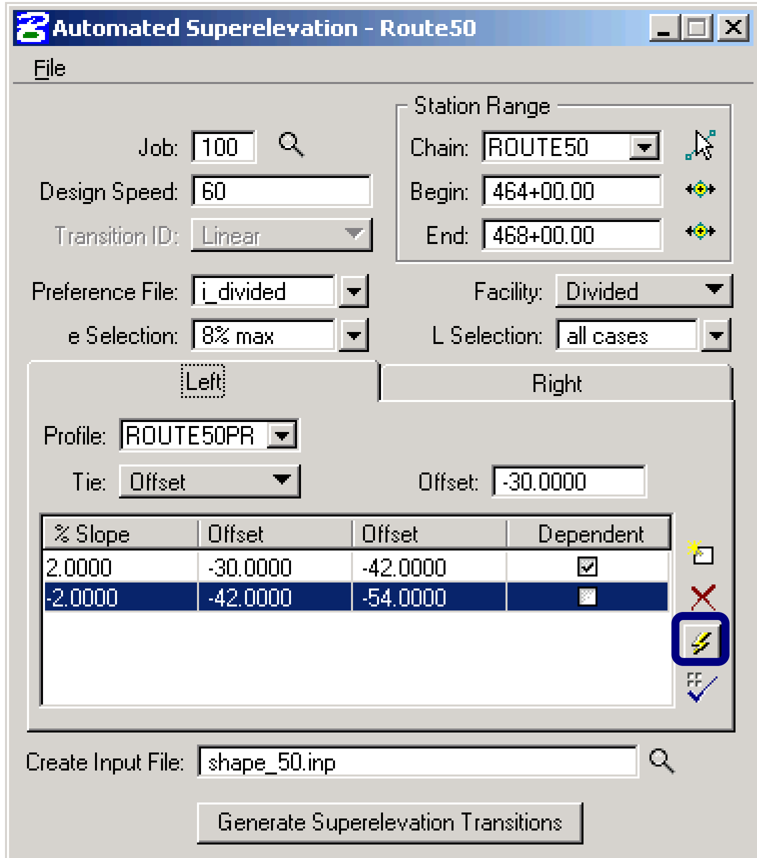
4. Choose **Calculate Superelevation** from the **Road Project** dialog to calculate the pavement cross slopes.



Copy the **MoDOT** run to **Route50** and enter the run.

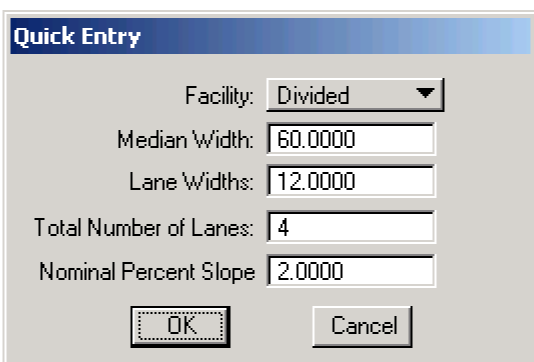
5. Create the Route50 shapes as follows and as depicted in the dialog to the right:

Job:	**100**
Design Speed:	**60**
Chain:	**Route50**
Begin Station:	**464+00**
Ending Station:	**468+00**
Reference File:	**i_dvided**
Facility:	**Divided**
e Selection:	**8% max**
L Selection:	**all cases**
Profile:	**ROUTE50PR**
Tie:	**Offset**



Click on the **Quick Entry** icon outlined in the dialog box to the right. This will bring up the dialog shown below. Fill it in as shown with the following:

Facility:	**Divided**
Median Width:	**60.00**
Lane Widths:	**12.00**
Total Lanes:	**4**
Normal % Slope:	**2.00**



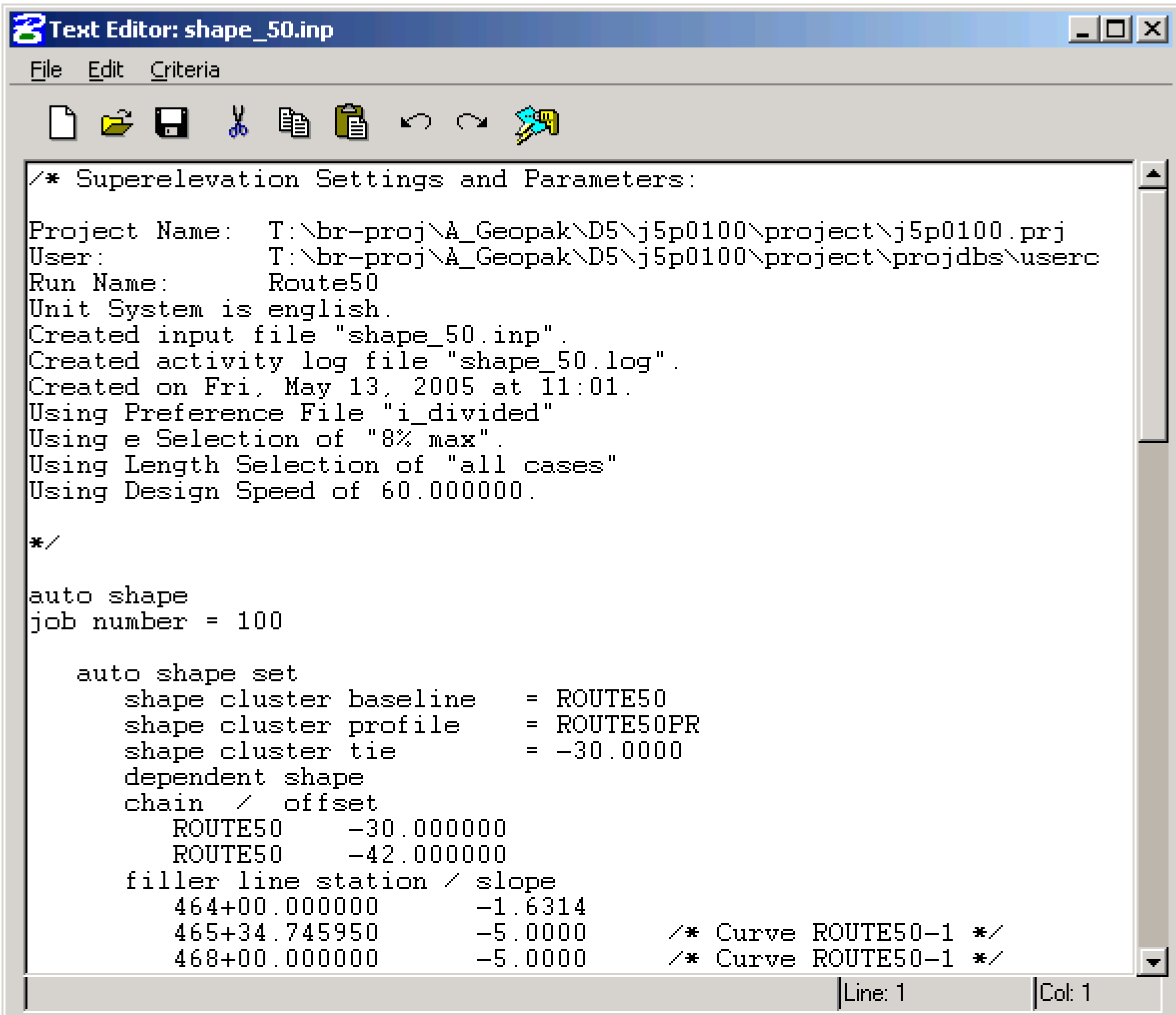
Click **OK**.

Modify the % Slope to –2.0000 for offsets 42-54 on the Left (negative) and Right (positive) sides.

Change the Input File to: **shape_50.inp**

Click on **Generate Superelevation Transitions**.

6. Clicking on the **Generate Superelevation Transitions** button will generate the INP file, which is displayed in the following dialog box.




```
/* Superelevation Settings and Parameters:

Project Name:   T:\br-proj\A_Geopak\D5\j5p0100\project\j5p0100.prj
User:           T:\br-proj\A_Geopak\D5\j5p0100\project\projdbs\userc
Run Name:       Route50
Unit System is english.
Created input file "shape_50.inp".
Created activity log file "shape_50.log".
Created on Fri, May 13, 2005 at 11:01.
Using Preference File "i_divided"
Using e Selection of "8% max".
Using Length Selection of "all cases"
Using Design Speed of 60.000000.

*/

auto shape
job number = 100

   auto shape set
      shape cluster baseline   = ROUTE50
      shape cluster profile    = ROUTE50PR
      shape cluster tie        = -30.0000
      dependent shape
      chain  /  offset
         ROUTE50    -30.000000
         ROUTE50    -42.000000
      filler line station / slope
         464+00.000000       -1.6314
         465+34.745950       -5.0000     /* Curve ROUTE50-1 */
         468+00.000000       -5.0000     /* Curve ROUTE50-1 */
```

7. Use UltraEdit or another text editor to view the log file:
   t:\br-proj\a_geopak\d5\j5p0100\data\j5p0100\data\shape_50.log.

8. Run the input file shape_50.inp by clicking on the **Create Superelevation Shapes** icon in the GEOPAK **Text Editor: shape_50.inp**. It is the icon shown to the right and it the last icon in the tool bar at the top of the dialog. Save the MicroStation drawing after creating the shapes and close the **GEOPAK Automated Superelevation** dialog. Click on **Yes** to **Save Superelevation Settings?** in the Alert dialog.

9. Select the **BigHorn** working alignment.

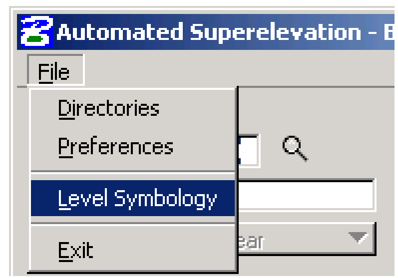
10. Click on the **Define** button to review the **BigHorn** working alignment definitions. Under the **Shapes** section, change the following symbology settings:

    Lv Names: **Geopak-Shapes 2**
    Colors: **2,7**

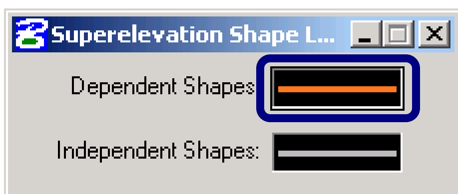
    Using different symbology lets the user distinguish between the shapes for the two alignments.

    Close the working alignment definition box by clicking on **OK**.

11. Select the **Calculate Superelevation** button from the Project Manager dialog. Copy the MoDOT run to **BigHorn**, and enter the run.

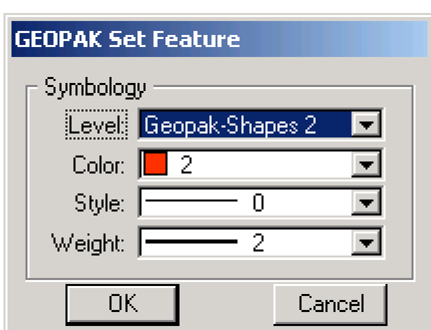


    In the upper left corner of the Automated Superelevation dialog select **File > Level Symbology**, as shown to the right. This brings up the following dialog, which allows the user to set the symbology for the shapes to be drawn by the tool.

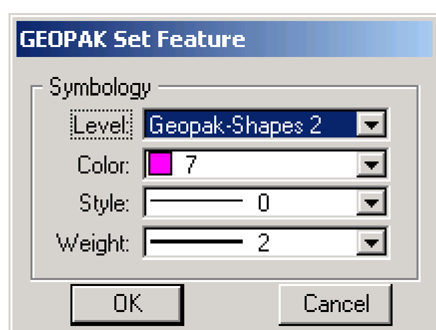


    The shape symbology needs to be changed to reflect the adjustments made to the Working Alignment Definition in the previous step. To change the symbology of the Dependent Shapes, double click on the symbology preview area outlined in the above. This brings up the **GEOPAK Set Feature dialog**.

    Change the **Dependent Shape** symbology to that shown below on the **left**. Click **OK** to save the changes. Change the **Independent Shape** symbology to that shown below on the **right**.



Dependent Shape Symbology

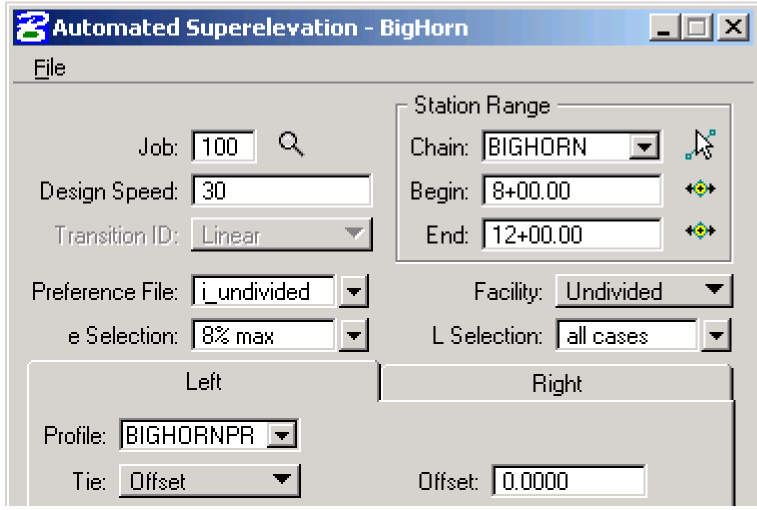


Independent Shape Symbology

    Close the **Superelevation Shape Level Symbology** dialog by clicking on the ☒ in the upper right corner.

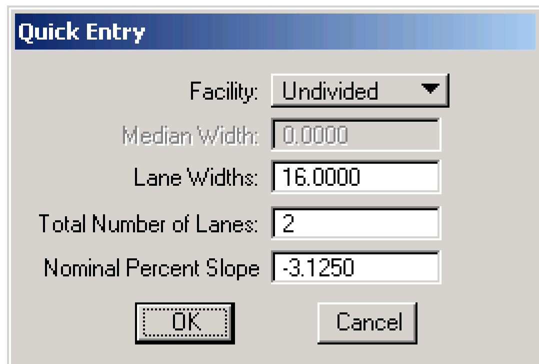
12. Create the **Big Horn** shapes as follows:

Job:	**100**
Chain:	**BIGHORN**
Begin Station:	**8+00**
Ending Station:	**12+00**
Design Speed:	**40**
Reference File:	**i_undvided**
Facility:	**Undivided**
e Selection:	**8% max**
L Selection:	**all cases**
Profile:	**BIGHORNPR**
Tie:	**Offset**

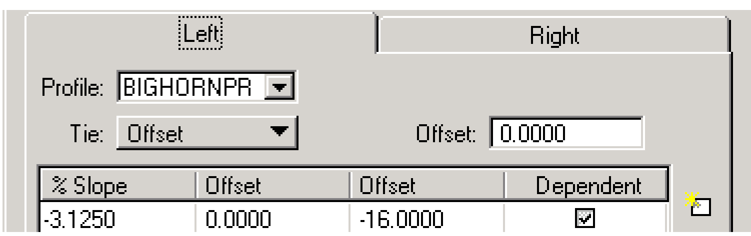


Use the **Quick Entry** dialog to set the lane information to the following:

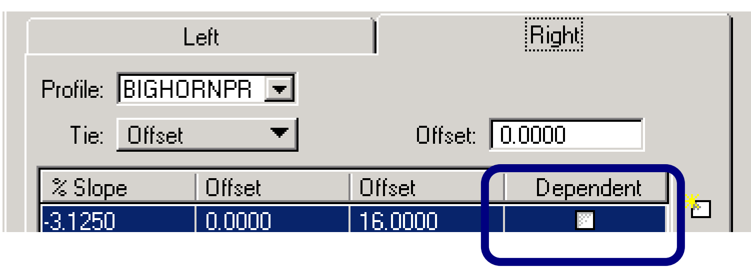
Facility:	**Undivided**
Lane Widths:	**16.00**
Total Lanes:	**2**
Normal % Slope:	**-3.125**



Click **OK** to fill the Left and Right tabs of the main dialog. The Left tab should now look like that shown below:



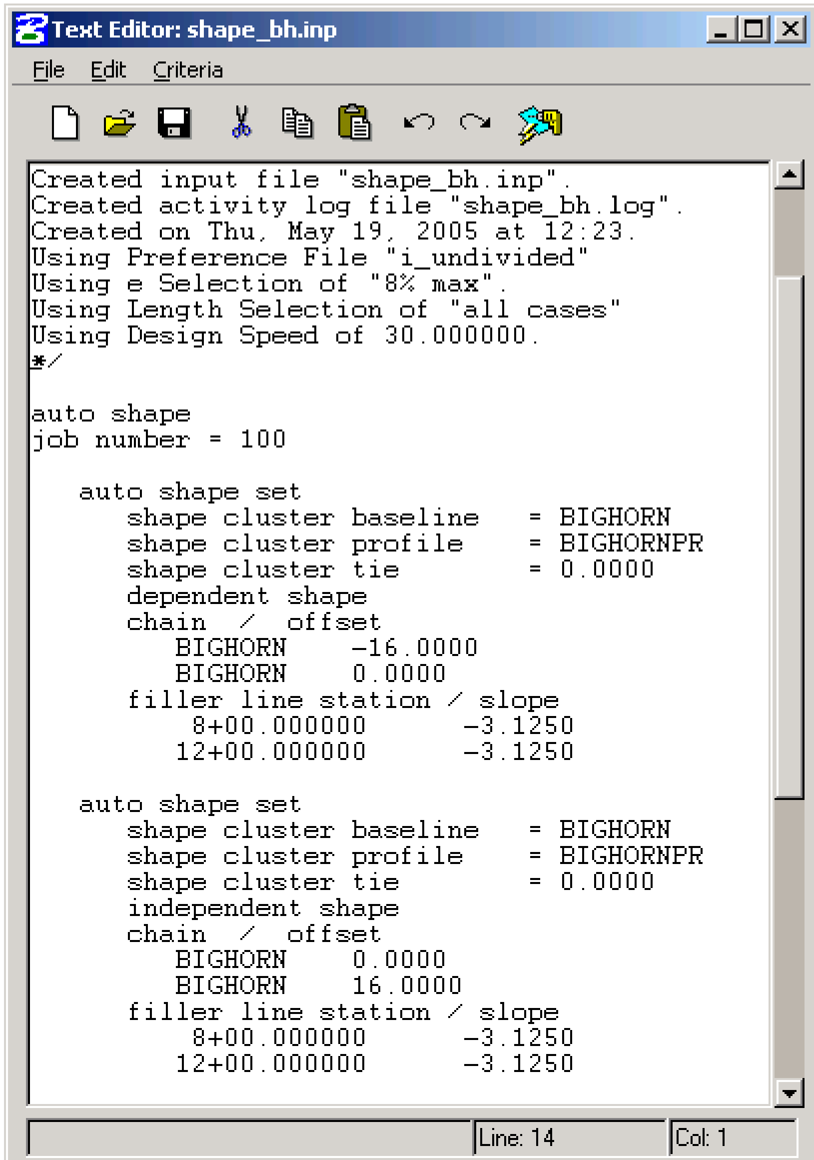
Switch to the Right tab and turn off the Dependent option, which is outlined in the following dialog.



Change the Input File to: **shape_bh.inp**, as shown to the right.

Click on **Generate Superelevation Transitions** to create the input file.

13. Edit the filler lines for both **auto shape sets** so there is a constant cross slope of **–3.125%** for the full station range and make sure the second set to an **independent shape**, as depicted below. Note: Because the profile grade line is at the center of the roadway, both shapes can get their elevations from the profile (the dependent condition). Changing one of the shapes to independent, however, enables the user distinguish between the two shapes.




```
Created input file "shape_bh.inp".
Created activity log file "shape_bh.log".
Created on Thu, May 19, 2005 at 12:23.
Using Preference File "i_undivided"
Using e Selection of "8% max".
Using Length Selection of "all cases"
Using Design Speed of 30.000000.
*/

auto shape
job number = 100

   auto shape set
      shape cluster baseline    = BIGHORN
      shape cluster profile     = BIGHORNPR
      shape cluster tie         = 0.0000
      dependent shape
      chain  /  offset
         BIGHORN     -16.0000
         BIGHORN     0.0000
      filler line station / slope
          8+00.000000       -3.1250
         12+00.000000       -3.1250

   auto shape set
      shape cluster baseline    = BIGHORN
      shape cluster profile     = BIGHORNPR
      shape cluster tie         = 0.0000
      independent shape
      chain  /  offset
         BIGHORN     0.0000
         BIGHORN     16.0000
      filler line station / slope
          8+00.000000       -3.1250
         12+00.000000       -3.1250
```

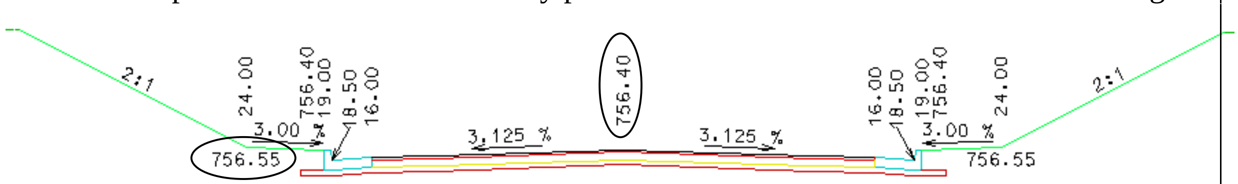
After editing the input file, **save** the changes by clicking on the floppy disk icon. 

Create the shapes by clicking on the **Create Superelevation Shapes** icon. 

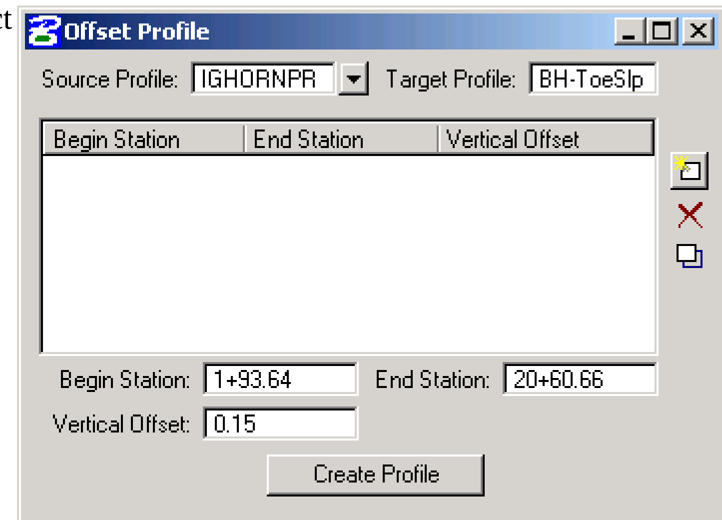
Exit the text editor.

Exit the superelevation run and **save** the changes to it and the **MicroStation file**.

14. The fill slopes will also be shaped to determine the bridge length. Since these shapes need to be associated with a profile, a location for the profile needs to be determined. The toe of the slope is the most logical location. From the cross section below, it can be determined that the toe of the slope is 0.15' above the roadway profile with a constant offset of 24' left and right.

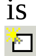


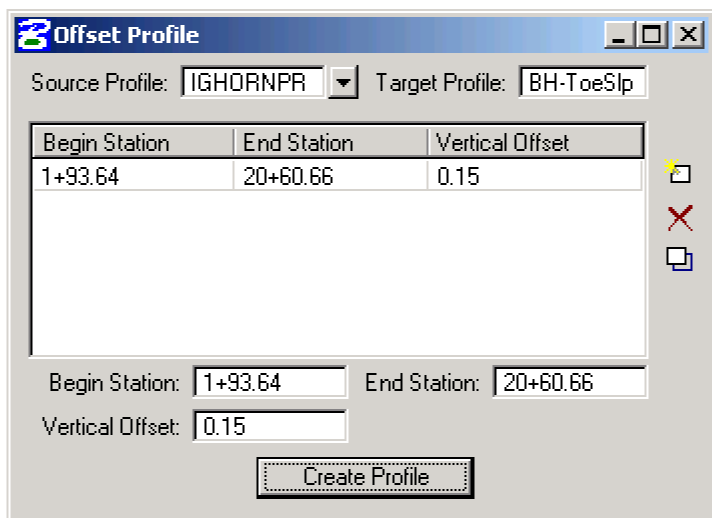
Go into Coordinate Geometry. Select **Element** > **Profile** > **Offset**. This will bring up the dialog box shown to the right.



Enter the following information as shown in the top figure to the right:

Source Profile: **BIGHORNPR**
Target Profile: **BH-ToeSlp**
Begin Station: **1+93.64**
End Station: **20+60.66**
Vertical Offset: **0.15**

Once this information is entered, click on the **Add** icon , which is the top icon on the right side of the dialog box. This will add the station range and the offset to the list box as depicted in the bottom figure to the right. To delete an item from the list box, highlight the line and click on the **Delete** icon , which is the middle icon on the right side of the dialog. If changes need to be made to an item in the list box, highlight that line, edit information in the fields at the bottom of the dialog and click on the **Edit** icon .



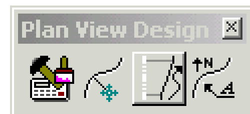
When the list box is complete, click on the **Create Profile** button. This stores the target profile, as indicated by the following message in the MicroStation Status Bar in the lower left hand corner of the MicroStation window: "*Profile BH_ToeSlp saved. Store Profile commands saved in BH_ToeSlp100.icu.*" This file is stored in the working directory and may be viewed using UltraEdit or any other text editor.

15. Click on the **Select** button in Project Manager. **Copy** the **BigHorn** working alignment to **BH-Slope** and enter the new working alignment.

    Click on the **Define** button and adjust the following definitions:
    In the **Shapes** section, change the **Colors** to **3**.
    Under **Profile View**, change the **Proposed Profile** to **BH-TOESLP**. Click **OK**.

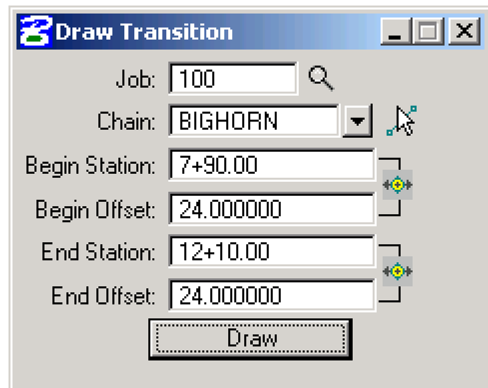
    To facilitate the creation of the shapes using **Shape Maker**, set **Scratch-1** as the **active** level, use **Level Display** to **turn off levels GEOPAK-Pattern line 1 and GEOPAK-Shapes 1**, and **turn off** the display for any **referenced files**. All that should be visible after doing this are the shapes for Big Horn Dr.

    Choose **Plan View Design** from Project Manager. This will bring up the toolbox shown to the right. Select **Draw Transition**, which is the third tool in the toolbox.



    Use Draw Transition to draw the following lines to serve as longitudinal lines for shapes:

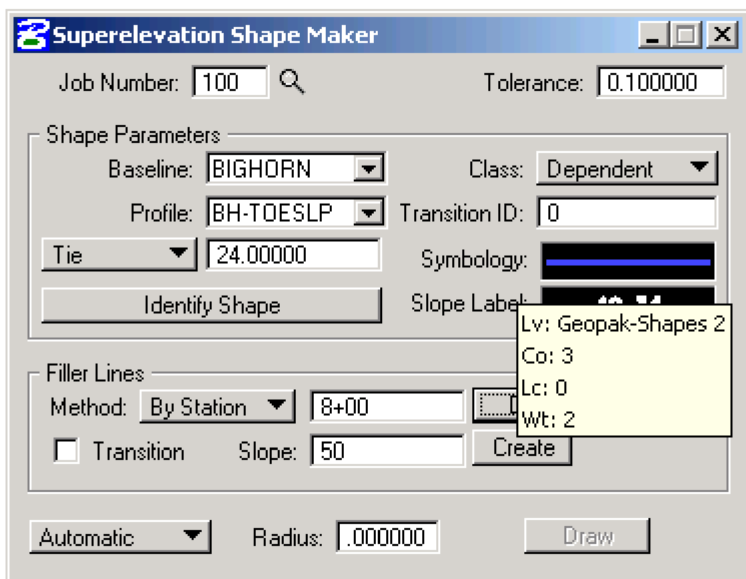
Beginning Station	**Beginning Offset**	**Ending Station**	**Ending Offset**
7+90	**24**	**12+10**	**24**
7+90	**-24**	**12+10**	**-24**
7+90	**-70**	**12+10**	**-70**
7+90	**70**	**12+10**	**70**



    Close the **Draw Transition** and the **Plan View Design** dialog boxes after the four lines are drawn.

16. Click on **Superelevation Shapes** in Project Manager.

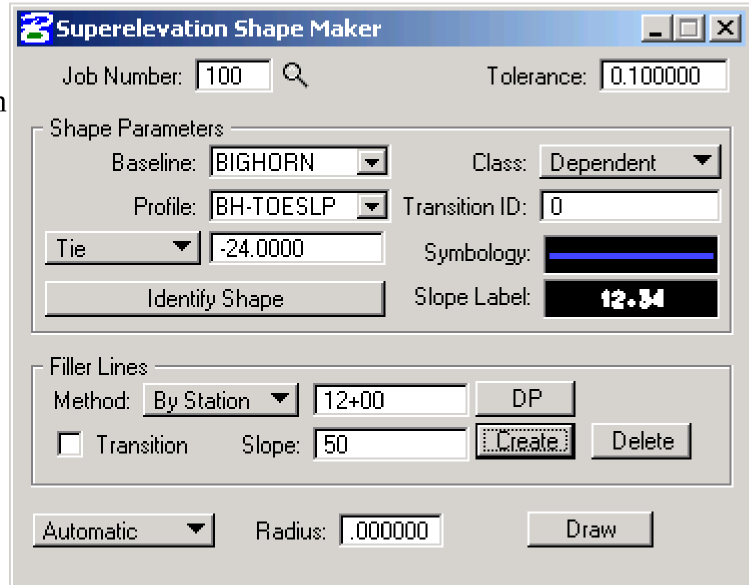
    Fill in the dialog so it is like the one to the right. Once this is completed, click on the **Create** button. This will draw a filler line at station 8+00.



    Change the Station to **12+00** and click the **Create** button a second time to draw the other filler line at Station 12+00.

    Click on the **Draw** button and data point inside the closed in area on the right side of Big Horn Drive.
    Note: On the screen it is actually to the left of the existing shapes.

17. Repeat the process on the left side of Big Horn, which is to the right of the existing shapes on the screen



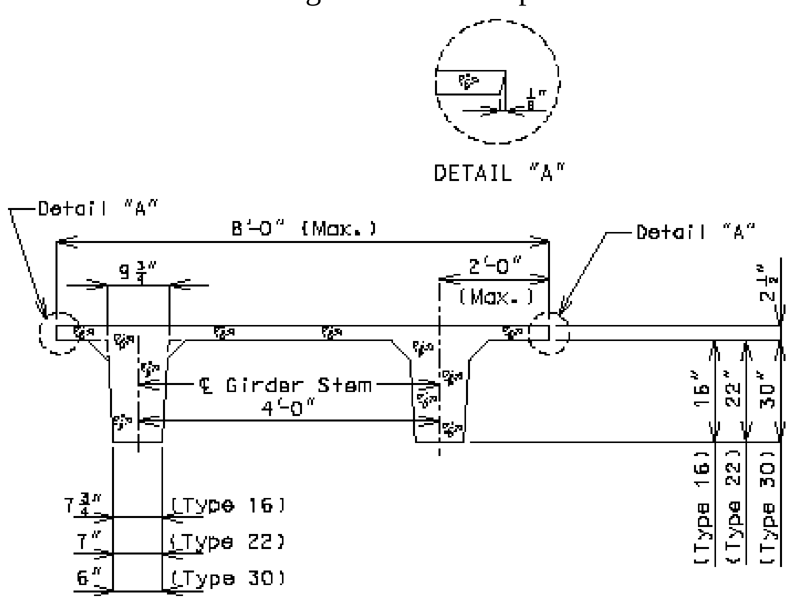
Change the Tie to **–24.00**, set the Station to **8+00** and click on the **Create** button to draw the first filler line.

Change the Station to **12+00** as shown to the right and click on the **Create** button to draw the second filler line.

Click on the **Draw** button and data point inside the closed in area on the left side of Big Horn Drive. Note: On the screen it is actually to the right of the existing shapes. Exit Shape Maker.

Refresh the view. Turn on **GEOPAK-Shapes 1** and **save** the changes to the DGN file.

18. A profile for Route 50 is needed to define the maximum height of the fill slopes. This profile is based upon the minimum clearance of 1' from the top of the end bent beam to the top of the fill slope (**LRFD 3.77.3.3-1**, Effective Jan. 2005). Since Big Horn Dr is 39' wide, Type 30 P/S Concrete Double Tee Girders will be used (based on **BM 3.56.1.6-1**, Effective Nov. 2000, as shown on the following page). From the figure below (**LRFD 3.56.2.1-1**, Effective Jan. 2005), the web depth is 30". Allowing ¼" for the bearing pads, ¼" for camber, and 8 ½" for the deck, gives a total depth of 39" (30 + ¼ + ¼ + 8 ½) = 3.25'. Adding the 1' clearance results in the maximum height of the fill slope at 4.25' below the top of the deck.



SECTION THRU P/S CONC. DBL. TEE GIRDER

Using **Offset Profile**, **create profile 50-PR-SLP 4.25' below Route50PR**.

Bridge Manual

P/S Concrete Double-Tee Girders – Sec. 3.56 **Page: 1.6-1**

38'-10" ROADWAY
GIRDER SPAN LENGTH (HS20 & HS20 MILITARY LOADING)

Superstructure

Allowable Span Length For P/S Concrete Double-Tee Girder Spans

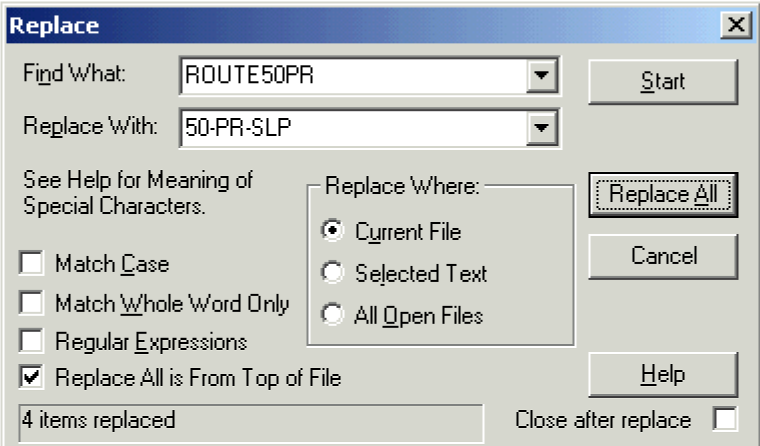
Span Length ℄ to ℄ Bent	Type 30 Span Length	Type 30 Girder Seq. No.	Type 22 Span Length	Type 22 Girder Seq. No.	Type 16 Span Length	Type 16 Girder Seq. No.
20'	20' thru 28'	320	20' thru 29'	230	20' thru 23'	130
21'						
22'						
23'						
24'					24' thru 28'	140
25'						
26'						
27'						
28'						
29'	29' thru 34'	330			29'	151
30'			30' thru 34'	240		
31'						
32'						
33'						
34'						
35'	35' thru 40'	340	35' thru 37'	251		
36'						
37'						
38'			38' & 39'	262		
39'						
40'						
41'	41' thru 44'	351				
42'						
43'						
44'						
45'	45' & 46'	362				
46'						
47'	47' thru 49'	372				
48'						
49'						
50'	50' thru 52'	383				
51'						
52'						

Big Horn Dr.
Width = 39'

Note:
The maximum span lengths shown for P/S Double-Tee Girders are based on a minimum of 2-spans (continuous) being used. If one of these P/S Double-Tee Girders is used as one simple span, then the span lengths should be reduced from the maximum allowable span shown, and the girder design should be checked.

Revised: Nov. 2000 **E5600**

19. The profile **50-PR-SLP** will be used for shapes that represent the maximum height surface for the bridge fill slope. These will be added to pattern_shape_j5p0100.dgn by editing and running an existing INP file.



Open shape_50.inp in UltraEdit. Highlight the shape cluster profile **ROUTE50PR**. Go to the UltraEdit pull down menu **Search** > **Replace**, to bring up the dialog to the left.

Enter **50-PR-SLP** in the **Replace With:** field as shown. Click on the **Replace All** button to change the name of the profile in the file.

Go to the 2nd and 4th auto shape sets and change the offset range to the values shown below (the value to be changed is shown in bold):

Changes to 2nd auto shape set

```
chain   /  offset
   ROUTE50    -42.0000
   ROUTE50    -64.0000
```

Change to 4th auto shape set

```
chain   /  offset
   ROUTE50     42.0000
   ROUTE50     64.0000
```

Scroll down to the **Plot Parameters** section of the input file and change level (lv) and color (co) symbology to the values shown below in bold.

```
Plot Parameters
   Dependent Shape
      lvname = Geopak-Shapes 3
      co = 8
      lc = 0
      wt = 2
   Dependent Text
      lvname = Geopak-Shapes 3
      co = 8
   Independent Shape
      lvname = Geopak-Shapes 3
      co = 4
      lc = 0
      wt = 2
   Independent Text
      lvname = Geopak-Shapes 3
      co = 4
```

Save the file as **shape_50_slp.inp**. This input file will be run later.

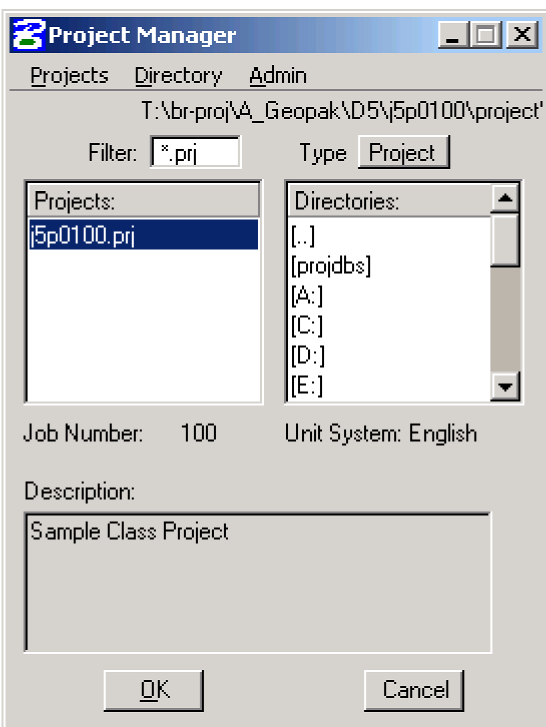
Exercise 14-2

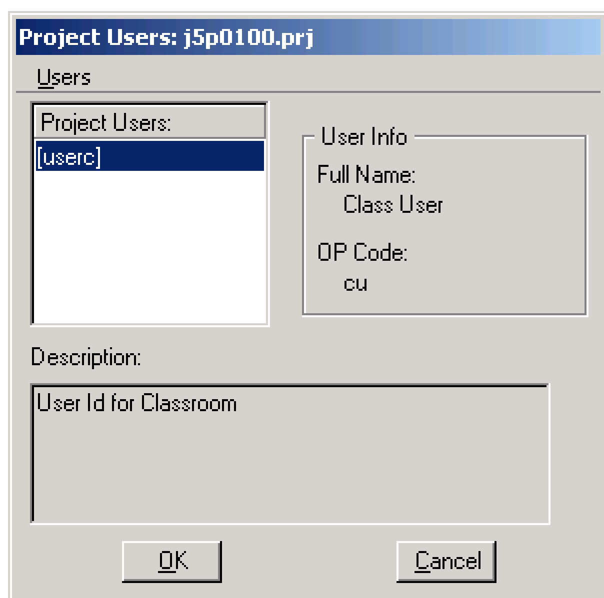
This is a group exercise to demonstrate the use of the GEOPAK superelevation tools to help determine end locations. Specifically, the tools will be used to find elevations from two shapes to locate where they intersect.

This exercise is based on the following design information: End of wing to end of wing length is controlled by the intersection of the spill slopes with the outside edges of the bridge deck. End bent locations are controlled by the requirement to maintain a minimum clearance of 1' from the top of the end bent beam to the top of the spill slope. This clearance needs to be checked at the outside face of the exterior girders unless the crest of a vertical curve for the lower roadway is located directly beneath the bridge. The location of the checks for this exercise was obtained from the cross section of the slab from Bridge Manual page 3.56.2.5-1 shown on the following page.

1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\pattern_shape_j5p0100.dgn**.

2. Open the project **t:\br-proj\a_geopak\d5\j5p0100\project\j5p0100.prj** as user **userc** and enter **Road**.





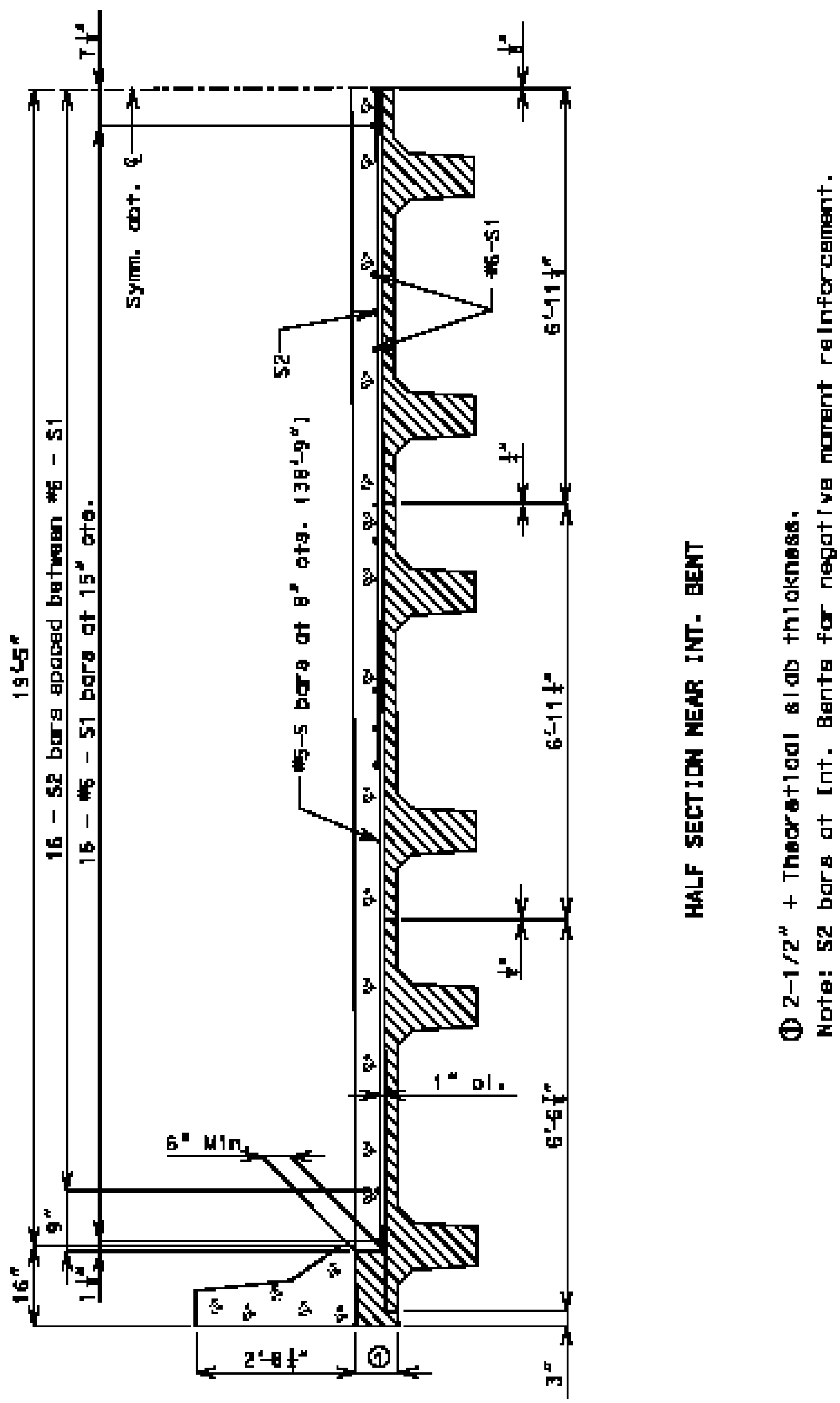
3. Select the **Route50** working alignment.

Bridge Manual

P/S Concrete Double-Tee Girders - Sec. 3.56 Page: 2.5-1

38'-10" ROADWAY (HS20 & HS MILITARY)
SLAB REINFORCEMENT

Reinforcement

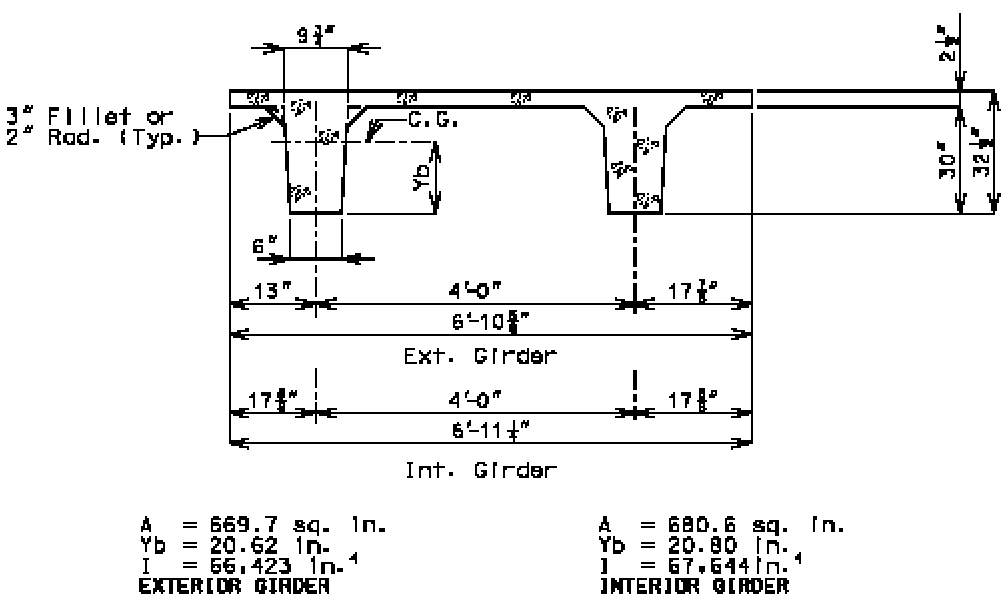


Revised: Nov. 2000 E5600

4. **Determine Critical Offsets:** Away from the bridge, the roadbed width is 40’ (6’ left shoulder, + two 12’ lanes + 10’ right shoulder). Centering the structure on the roadbed places the centerline of structure two feet to the right of the centerline of the two driving lanes, which is 42’ to the right of the highway’s horizontal alignment. Consequently the centerline of structure is 44’ (42’ + 2’) to the right of the alignment. Offsets for the bridge gutterlines are 24’-7” (44’ - 19’-5”) and 63’-5” (44’ + 19’-5”). Adding the 16” barrier, the **offsets for the bridge deck edges are <u>23.25’</u> & <u>64.75’</u>**. These are the offset values that will be use to locate the intersect point of the spill slope with the bridge deck.

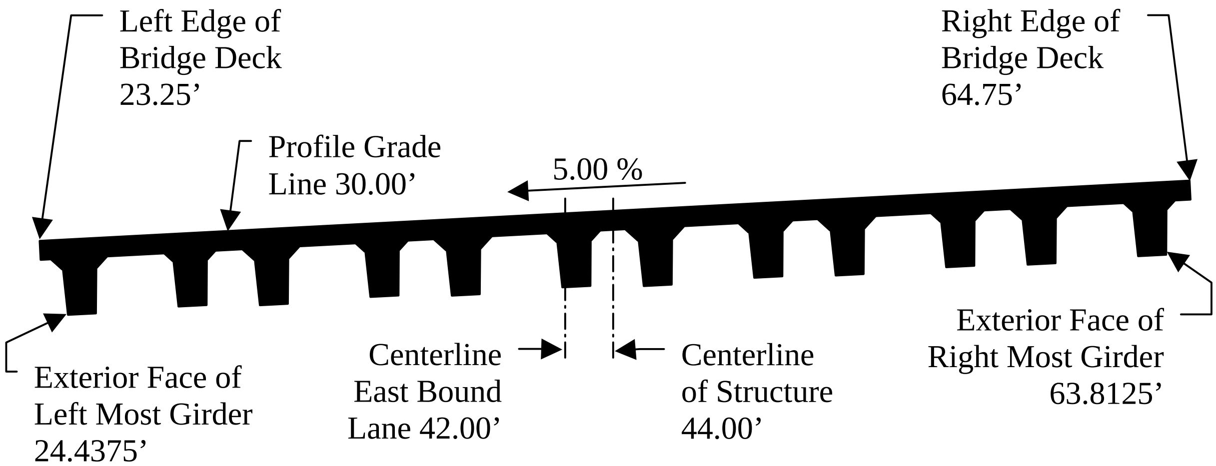
   The figure from the Bridge Manual on the previous page show the horizontal width of the flanges on the interior double-tees as 6’-11 ¼”. Because the bridge is curved, this value will be increased to 6’-11 3/8” to reduce the maximum exterior overhang on the outside edge of the curve.

   Also, because the deck is curved to the left, its edge will come in towards the girders at center span by about 1 ½” on the left side and move away from the girder on the right side by about the same amount. To account for that, the deck will be shifted to the right by 1 ½”. The following figure from **BM page 3.56.1.6-10** shows that for a 38’-10” roadway and Type 30 girder, the normal overhang from the centerline of the exterior girder is 13”. This will be increased to 14 ½” (13” + 1 ½”) on the left and reduced to 11 ½” (13” - 1 ½”) on the right side at the end of each span. With the 3” full depth cast in place slab overhang on the outside of the girder flange and with the 6” wide web, the exterior faces of the girders at the end bent will also be about 14 ½” from the edge of the slab on the left and 11 ½” from the edge of the slab on the right side of the deck at the end bents.



   Because the four interior girders have been widened by 1/8”, the overhangs will be reduced by ¼” (2 girders per half section x 1/8”). Consequently, the **horizontal offsets from the alignment for the exterior girder faces are** 23.25’ + 14 ¼” (1.1875’) = **<u>24.4375’</u> on the left** side and 64.75’ – 11 ¼” (0.9375’) = **<u>63.8125’</u> on the right** side. These will be plotted to locate the top of the spill slopes at the ends of the bridge.

5. The location of the critical offsets are shown on the follow cross section of the bridge away from a bent. Because the slope of the roadway under the bridge is less than that of the bridges super elevation, exterior face of the right most girder will control the location of the end bents.



The first set is to determine the change in elevation along the bridge deck from the profile grade line to the critical offset. This change in elevation is based on the 5% superelevation on the bridge plus the offset distance from the profile grade line to the critical point. Based on the above figure this change in elevation is:

0.05 * (63.8125' - 30') = 0.05 * (33.8125') = 1.690625.

The 4.25' distance from the top of deck to the top of the fill slope must be subtracted from this value. Thus the total vertical offset from the Route 50 proposed profile to profile for the top of the fill slope at the exterior face of the right most girder is:

1.690625 – 4.25 = -2.559375.

Based on this information, create the needed profile. To do this, go into Coordinate Geometry for Job **100** with Operator Code **cu**. Use the **Element** > **Profile** > **Offset** tool with the following settings:

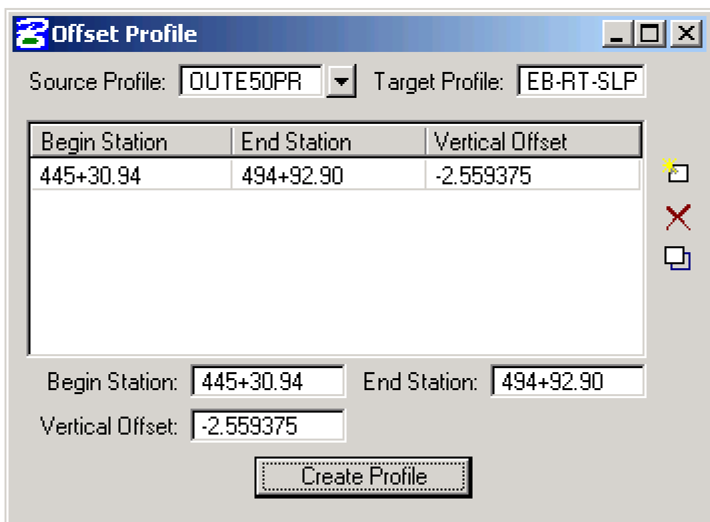
Source Profile = **Route50PR**

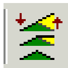
Target Profile = **EB-RT-SLP**

Begin Station = **Route50PR beginning station**

End Station = **Route50PR ending station**

Vertical Offset = **-2.559375**



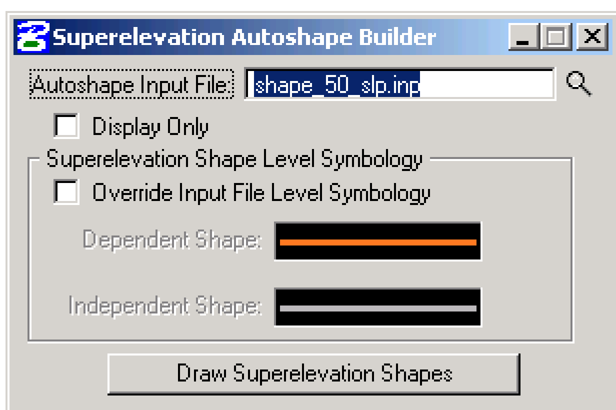
6.  Several tools from the **Superelevation Shape Manager** will be used to obtain elevation information from the shapes. The icon for the manager (shown above) is the forth icon from the right in the **Cross Sections** toolbox, which is located in the lower left hand corner of the **Road Tools** as shown in the figure to the right. The expanded Cross Sections toolbox is shown below.

Bring up the **Superelevation Shape Manager Tools** shown below.

The tools in this pallet are:

 Automated Superelevation,  Autoshape Builder,  Shape Maker,
 Shape Analyst,  Shape Profiler,  Shape Editor,
 Shape Selector, and  Shape Properties.  Shape to DTM

Open the **Autoshape Builder**, shown below. Click on the **Magnify Glass** icon and select **shape_50_slp.inp**. Press the **Draw Superelevation Shapes** button to run the input file.



Turn off level GEOPAK-Shapes 1.

7. In order to find the needed elevations, plot the outside face of the right exterior girder. Elevations from the shapes will be obtained at set intervals along this line.

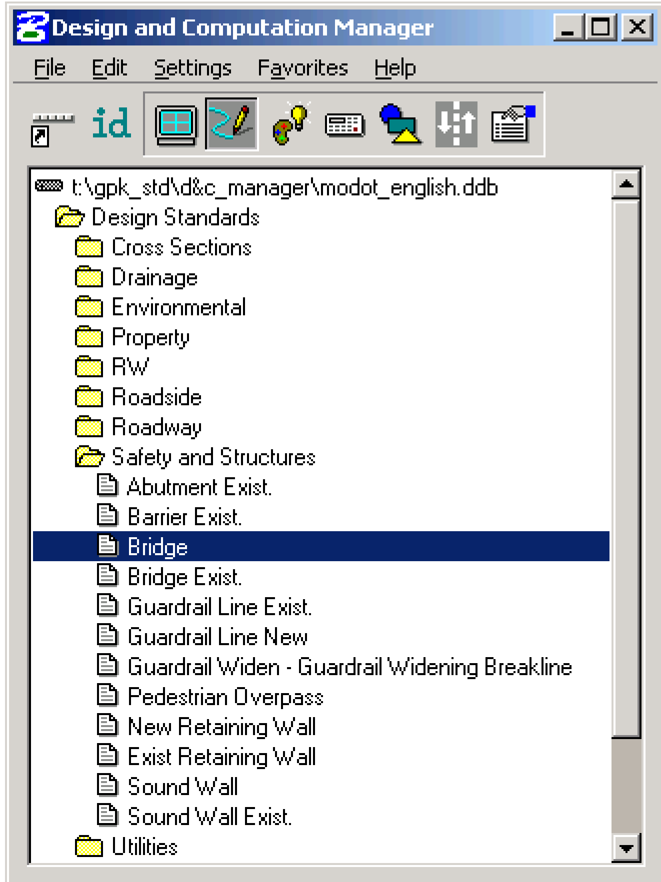
   To do this, open **Design and Computation Manager**.

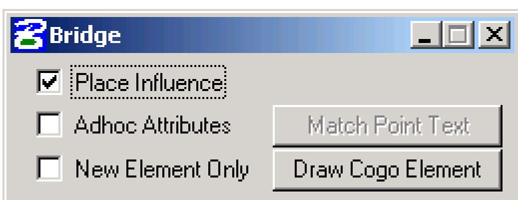
   Expand the **Design Standards** folder.

   Open **Safety and Structures** subfolder as well.

   Select **Bridge** from the list of items in that folder, as shown in the figure to the right.

   Since a Design Standard is being plotted, make sure **Place Influence** is checked in the Operations box as shown in the following figure.

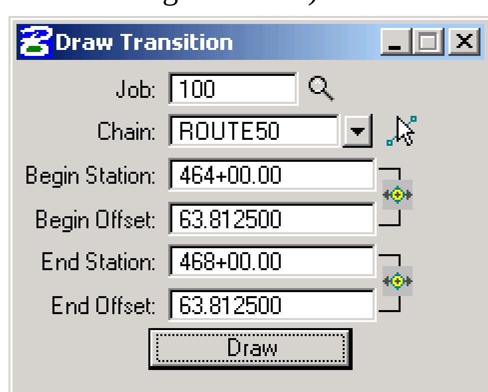




8. Use the **Draw Transition** tool (the third icon in the Plan View Design tool box) to draw the following line relative to the **Route 50** chain:

Beginning		**Ending**	
Station	**Offset**	**Station**	**Offset**
464+00	**63.8125**	**468+00**	**63.8125**

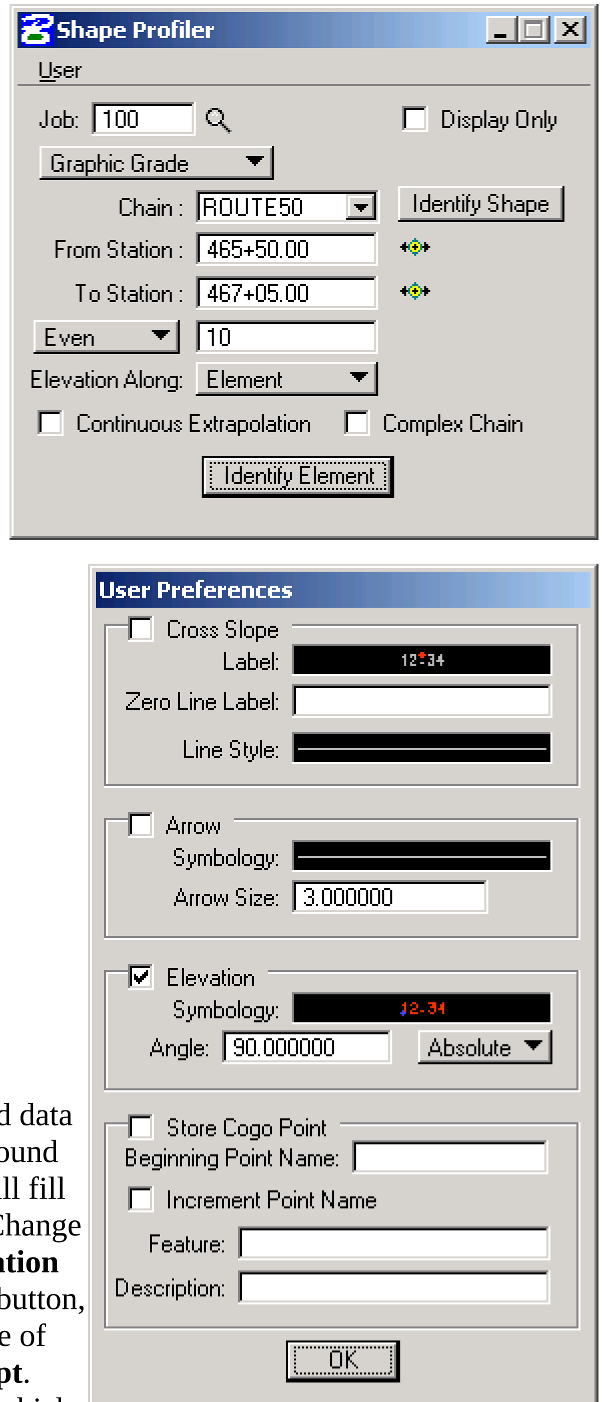
   The values for drawing the line are shown in the figure to the right.



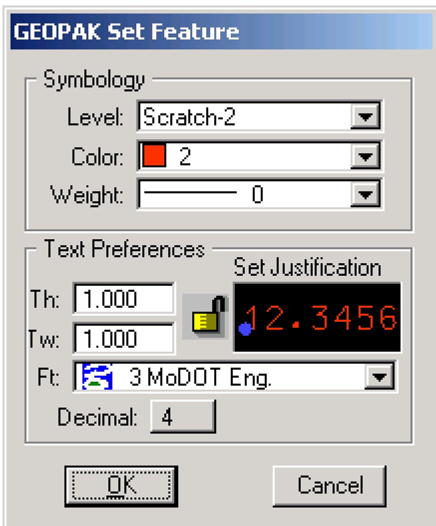
   After drawing the drawing the line, close the D & C Manager and Draw Transition dialogs.

   Save the changes to the MicroStation Drawing.

9. Open the **Shape Profiler** tool. This will bring up the top dialog to the right.

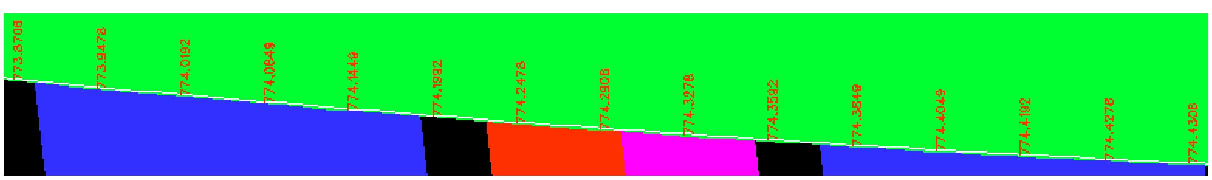


Go to **User > Preferences** in Shape Profiler to customize the profilers output as shown in the bottom figure on the right. Double click on the Elevation Symbology preview. This brings up the **GEOPAK Set Feature** dialog shown below. Set the **Symbology**, **Text**, and **Justification** to those options shown. Click **OK** to accept the **Set Feature** settings.



Click **OK** in the **User Preferences Dialog**.

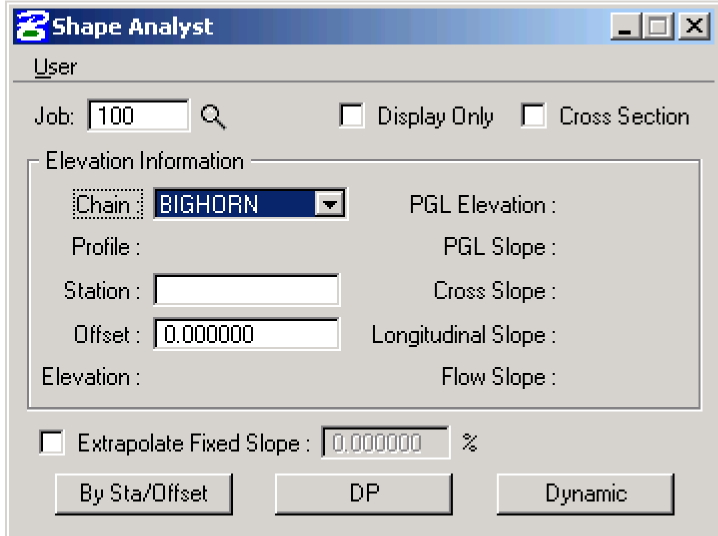
In **Shape Profiler**, click on **Identify Shape** and data point on the shape for the driving lane of eastbound Route 50 where it crosses Bighorn Dr. This will fill in the Chain and Station fields for the shape. Change the **From Station** to **465+50.00** and the **To Station** to **467+05.00**. Click on the **Identify Element** button, **data point** on the line defining the outside edge of the right exterior girder, and data point to **accept**. The end result is depicted in the figure below, which gives the elevations along the girder edge one foot below the top of the end bent beam.



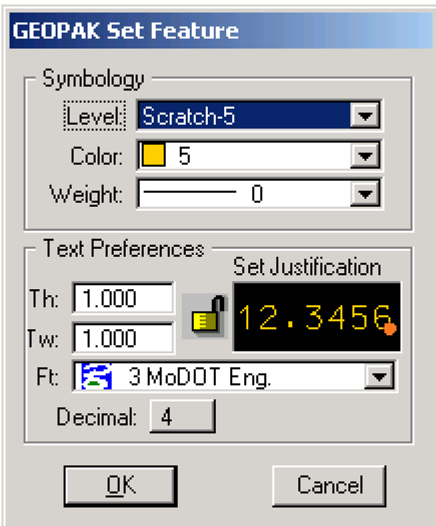
10. To determine the elevations on the fill slopes, use **Level Manager** to turn off levels **GEOPAK-Shapes 3** so only the shapes for Big Horn Dr. are visible.

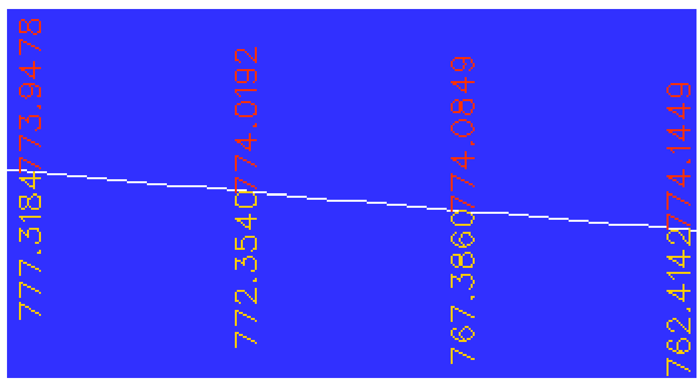
Select the **Shape Analyst** tool by clicking on the following icon in the Shape Manager .

This will bring up the dialog on the right. Select the **BIGHORN** chain.



Go to **User > Preferences**. Change the Elevation Symbology settings to those shown below.



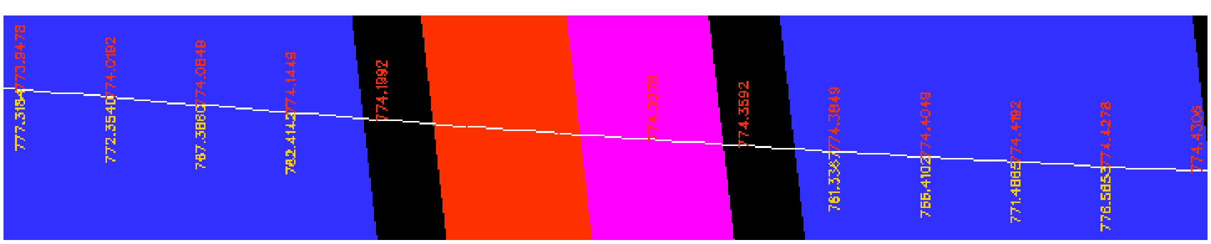


Click **OK** in both **Set Feature and User Preferences**.

Set the tentative **snap** to **key point**.

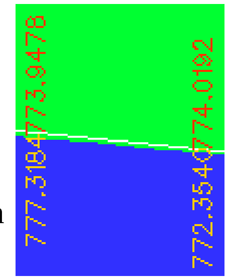
Click on the **DP** button in **Shape Analyst**. Tentative snap on the text giving the elevation at Station 465+70 (773.9478) and accept the snap, this will plot the fill slope elevation at that location. Repeat the process for the next three values plotted by the profiler. The end result is shown above. **Note**: To snap to the text more easily turn off the Fill View Attribute.

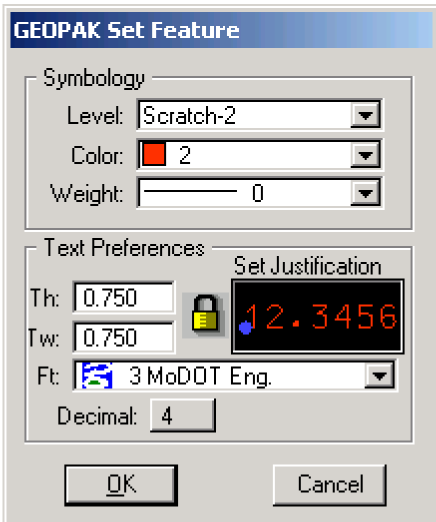
11. Move to other end of the bridge and plot the slope elevations at that end of the bridge, as shown in the following figure.



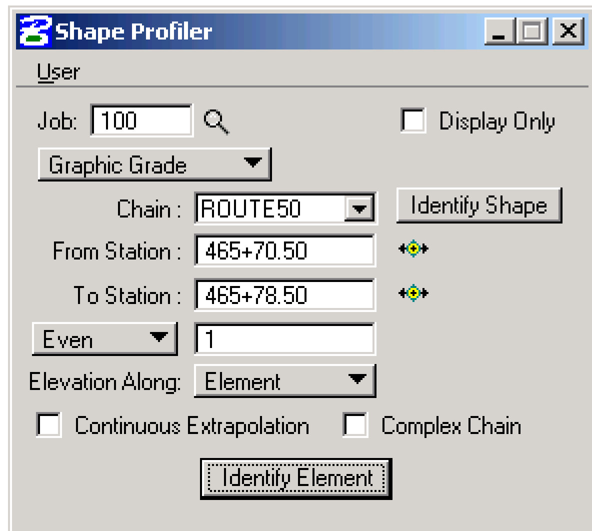
Turn on the display for level **GEOPAK-Shapes 3**.

12. Window in on the SW corner between Station 465+70 and 465+80, as was done to create the figure on the right. The plotted elevations indicate that the projection of the fill slope goes above its maximum allowable height under the bridge deck in this station range. While linear interpolation could be used to establish a crossing point, greater accuracy can be accomplished by using the shapes. To do this, elevation information will be obtained from the shapes at 1' increments.



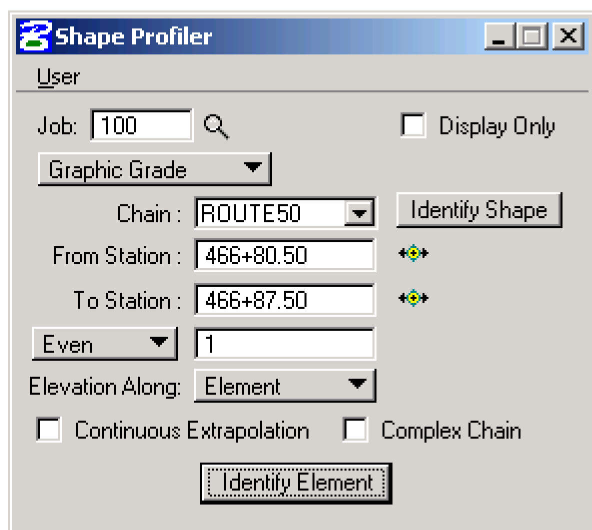


Switch to **Shape Profiler** and adjust the **User > Preferences** Elevation Symbology settings to those shown to the left. The change in text size is being done to distinguish the foot from the 10' increment values.



Based on the elevations given, the crossing point is between Route 50 Sta. 465+70 and 465+80; therefore, use **Shape Profiler** to plot elevations relative to Route 50 at Sta. 465+71 to 465+78 at 1' increments. Use the following settings as shown in the top figure to the right:

Chain:	**ROUTE50**
From Station:	**465+70.50**
To Station:	**465+78.50**
Increment:	**Even 1**

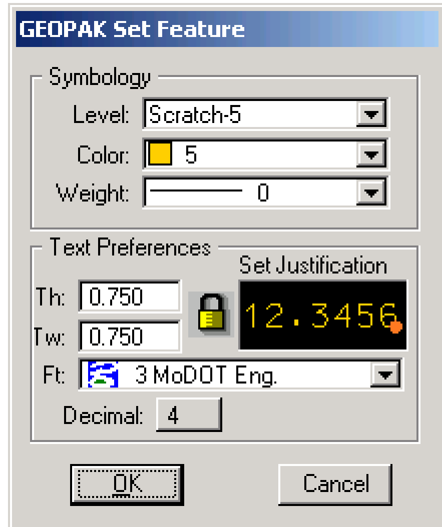


Do the same thing at the other end of the bridge between Route 50 Sta. 466+80 and 466+90. Use the following settings:

Chain:	**ROUTE50**
From Station:	**466+80.50**
To Station:	**466+87.50**
Increment:	**Even 1**

13. To obtain the elevations on the fill slopes, use **Level Manager** to **turn off** level **GEOPAK-Shapes 3** so only the shapes for Big Horn Dr. are visible.

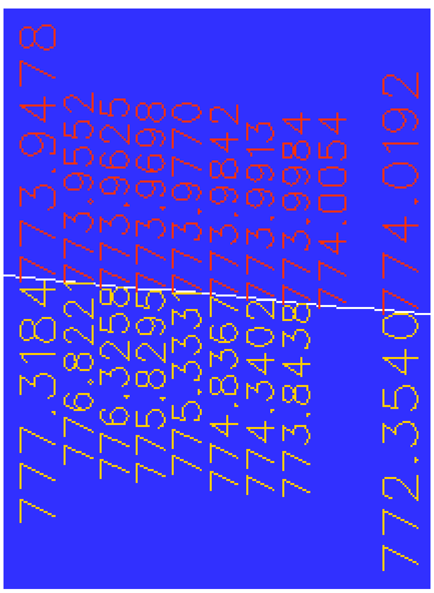
Select **Shape Analyst** by clicking on its icon in the Shape Manager tools . Select the **BIGHORN** chain.



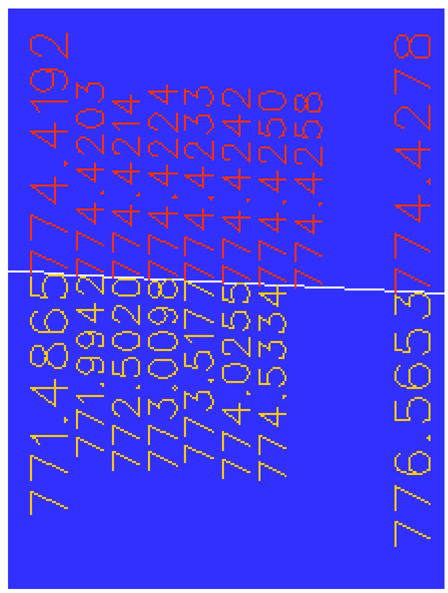
Go to **User > Preferences** and change the **Elevation Symbology** settings to those shown to the right. Click **OK** in both the **Set Feature** and **User Preferences** dialogs to accept the changes.

Make sure your **snap** is set to **key point**. Click on the **DP** button in **Shape Analyst**. Tentative snap on the text plotted in the previous step. This will plot the fill slope elevation at that location. **Note**: It may help to turn of the Fill View Attribute (MicroStation menu **Settings > View Attributes**) to make it easier to snap to the text.

Screen captures from each corner of the bridge are shown below.



SW Corner of Bridge



SE Corner of the Bridge

Compare your elevations to those given below.

Location	Station	Deck Elev. Minus 4.25'	Slope Elevation
SW Corner	465+76	773.9913	774.3402
SW Corner	465+77	773.9984	773.8438
SE Corner	466+85	774.4242	774.0255
SE Corner	466+86	774.4250	774.5334

Exercise 14-3

This group exercise uses the GEOPAK profile tools to plot proposed fill slopes under the bridge as they pass under the right exterior girder. Data from Exercise 14-2 provides the information needed to accomplish this task. Once the fill slopes have been plotted, they can be used to determine the minimum from front face to front face of the end bents. These will be the horizontal lengths as measured along the alignment for Route 50.

1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\profile_j5p0100.dgn**.

   Do a MicroStation fit-view. At the top of the drawing are three diagonal lines. Adjust the MicroStation window so you are zoomed in on the right most diagonal line and the text above it and to the right. This area will be used to plot the right edge of the bridge.

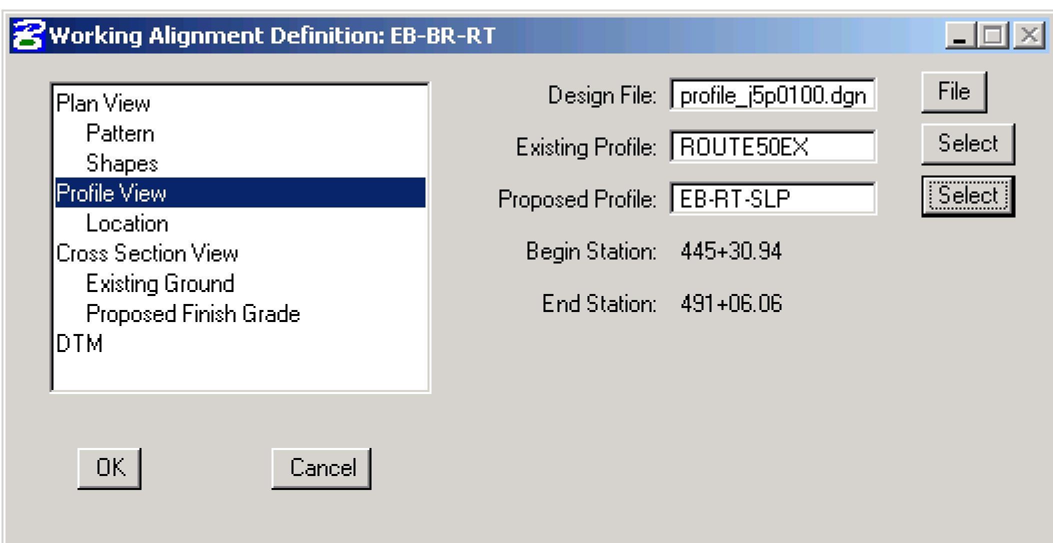
2. Open the project **t:\br-proj\a_geopak\d5\j5p0100\project\j5p0100.prj**.

   Enter the as user **userc**.

3. To keep track of the information for the left edge of the bridge, copy the **Route50** working alignment to **EB-BR-RT** and enter that working alignment.

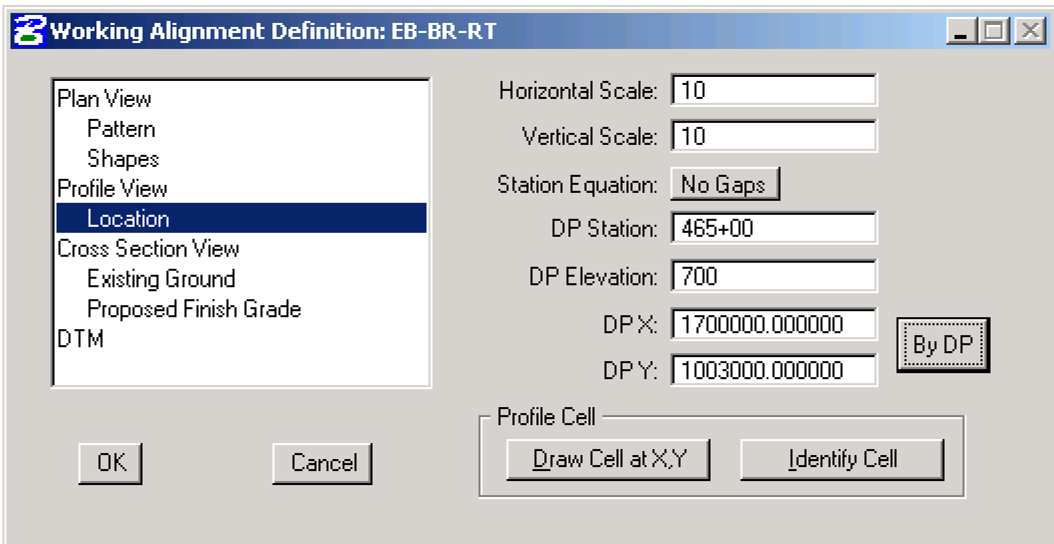
   Make the following changes in the **Profile View** section of the Working Alignment Definition:

   Proposed Profile: **EB-RT- SLP**



Adjust the values in the **Location** section of the Working Alignment Definition to those shown in the following figure:

Horizontal Scale:	**10**
Vertical Scale:	**10**
DP Station:	**465+00**
DP Elevation:	**700**



Click on the **By DP** button and snap to the upper end of the diagonal line and accept. This will set the DP X and DP Y values to those shown above.

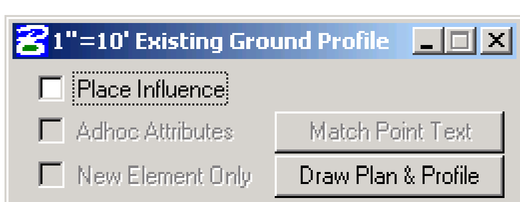
Place the profile cell by clicking on the **Draw Cell at X,Y** button. The active MicroStation text setting controls size of the text in the cell.

Save the changes to the working alignment definition by selecting the **OK** button.

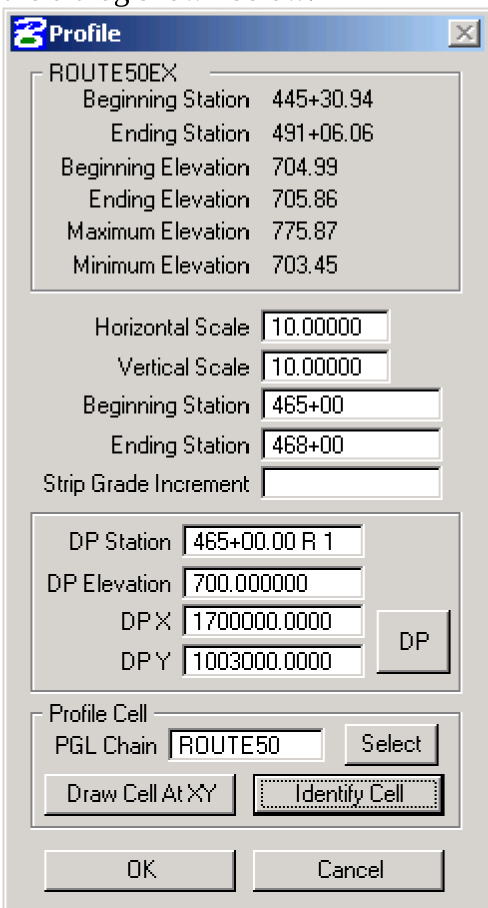
4.  Open **Design and Computation Manager** (D&C) from Road Tools using the icon shown to the left. It will be used to plot the profiles for the left edge of the bridge. The first one to be plotted is **EB-RT-SPL**, which defines the maximum height of the fill slope.

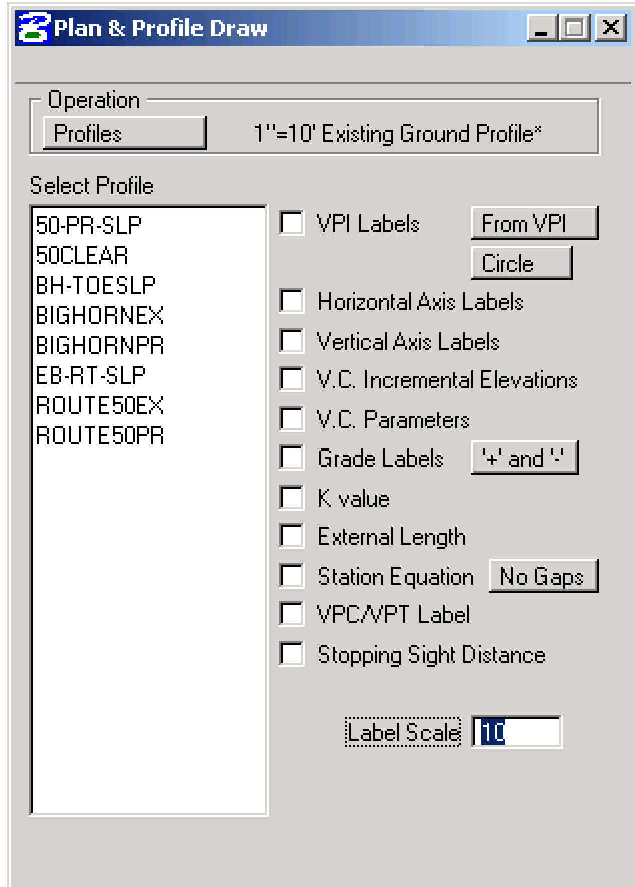
Navigate to:
Drafting Standards\Profile\Existing Ground Profiles\1”=10’ Existing Ground Profile.

Click on **Draw Plan & Profile** in the Operations box shown below.



Change the label scale to **10** as depicted to the right and click on **ROUTE50EX** in the Select Profile list. This will bring up the dialog shown below.





Change the following values:

Begin Station: **465+00**
Ending Station: **468+00**

Click on the **Identify Cell** button, data point on profile cell plotted in the previous step, and data point to accept.

Select **OK** to plot the profile.

In D&C Manager, **double-click** on:
Proposed Ground Profiles\10 Scale Proposed Ground Profile 1”=10’’ H & 1”=10’ V. This will update **GEOPAK Plan & Profile Draw** to the defaults for proposed profiles.

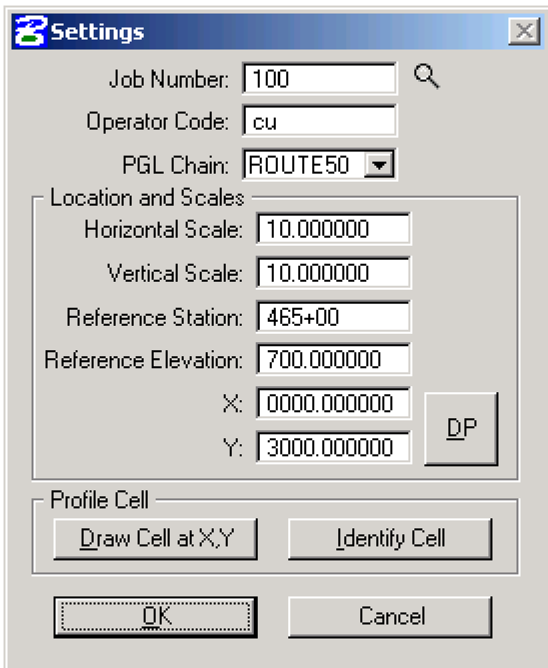
Select **EB-RT-SLP** from the **Select Profile** list.

The settings should be the same as shown above in the figure on the left except for the name of the profile at the top of the dialog and the profile information. Select the **OK** button to plot the EB-RT-SLP profile as the propose profile.

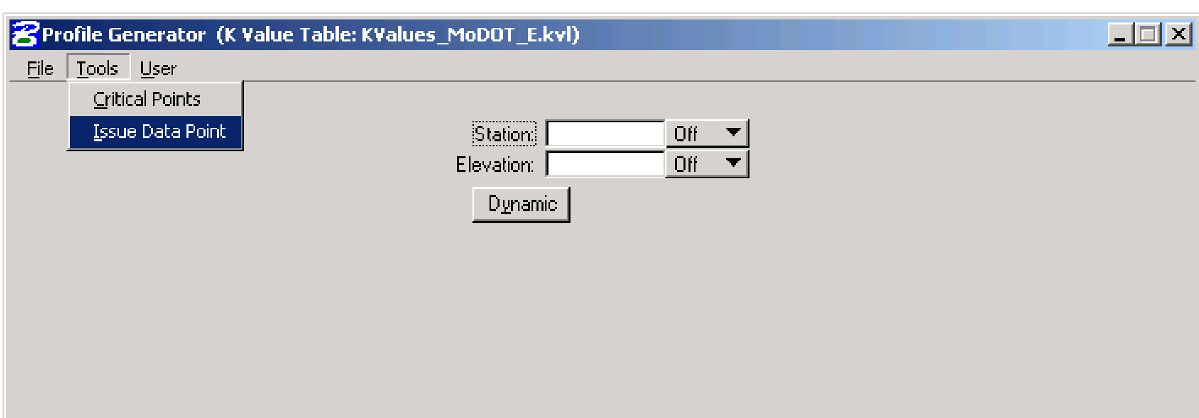
5. In the main D & C dialog, switch to:
   Design Standards \ Cross Sections \ Proposed Surfaces \ Ground (Proposed).

   Make sure **Place Influence** is turned **checked**. This will set the MicroStation symbology to those for fill slope under the bridge. Keep D & C open.

   Go into **Vertical Alignment** from the Road Project Dialog, which will bring up the **Settings** dialog box shown below.

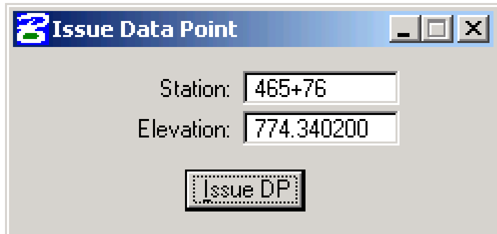


   Everything should be set from the Working Alignment Definition. If your settings do not match those shown above, click on the Identify Cell button in the dialog, data point on the profile cell for the EB-LT profiles. Click the **OK** button. This will bring up the **Profile Generator** dialog box:



   Go to **Tools >> Issue Data Point** as shown above.

6. Use the Issue Data Point to plot the fill slopes. To do this, active the MicroStation **Place Line** tool. Enter the following values into the Issue Data Point dialog as shown below:
   Station: **465+76** Elevation: **774.3402**.



Click the **Issue DP** button to begin a fill slope line.

Issue data points for the following values to draw the rest of the line:

Station	Elevation
465+77.00	773.8438
465+80.00	772.3540
465+90.00	767.3560
466+00.00	762.4142
466+07.44	758.7149

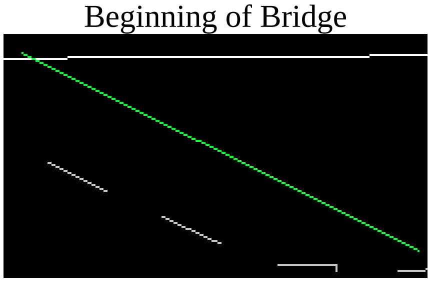
Do a MicroStation reset to end the line. Draw a second line for the other fill slope using the following values:

Station	Elevation
466+55.20	758.9035
466+60.00	761.3367
466+70.00	766.4102
466+80.00	771.4865
466+85.00	774.0253
466+86.00	774.5334

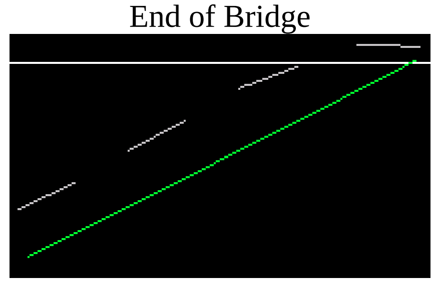
Close D & C Manager and Profile Generator.

7. The lines plotted in the previous step are shown below. The point of interest is where the solid fill slope line crosses the line parallel to the proposed alignment.

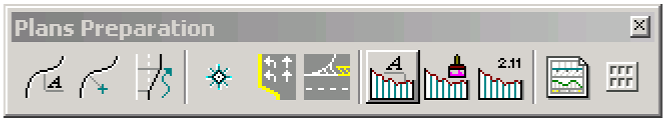
Beginning of Bridge



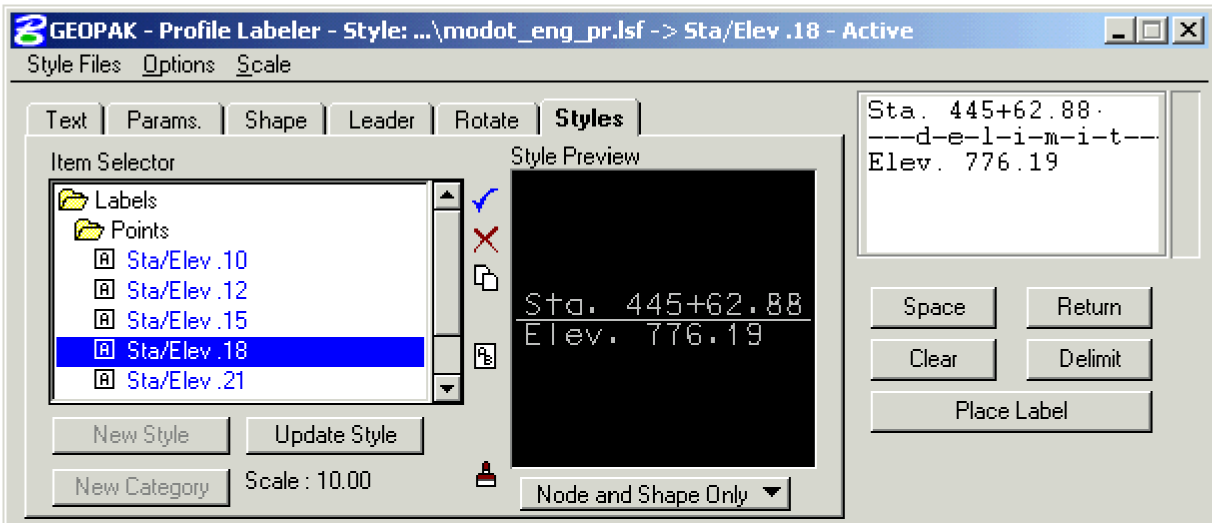
End of Bridge



8. Use the Profile Labeler to find the station and elevation where the fill lines and **EB-RT- SLP** cross. Profile Labeler is the fifth tool in the Plans Preparation toolbox shown below.

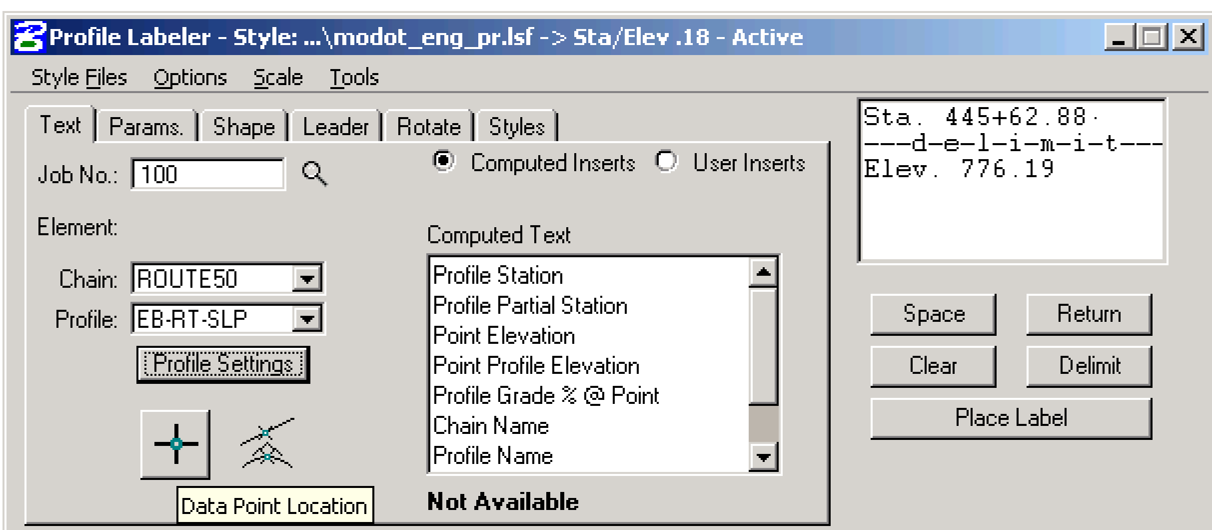


Go to the **Styles** tab in **Profile Labeler**. Open the **Points** folder and double click on the **Sta/Elev .18** style in the **Item Selector** as shown in the following figure.



Go to the **Scale** >> **Change Scale** pull down menu and make sure the **Scale Style** is set to **10**.

Switch to the **Text** tab and select the **Data Point Location** button indicated in the dialog box depicted below. If the Data Point Location icon is not there, click on Profile Settings and click OK in the dialog box that appears. Snap to the intersection of the fill-slope line with the plotted profile and accept the snap.



Click on the **Place Label** button and place the label.

9. Compare your intersection points to the values given below.

Location	Station	Elevation
Bent 1	465+76.69	774.00
Bent 4	466+85.79	774.42

These station values can be used to determine the minimum distance from front face of end bent to front face of end bent along the right exterior girder. Remember, however, that the stationing is measured along the chain, which is at the centerline of median. This needs to be kept in mind when determining the actual bridge length.

Save changes to the MicroStation drawing.

Exercise 14-4

With the information from the previous two exercises, it is possible to layout the eastbound bridge. This group exercise will use COGO to store and plot needed locations.

1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\plan_50_j5p0100.dgn**. Attach as a reference **t:\br-proj\a_geopak_\d5\j5p0100\data\plan_bh_j5p0100.dgn**. Window in on the intersection of the two alignments so Route 50 stations 465+00 to 468+00 are visible.

2. Open the project **t:\br-proj\a_geopak\d5\j5p0100\project\j5p0100.prj**.

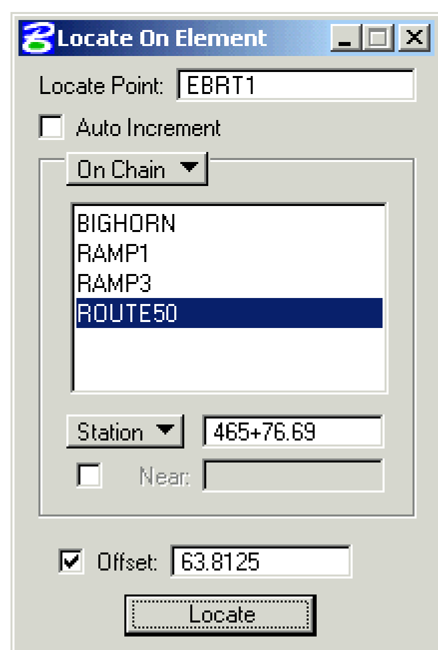
   Enter the as user **userc**.

   Switch the Working Alignment to **Route50**.

3. Enter **Coordinate Geometry**.

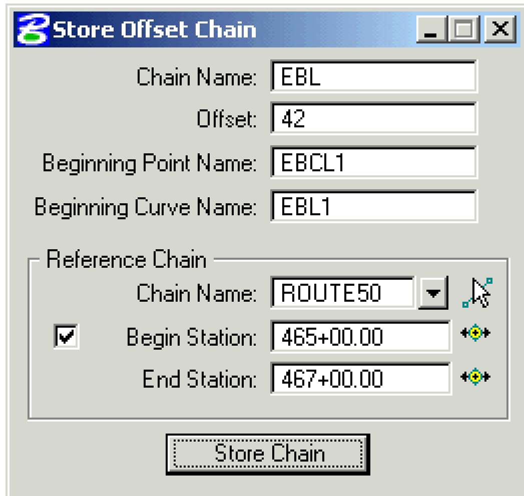
   Go to **Tools > Locate > On Element** to bring up the dialog shown to the right. It is used to store a point on a curve, a spiral, or a chain. Choose the **On Chain** option. The **Station** option will be used to store points on chain **ROUTE50**.

   Store the points listed in the table below. They are based on information obtained in Exercise 14-2 and locate where the fill slope intersects the profile EB-RT-SLP, which determines the minimum distance from the front face one end bent to the front face of the other end bent. The stationing is for Route 50. The dialog box for storing the first point is shown to the right.



Location	Pt. Name	Station	Offset
Bent 1 Front Face	**EBRT1**	**465+76.69**	**63.8125**
Bent 4 Front Face	**EBRT4**	**466+85.79**	**63.8125**

4. The location of the bents is based on layout lengths along the centerline of the eastbound lane. Storing a chain at this location will ease the calculation of lengths along this line. Since this line is located 42' to the right of chain **ROUTE50**, the store chain from offset chain command will be used. The dialog for this command is located in the COGO menu **Element > Chain > Store > Offset Chain** and is depicted below.

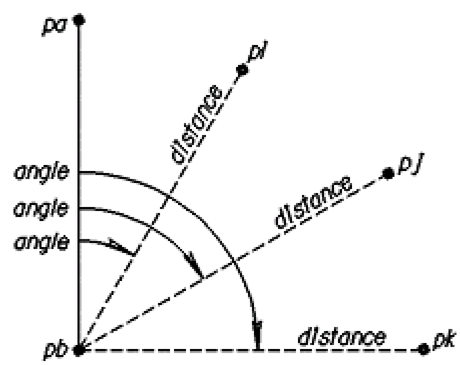


Fill out the top of the dialog box as shown, select **ROUTE50** as the Reference Chain, and press **Store Chain**.

5. The skew of the bents is based on a radial line to Route 50 running through the intersection of the Route50 and BigHorn alignments so that the bents are roughly parallel to Big Horn Dr. Determine the angle between this radial line and Big Horn Dr. where it crosses Route 50 chain by using the angle command:

ANGLE pa pb pi-pk,

where the point numbers are used as defined in the figure and referenced to the job as follows:



pa = **PT BIGHORN-1**
pb = **10** (Point at alignment intersection)
pi = **CC ROUTE50-1**

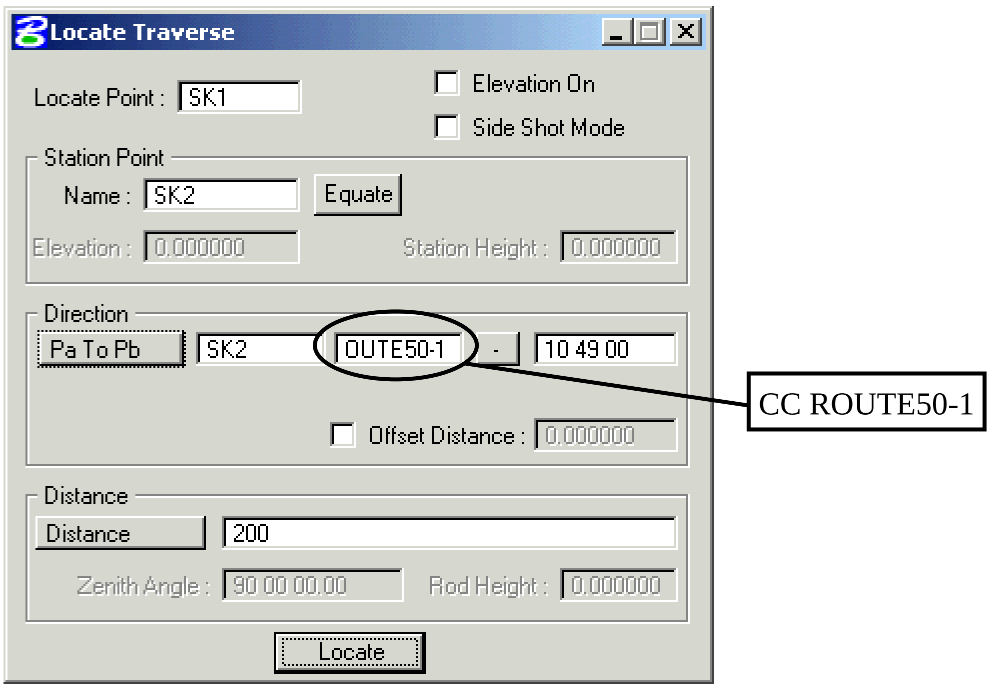
Key in the COGO command: **ANGLE PT BIGHORN-1 10 CC ROUTE50-1**

The returned value is rounded to a right advance skew of 10° 49'.

6. Store two points (SK1 and SK2) to define the direction of the bents from left to right.

   Locate point SK2 at the intersection of the BIGHORN and EBL chains (Tools > Intersect).

   Locate point SK1 200' from SK2 on a direction 10° 49' to the left of a line from SK2 to the center of curve Route50-1 (Tools > Locate > Traverse). The dialog box is shown below:



   The circled field in the dialog to show all of the text for the field. Use the value in the text box to the right of the dialog for that filed. After filling in the information click on **Locate** to store the point.

7. Determine the minimum distance between centerlines of bearing at the end bents and point SK2 as measured along the centerline of the eastbound lane.

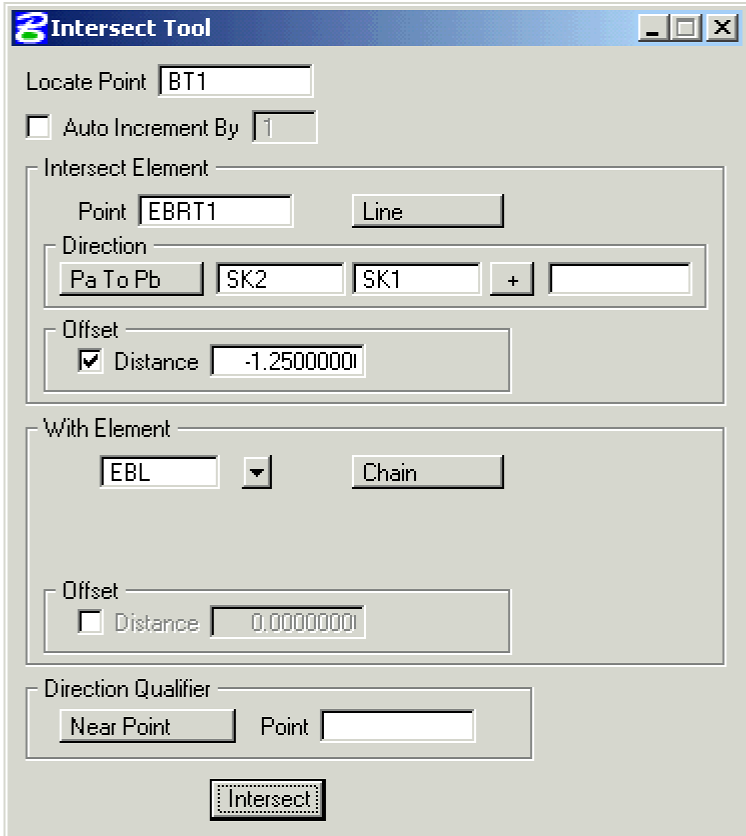
   To locate the points, use the intersect tool (**Tools > Intersect**) to project points **EBRT1** and **EBRT4** onto chain **EBL** using the direction from **SK2** to **SK1** with an offset of 15" (1.25'), which is one half of the with of the end bent beams. Call the new points **BT1** and **BT4**. The COGO Key-in commands are:

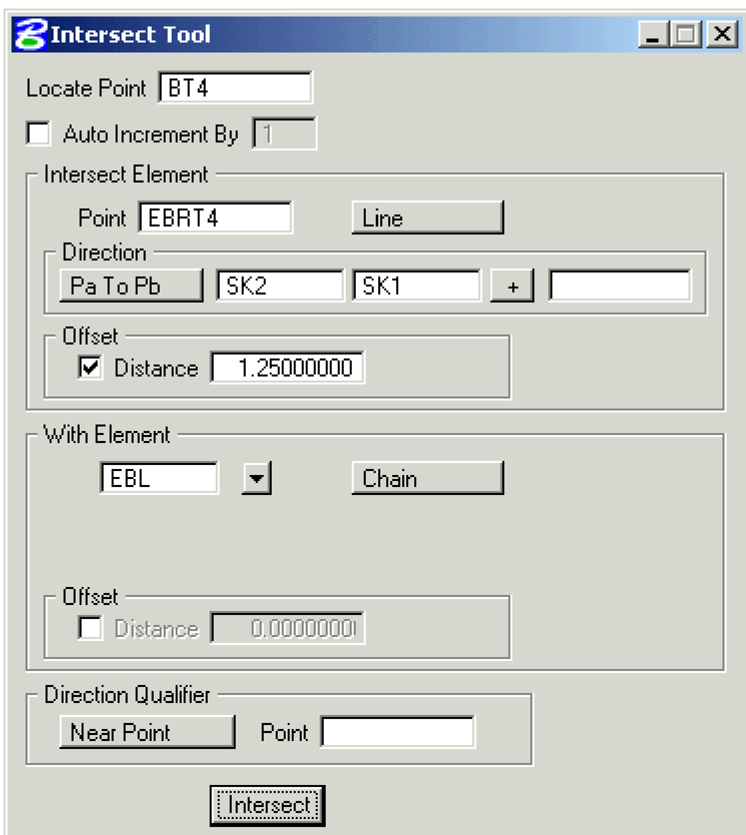
   LOCATE BT1 INTERSECT LINE EBRT1 SK2 TO SK1 OFF -1.2500 CHA EBL

   LOCATE BT4 INTERSECT LINE EBRT4 SK2 TO SK1 OFF 1.2500 CHA EBL

   The dialogs for storing these points are shown on the following page.

7. (Continued)


Intersect Tool
Locate Point BT1
Auto Increment By 1
Intersect Element
Point EBRT1
Line
Direction
Pa To Pb
SK2
SK1
+
Offset
Distance -1.2500000
With Element
EBL
Chain
Offset
Distance 0.0000000
Direction Qualifier
Near Point
Point
Intersect


Intersect Tool
Locate Point BT4
Auto Increment By 1
Intersect Element
Point EBRT4
Line
Direction
Pa To Pb
SK2
SK1
+
Offset
Distance 1.25000000
With Element
EBL
Chain
Offset
Distance 0.0000000
Direction Qualifier
Near Point
Point
Intersect

7. (Continued)
To measure the distance along the EBL chain for the points **BT1**, **SK2**, and **BT4**, us the inverse command (**Tools** > **Inverse**), as shown in the following dialog. Be sure to **toggle on Distance Along Chain** and enter **chain EBL**.

The COGO output is:

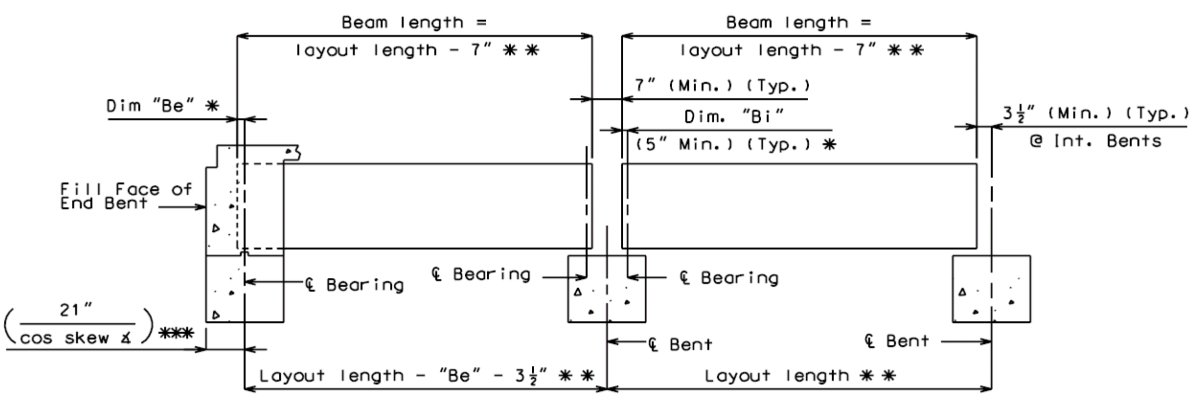
```
Point         X                Y          Station/Region  Offset  Distance
-----  -------------- -------------- --------------- -------- --------
BT1    1,700,122.1665   999,252.1784    465+71.97   1    0.0000
                                                                 57.2216
SK2    1,700,179.1964   999,247.5093    466+29.19   1    0.0000
                                                                 56.8846
BT4    1,700,235.9706   999,243.9813    466+89.07   1    0.0000
```

Consequently, the distance as measure along the centerline of the east bound lane between the centerline of Bent 1 and SK2 must be at least 57.23’, 56.89’ between SK2 and the centerline of the last bent, and 114.1’ for the whole bridge.

8. Calculate the overall **Design Layout Length** for the bridge.

Based on **BM 3.55.3.1-3** (shown below), overall layout length for the bridge is:

$$\Sigma \text{ (CL Bent to CL Bent)} + 2 * (B_e + 3\ ½”).$$



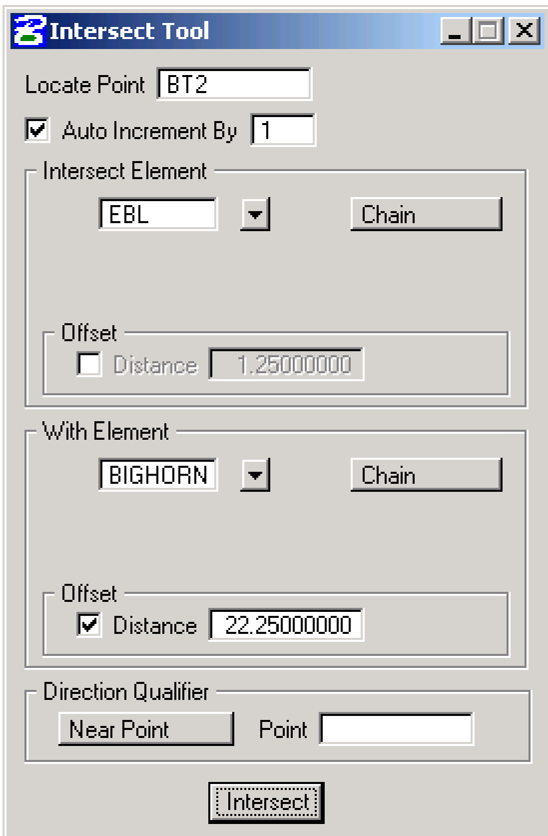
Integral End Bents

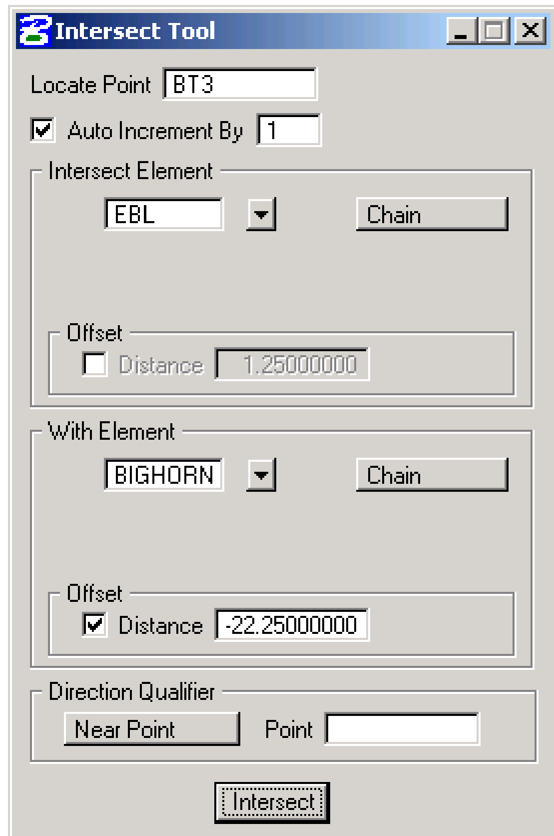
For this bridge B_e = 5 ½” and B_e + 3 ½” = 9” = 0.75’. Thus, the minimum layout length:

for the whole bridge = 114.1’ + 2 (0.75’ = 114.1’ + 1.5’ = 115.6’ **Use 116’**
from Bent 1 to SK2 = 57.23’ + (5 ½ + 3 ½)” = 57.23’ + (0.75’) = 57.98’ **Use 58.0**
from SK2 to Bent 4 = 56.89’ + (9)” = 56.89’ + 0.75’ = 57.64’ **Use 58.0**

9. Determine the layout length for each span.

According **LRFD 2.4.1.2-1**, the minimum clearance between the front of the curb (offset of 18.5’) and Bents 2 and 3 needs to be 2.0’. Assuming a maximum bent width of 3.5’, the offset for the centerlines of Bents 2 and 3 from the BigHorn chain needs to be at least 18.5’ + 2.0’ + 3.5’/2 = 22.25’. Use the intersect tool to **store point BT2 at the intersection of chain EBL & chain BigHorn offset 22.25’ to the right** and **store point BT3 at the intersection of chain EBL & chain BigHorn offset 22.25’ to the left**. The dialog settings for storing the two points are shown below.





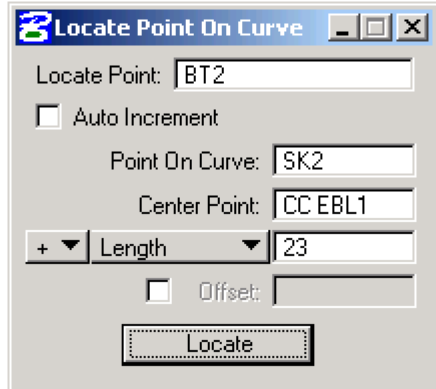
Use the Inverse command to find the distance along chain EBL for points BT2, SK2, and BT3. The results are:

```
Point          X               Y          Station/Region   Offset  Distance
-----  --------------  --------------  ---------------  --------  --------
BT2    1,700,156.6040   999,249.2238    466+06.53   1    0.0000
                                                                   22.6575
SK2    1,700,179.1964   999,247.5093    466+29.19   1    0.0000
                                                                   22.6243
BT3    1,700,201.7685   999,245.9731    466+51.81   1    0.0000
```

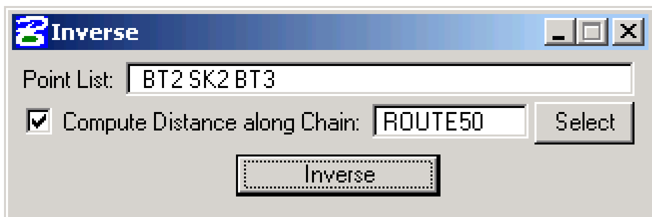
Rounding these values up to the nearest 0.5’, use the following **layout lengths: Span 1-2 = 35.0’** (58.0 – 23.0’), **Span 2-3 = 46.0’** (23.0’ + 23.0’), and **Span 3-4 = 35.0’** (58.0’ – 23.0’).

10. Determine the bridge's tie station, which will be at Bent 2.

Use **Tools** > **Locate** > **Point on Curve** to **relocate point BT2 at the centerline of Bent 2 where it crosses chain EBL** using one half of the length of span 2-3 from SK2. The dialog is shown to the right.



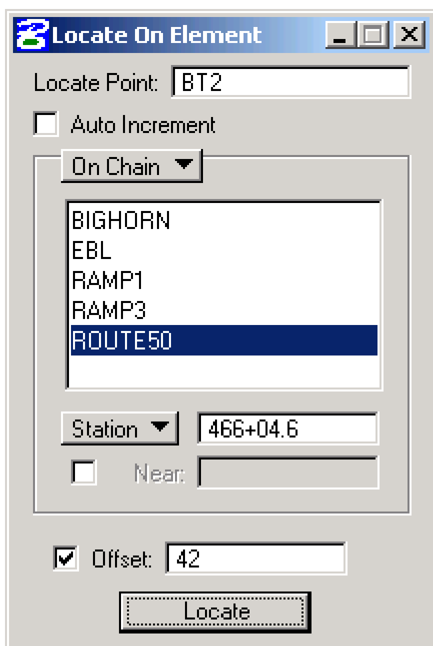
Use the Inverse tool to find the station and offset of point BT2 relative to chain Route50. Since the inverse tool requires more than one point, some dummy points are included in the following dialog:



Base on the COGO output information shown below and rounding to the nearest tenth, the **tie station is 466+04.6**.

```
Point         X              Y          Station/Region   Offset  Distance
-----  -------------- -------------- --------------- -------- --------
BT2    1,700,156.2625   999,249.2511    466+04.65   1    42.0000
```

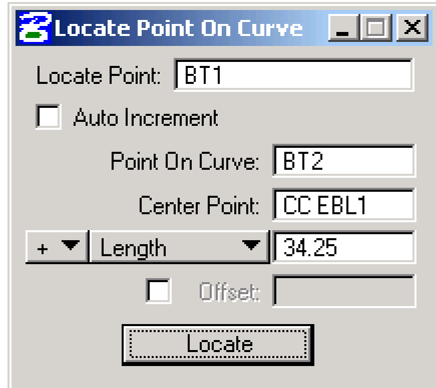
Use Tools > **Location** > **On Element** to **restore point BT2 at chain Route50 station 466+04.6 and a 42' offset**. The dialog with the proper settings is:



11. The intersection of the centerlines of the other bents with the centerline of the EBL can be located based on point BT2 and the span layout lengths.

    Use **Tools** > **Locate** > **Point on Curve** to **relocate points, BT1, BT3, and BT4 where the centerline for each bent crosses curve EBL1**. The distances along the curve are given in the following table. The dialog for storing point BT1 is shown to the right.

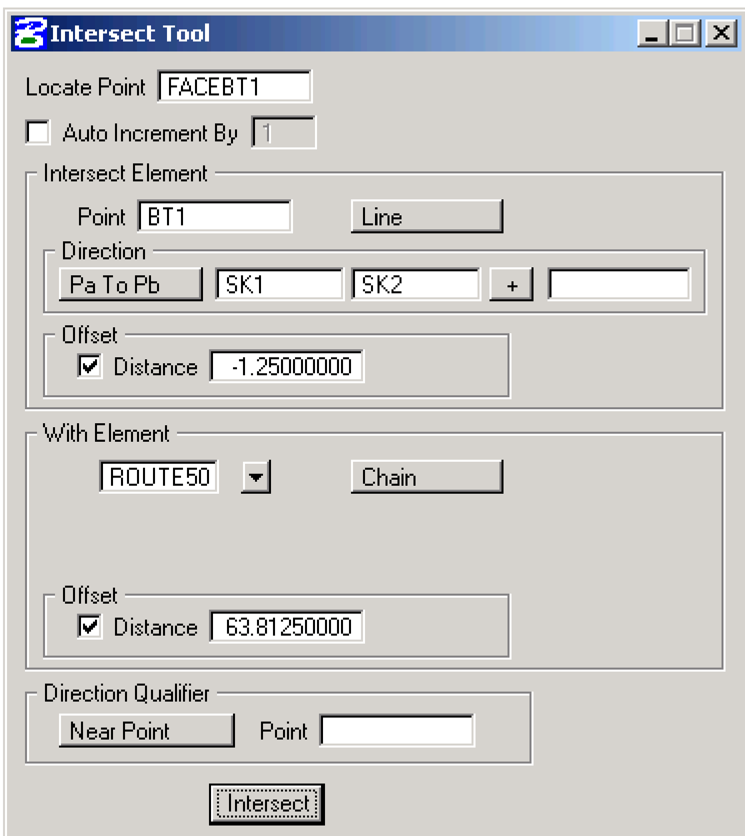
Point	Dist. along EBL1 from tie	Direction
BT1	35' - 0.75' = **34.25'**	+ (clockwise)
BT3	**46.0'**	- (counterclockwise)
BT4	46' + 35' - 0.75' = **80.25'**	- (counterclockwise)



12. Check the location of Bents 1 and 4. To do this, store two points where the front face of each end bent crosses the outside face of the right exterior girders (Route 50 offset 63.8125', as determined in exercise 14-2) and compare the points to EBRT1 and EBRT4. Call the new points FACEBT1 and FACEBT4.

    Use **Tools** > **Intersect** to store the two points. The dialog for storing **FACEBT1** is shown to the left. (**Note**: The 1.25' offset accounts for ½ of the beam width.)

    Use **Tools** > **Inverse** to measure the distance along chain Route50 for the following list of points: **FACEBT1 EBRT1 EBRT4 FACEBT4**. If the station values relative to Route 50 are all increasing, the location of the end bents is okay.



Chapter 15

Proposed Cross Sections & Typical Section Generator

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15.1 Objectives

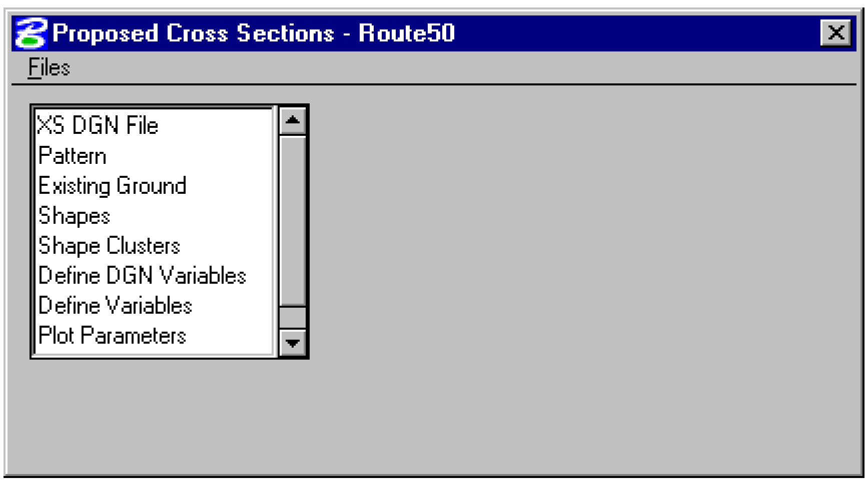
- Use Project Manager to create proposed cross-sections using the Typical Section Generator Tool.
- Understand what criteria files are and how Geopak Typical Section Generator uses them to define side slope conditions for proposed cross-sections
- Become familiar with MoDOT's Typical Section Generator.

15.2 Accessing

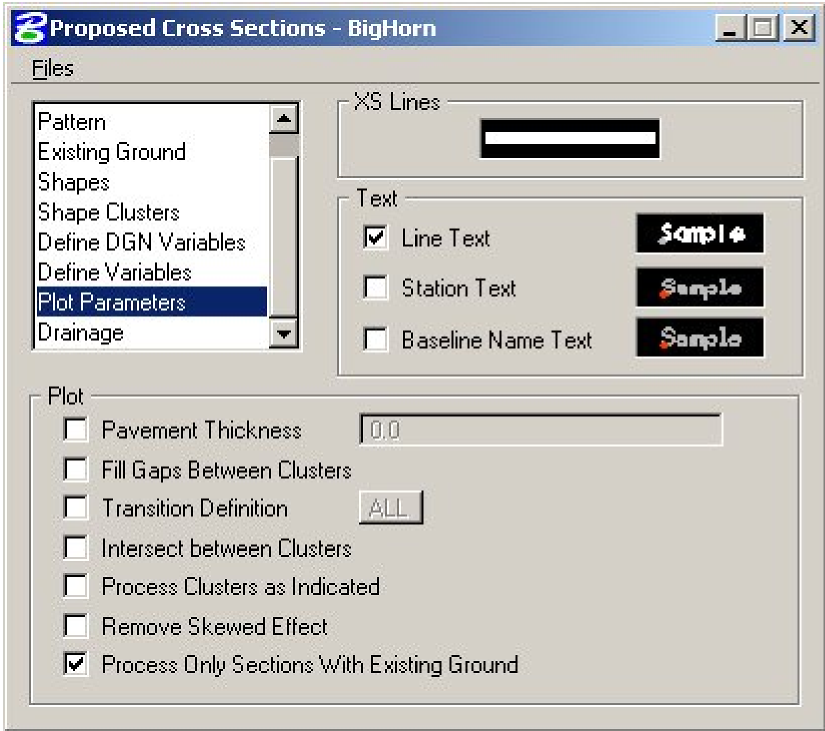
Proposed cross-sections can be accessed from **Project Manager >> Proposed Cross Sections**. IMPORTANT NOTE: If the default MoDOT run is older than 06/08/2004 it needs to be replaced

15.3 Dialog

When the **Proposed Cross Sections** button in the Road Project Manager is pressed, the Select Run dialog is displayed. An existing run may be selected or new run may be started. When complete, press the **OK** button, which will close the Select Run dialog and open the proposed cross sections dialog as depicted below.

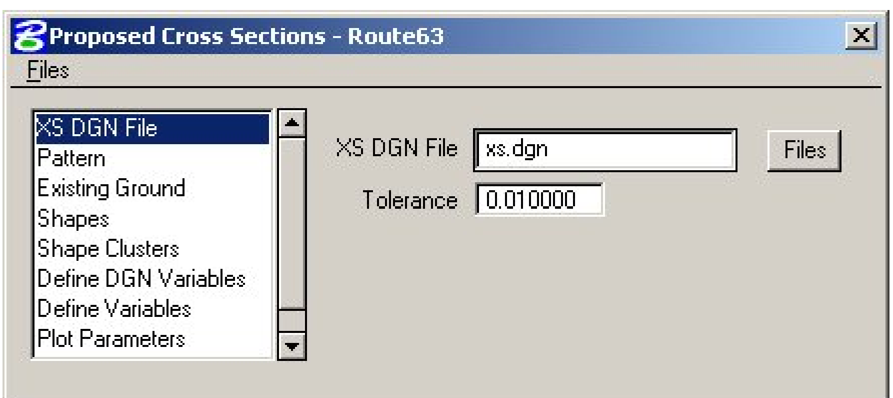


The left side of the dialog contains the list of parameters required to process proposed cross sections. When each parameter is selected, the dialog changes to reflect the requirement of each parameter. For example, when **Plot Parameters** is selected, the dialog changes to reflect the various plot parameters and text as depicted on the next page.



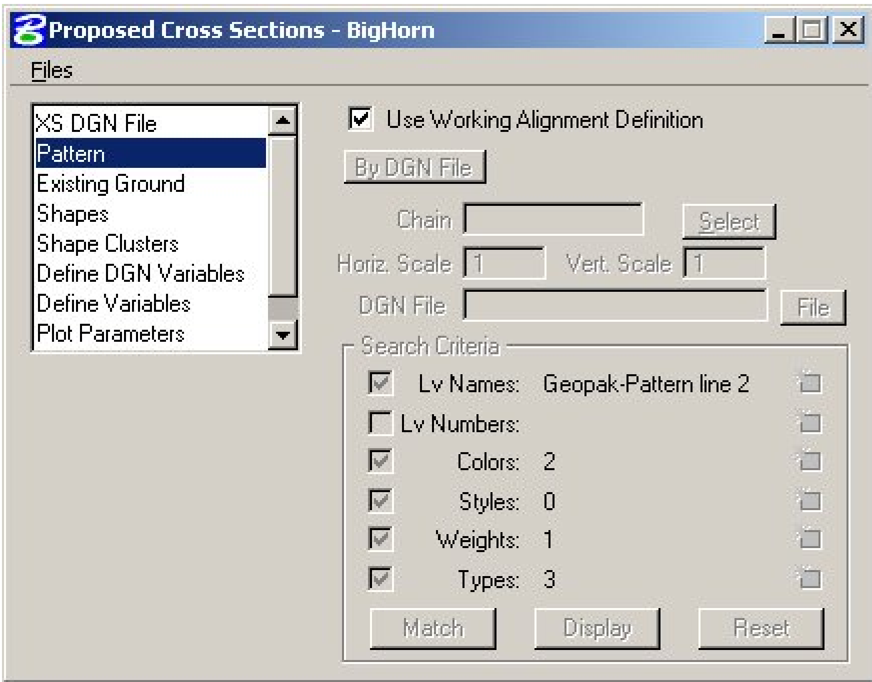
15.3.1 XS DGN File

XS DGN File controls the Microstation file in which the original ground cross-sections are located. The proposed cross section elements will be placed into this file.



15.3.2 Pattern

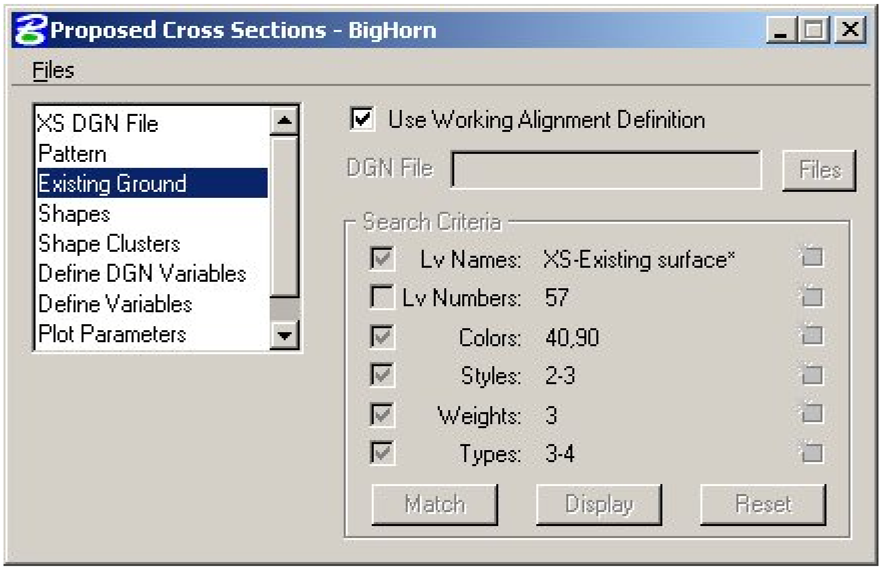
When **Pattern** is selected, the dialog changes to the illustration below. This section contains information on how to find the pattern lines used to create the original ground cross-sections.



Three dialogs (Pattern, Existing Ground, and Shapes) support a toggle to **Use Working Alignment Definition**. For example, in the Pattern dialog above, the toggle is not active; therefore the user must supply all pattern information. However, if the toggle is active when one of these three dialogs is invoked, the data information part of the dialog is ghosted and the required information is utilized from the current working alignment. If the toggle is activated, and the required information is not stored within the current working alignment, an Alert message is displayed. It is recommended to use the working alignment definition when this toggle is available.

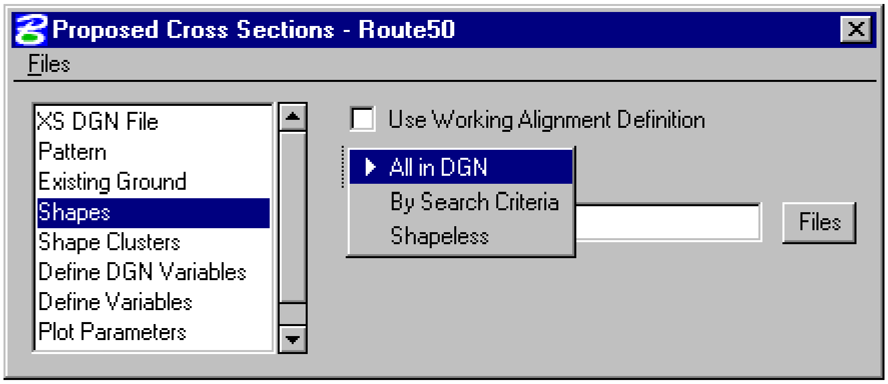
15.3.3 Existing Ground

Existing Ground section contains information to identify the symbology of the existing ground cross-sections. The user toggles on the **Search Criteria** options needed to identify the existing ground, then selects the values for those options. The **Use Working Alignment Definition** toggle is also available.



15.3.4 Shapes

When the **Shapes** parameter is selected, the dialog is displayed as depicted below.



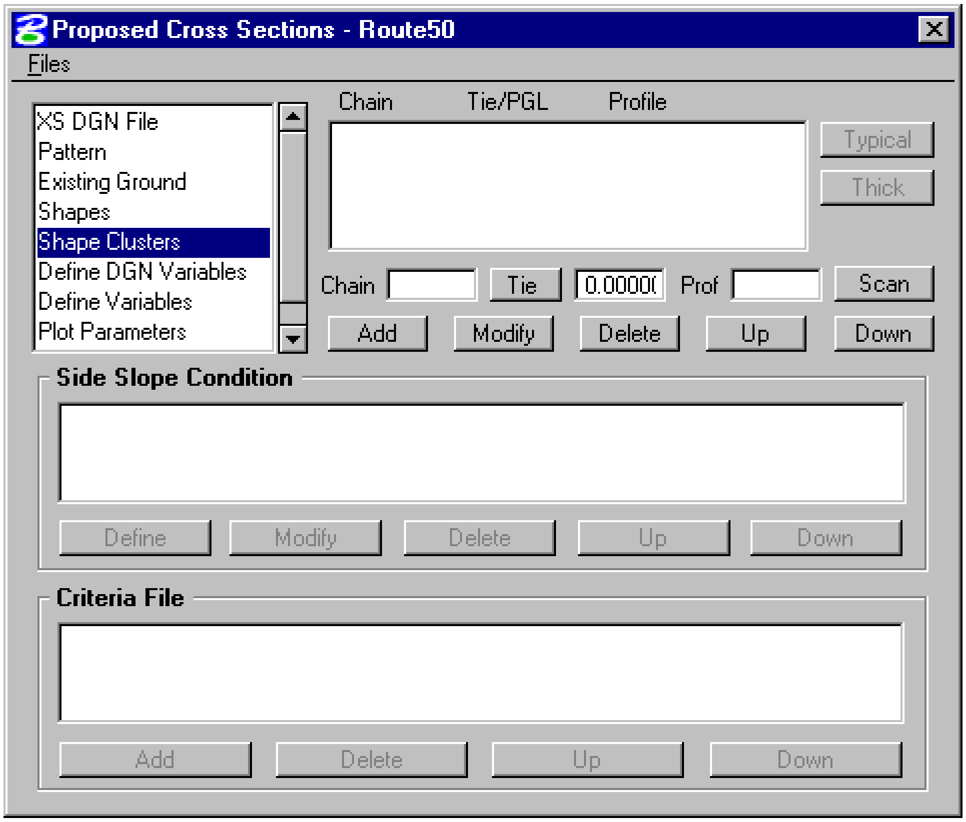
Three options are supported as depicted in the exploded view:

- **All in DGN** - All shapes within the specified file are utilized.
- **By Search Criteria** - Only those shapes that match the specified search parameters are utilized.
- **Shapeless** - No shapes are utilized. In this option, there is no field for a shapes file name or files button.

The **Use Working Alignment** toggle is also available.

15.3.5 Shape Clusters

When the **Shape Clusters** parameter is selected, the dialog dynamically changes as depicted below.



The user may **Add, Delete,** or **Modify** any specified shape clusters. When the **Scan** button is pressed, Geopak scans the design file and uses the search criteria specified in the **Shapes** dialog to lists all matching shape clusters. In the case of shapeless criteria, the user must define the cluster by typing in the Chain, Tie/PGL and Prof, then pressing the **Add** button.

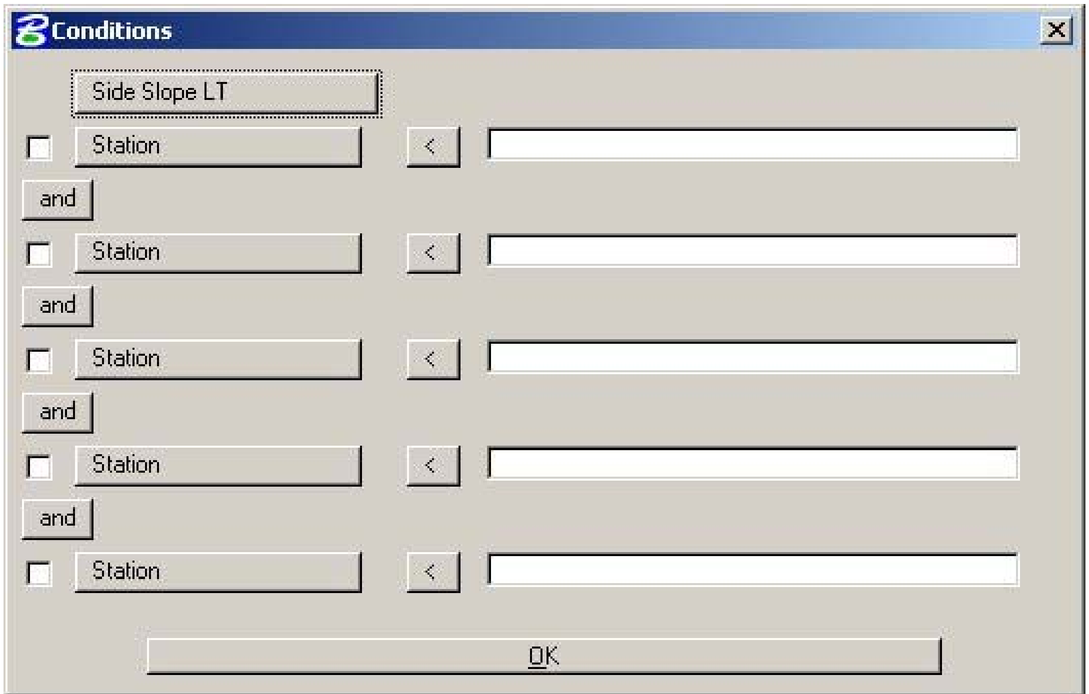
15.3.5.1 SIDE SLOPE CONDITIONS

The **Side Slope Conditions** define what happens for each side of the shape cluster, and/or within a specified station range on the specified side of the shape cluster. The side slope conditions can be defined either by Conventional Side Slope Definition or by using the **Typical Section Generator** tool.

15.3.5.2 CONVENTIONAL SIDE SLOPE DEFINITION

To set up the side slopes conditions by conventional methods, the user needs to choose the **Define** button from the shape clusters dialog box. The define button is available once a shape cluster is added.

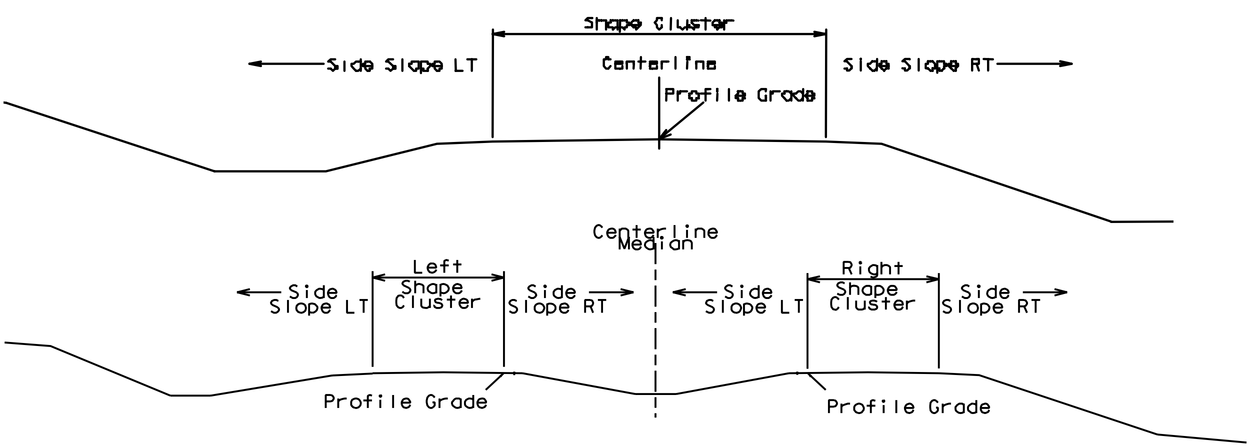
When choosing the Define button the following dialog box is displayed



The user can choose **Side Slope LT**, **Side Slope RT**, or **Offset Minus/Plus Side Slope LT/RT**.

Certain conditions such as Station > 5+000, or Median Width <= 7.2 can be set up to apply the side slope information if those conditions are met. For example, the side slope condition *Side Slope LT where Station >= 15+00 and Station <= 23+00* would apply the specified criteria files (criteria files are discussed later) to the left side of the shape cluster only between and including stations 15+00 and 23+00.

It is important to remember that the side slope conditions pertain to the left or right side of the shape cluster, not the left or right side of the baseline.



15.3.5.3 CRITERIA FILE

For each **Side Slope Condition** criteria files are added based upon the type of features to be drawn in the cross-sections. Criteria files will be covered in Section 15.4.

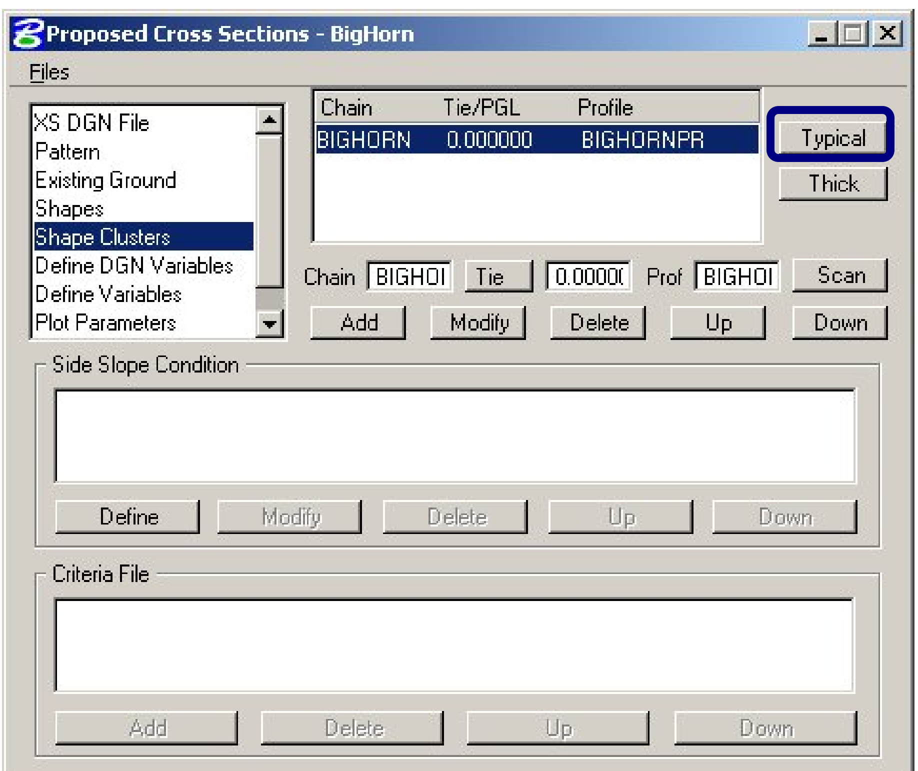
15.3.5.4 TYPICAL SECTION GENERATOR

The Typical Section Generator (TSG) tool allows the user to select a picture representing the project typical section to set up the side slope conditions and appropriate criteria files. This tool is designed for accommodating 90% of project cases.

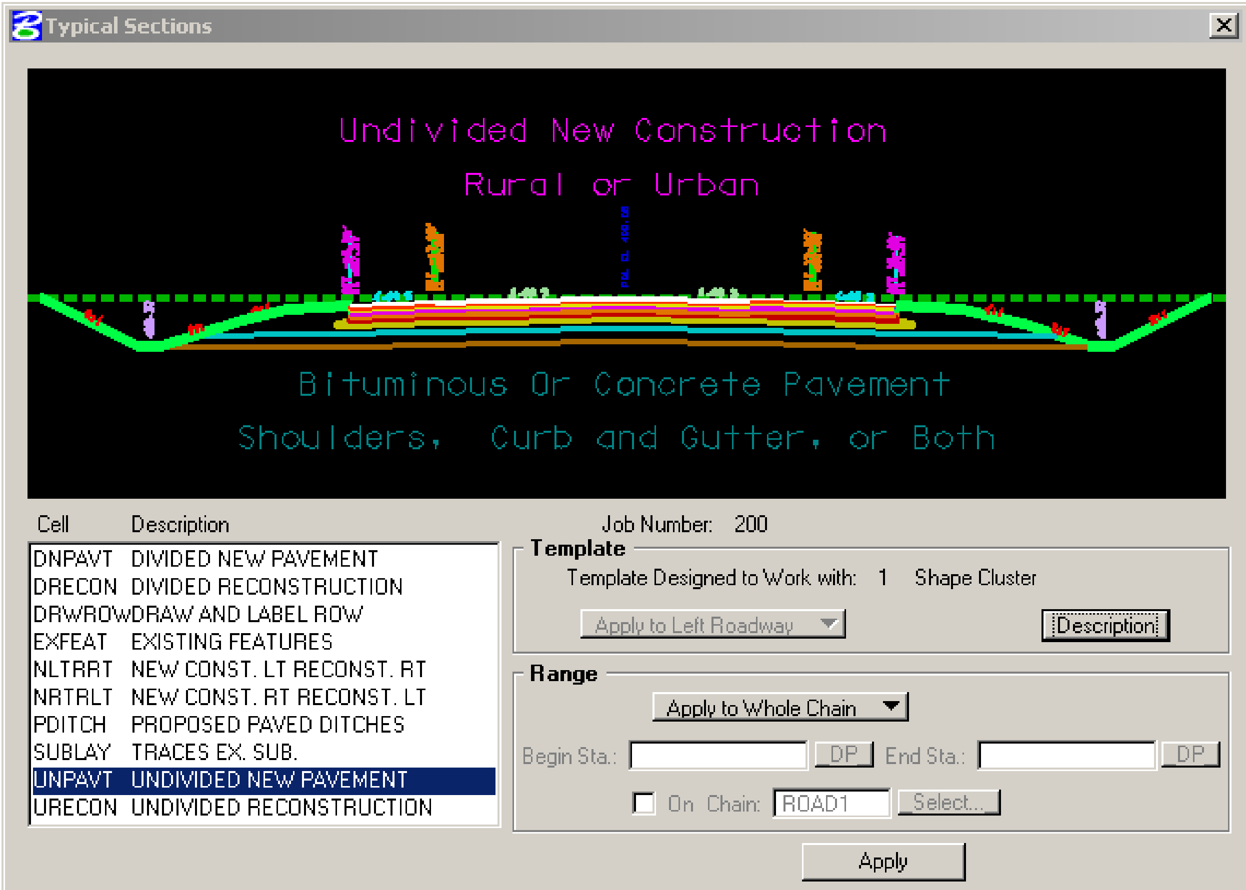
The TSG is a powerful and versatile tool. It can be used for both rural sections, urban sections or a combination of the two. Similarly, this tool can be used for both bituminous and rigid pavement as well as a combination of the two within the same project. The tool allows the user to select a particular typical section for one or multiple station ranges.

The TSG works by searching for plan view elements and then it draws the proposed cross section elements based on the typical section selected and the plan view elements found. Therefore, it is required placing **ALL plan view elements** using the **Design and Computation Manager** (D&C Manager). Each typical section has a **Help File**, which specifies the D&C Manager path to all available plan view elements. These help files can be accessed through the CADD Support internal web page.

To access the Typical Section Generator, select the **Typica**l button in the dialog box below.



The Typical Section dialog box opens and it is displayed below

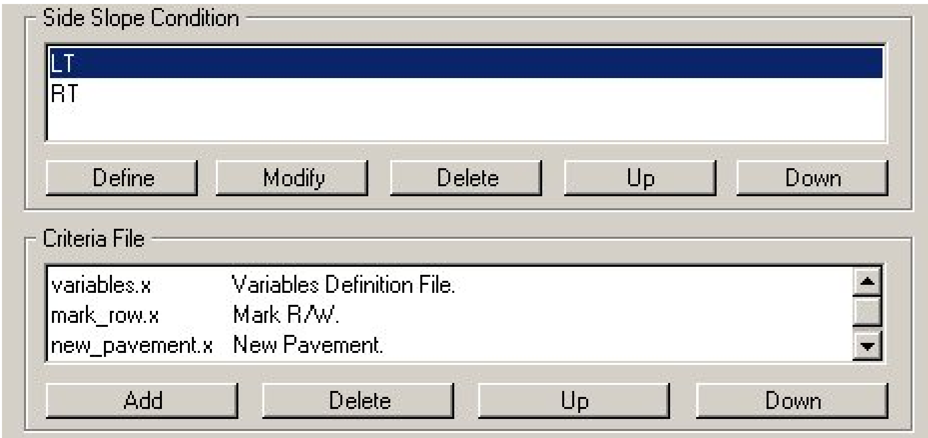


The user has a list of ten (10) different typical sections from which to choose. Each typical section has a picture and a description, which can be accessed by clicking on the **Description** button. The description shows in great detail what plan view elements are required in order for the typical section generator to work. In addition, it explains all the define and redefinable variables. **Define Variables** and **Redefinable Variables** are explained in **Section 15.3.7** & **Section 15.3.8** respectively.

The dialog offers information such as the job number and how many shape clusters are required for using the individual template. When the template requires two (2) shape clusters, the user will be required to apply the typical section to both sides of the roadway. It is ***imperative*** that the roadway template is applied to the left of the roadway first.

In addition, the user has the option to apply the selected typical section to either the whole chain or a particular station range. The user will also have the option to choose a particular chain. Note that if using working alignment definition, choosing a chain will not be necessary.

When the apply button is selected in the TSG, the side slope conditions are automatically populated with the appropriate criteria files.

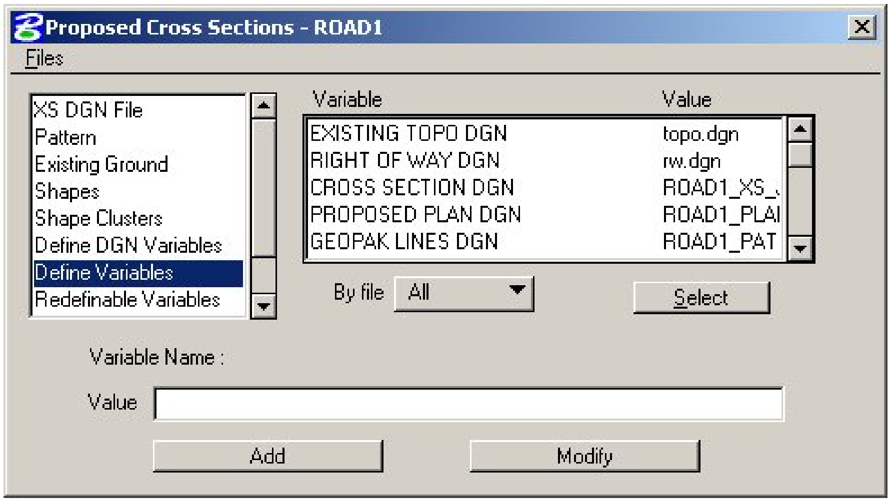


15.3.6 Define DGN Variables

The **Define DGN Variables** option allows the user to define how to locate Microstation elements used by the criteria files. **Define DGN Variables** can be determined from the element symbology, or from the symbology and attributes assigned in the D&C Manager database. MoDOT users do not need to define the DGN Variables. These are defined within the criteria files.

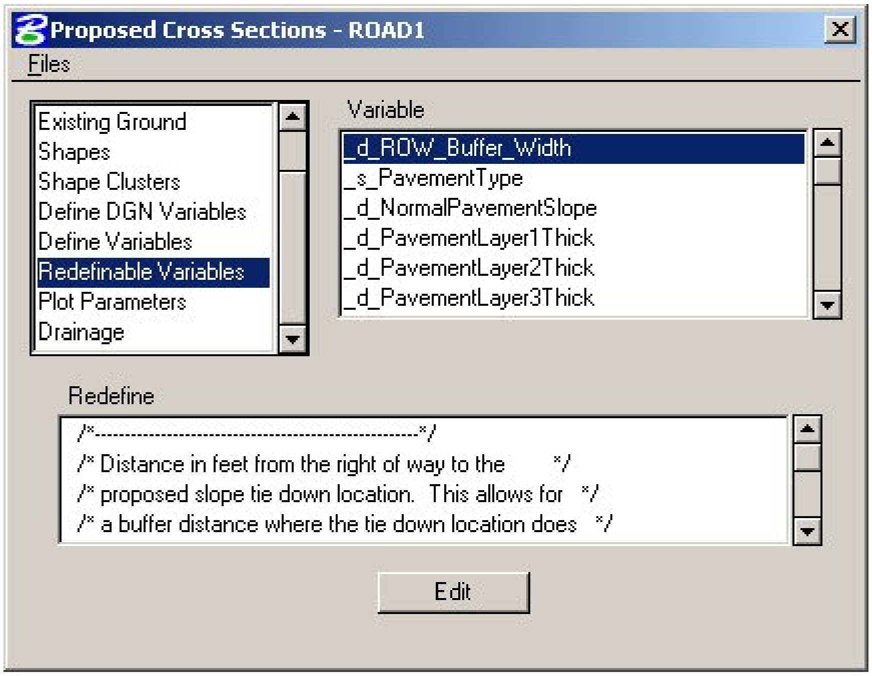
15.3.7 Define Variables

Define Variables are variables that allow the user to enter certain information regarding plan view elements, special chains and profiles, and Microstation files to be used as well as the appropriate scale used for text and symbol size. The user can select the variable from the list, then enter the value and select the **Modify** button.

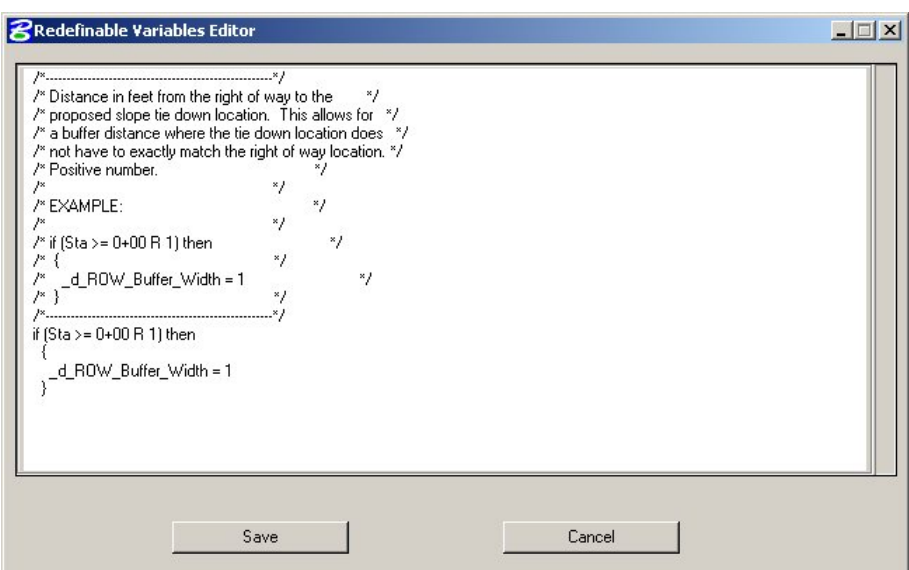


15.3.8 Redefinable Variables

Redefinable Variables are variables that allow the user to enter job specific values for certain items to be drawn with the typical section generator. Some of these items include, but are not limited to type of pavement, pavement thickness, type and thickness of shoulders, ditch width, side slopes, etc. These variables can be "redefined" for various station ranges. The variable displayed will depend on the typical section selected.

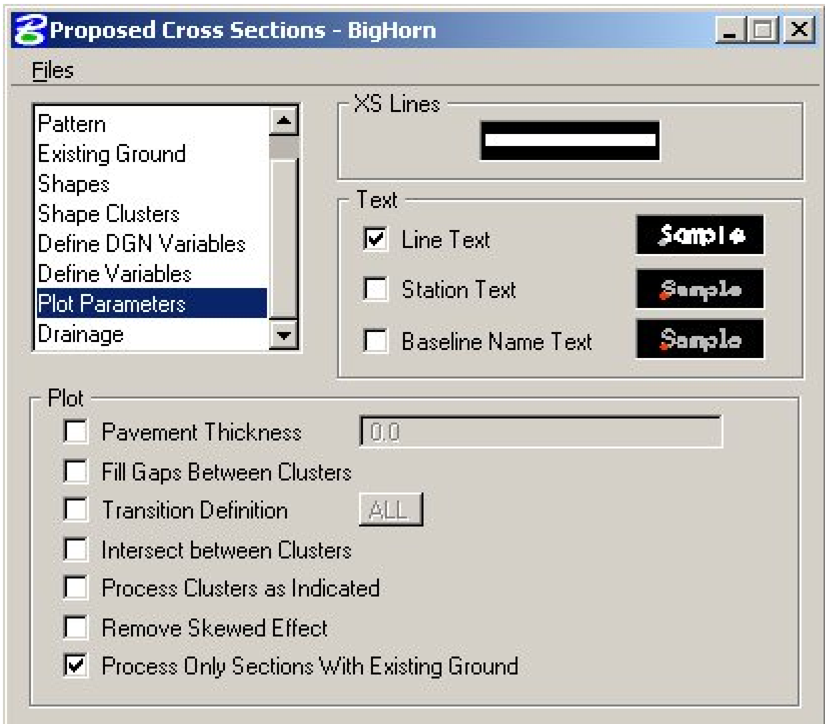


Each redefinable variable is set to a default value. The user selects the variable from the list and click on the **Edit** button to input the appropriate value for the specific project. The editor opens and the user can edit the value.



15.3.9 Plot Parameters

Plot Parameters allow the user to determine how the data from the superelevation shapes are going to appear. **XS Lines** determine the symbology of the pavement surface. **Text** plots various pieces of text relating to the cross-section. **Plot** allows the user to control different aspects relating to the cross-sections and criteria files. The **Plot Parameters** dialog box is displayed below.



Pavement Thickness will plot a depth of pavement below the pavement surface. MoDOT users should leave this value at 0.0. The pvmt_layers.x criteria file should be used to draw the depth of pavement.

Fill Gaps Between Clusters will draw a line between two shape clusters if the criteria does not fill between them.

Transition Definition defines the use of superelevation parabolic transitions. MoDOT users should use the ALL option.

Intersect Between Clusters will extend or trim elements in a median to create a finished, clean appearance.

Process Clusters as Indicated will force the criteria to process the clusters as they are listed in the **Shape Clusters** dialog. If this option is turned off, the clusters will be processed left to right.

Remove Skew Effect will force Geopak to correct itself back to the pattern line if a skewed element is encountered in the processing of the criteria files.

Process Only Sections With Existing Ground will process the proposed cross sections for only those cross section cells that have existing ground drawn.

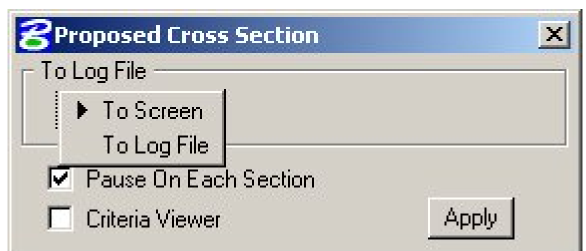
15.3.10 Drainage

The **Drainage** section allows the user to draw the drainage components into the cross sections. The drainage .dgn file, and the drainage project database must be specified.

15.3.11 File Menu

Under **Files**, the options are **Run, Save Settings, Export...** and **Exit.** To process the cross-sections, press the **Run** button, which invokes the Process Cross Section dialog. **Save Settings** simply saves the current settings to the run, and can be recalled at a later time. When the **File > Export** option is selected, the user may save the dialog information in an ASCII input file for subsequent processing. The **File > Exit** option enables the user to exit the **Proposed Cross Sections** dialog box. The software also prompts the user with an **Alert** box if the settings should be saved before exiting. Pressing the **Yes** button will save the current dialog settings, **No** will not save the settings, but both buttons will exit to the **Project Manager**.

15.3.12 Process Cross Sections



When **File >> Run** is chosen, the dialog to the right appears.

The output can be displayed on the screen only, or written to a log file and displayed to the screen. The **Pause On Each Section** option allows the user to view each section as it is drawn. **Criteria View** displays each step in the criteria file. This is primarily for debugging purposes.

15.4 Criteria Files

One of the most powerful and flexible features of GEOPAK is the use of criteria in generating proposed cross-sections. Within criteria, design conditions can be evaluated and complicated design decisions executed in response to these design conditions. The flexibility of criteria allows the designer to make the design as basic or as complex as the project requires. Numerous baselines can interrelate as ditches and medians are drawn between roadways and ramps. Sophisticated drainage details can also be drawn with criteria. The list is endless.

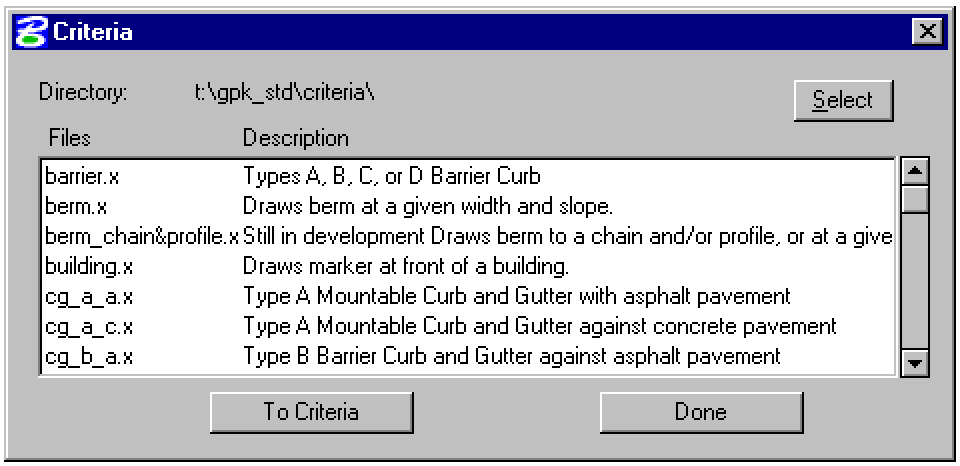
Cross-section criteria are used to draw cross-section features outside of the mosaic of superelevation shapes typically representing pavement. Operationally, the software constructs the cross-section features derived from the mosaic of shapes first. Then, the software constructs the remaining portions of the cross-section through the application of criteria emanating out from the outer edges of the mosaic of shapes.

MoDOT users do not need to know how to write criteria. A criteria library has been established. As users encounter situations that require a new criteria file, they should contact the CADD Support Center to have that criteria file written.

Note: Criteria files written or modified outside of the CADD Support Center, and criteria writing **WILL NOT BE SUPPORTED**.

15.4.1 MoDOT's Traditional Criteria Library

MoDOT's criteria library is located in the directory t:\gpk_std\criteria. Within the **Shape Clusters** section of the **Proposed Cross Section** dialog, the user can choose the **Add** button in the **Criteria File** portion of the dialog box. The following dialog will appear.



The user simply selects the criteria file to be included, and then clicks the **To Criteria** button. The criteria files must be listed in the order they are to be processed. Once they are selected, they can be re-arranged within the **Proposed Cross Sections** dialog box.

With each run, the **Setup.x** criteria file must be chosen as the first criteria file in each side slope condition. This file allows the user to choose the plotting scale and the files that are being used for the plan, shape, and cross-section information. This data is required for other criteria files.

The criteria files will have a short description to help identify what they will do. The criteria file name will also give a basic idea of what the criteria file is. For example, cg_b_c.x will draw a type B curb and gutter and cap the edge of pavement as concrete (vertical line). The file cg_b_a.x will draw a type B curb and gutter and cap the edge of pavement as asphalt. Help documents are available on the intranet for further information on the criteria library.

15.4.2 MoDOT's TSG Criteria Library

MoDOT's typical section criteria library is located in the directory t:\gpk_std\typicals.

Exercise 15-1

This begins a series of exercises that will demonstrate another method for determining bridge length, which will by using cross-sections. The proposed cross sections for Route50 are drawN in this group exercise. Later exercises will use these and other cross sections to create a proposed TIN and determine the bridge length from this surface model.

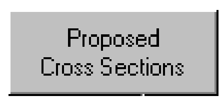
1. Open the MicroStation file **t:\br-proj\a_geopak\d5\j5p0100\data\xs_50_j5p0100.dgn**.

2. Open the project **t:\br-proj\a_geopak\d5\j5p0100\project\j5p0100.prj**.

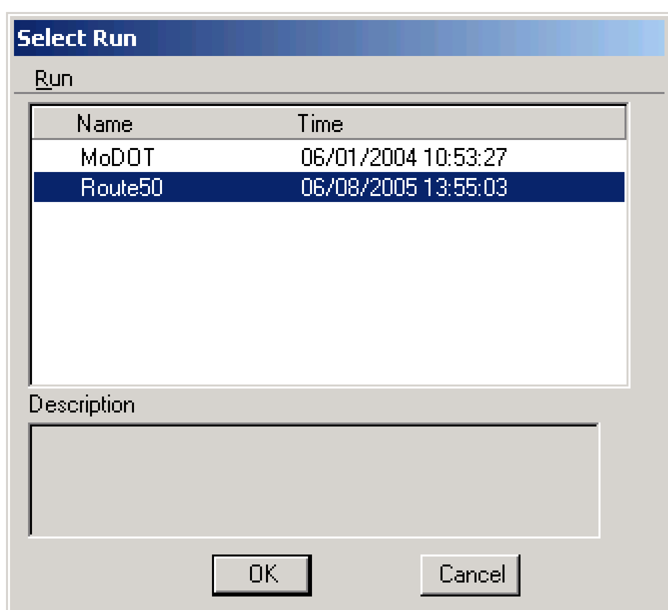
   Enter the as user **userc**.

3. Select the **Route50** working alignment.

4. Choose **Proposed Cross Sections** from the **Project Manager** dialog.



   Copy the **MoDOT** run to **Route50**, and open the **Route50** run.



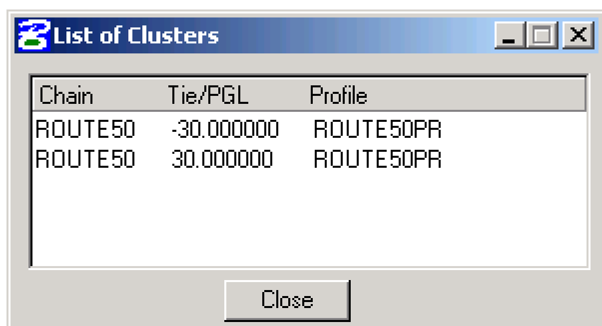
5. Be sure the following items are set in the given sections of the dialog:

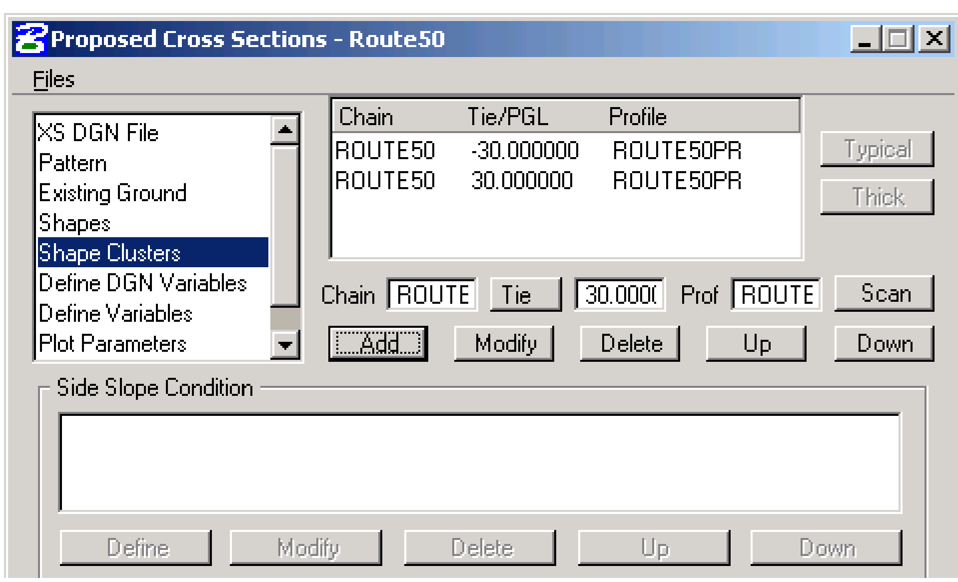
XS DGN File:	**xs_50_j5p0100.dgn**
Pattern:	**Use Working Alignment Definition**
Existing Ground:	**Use Working Alignment Definition**
Shapes:	**Use Working Alignment Definition**

6. In the **Shape Clusters** section of the dialog, choose the **Scan** button. Add the two shape clusters in the following order:

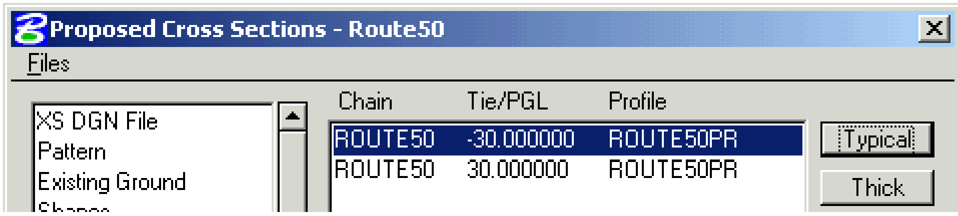
Chain	Tie	Profile
ROUTE50	**-30**	**ROUTE50PR**
ROUTE50	**30**	**ROUTE50PR**

The clusters are added by highlighting a cluster in the top dialog shown below and clicking on **Add** in the Proposed Cross Sections dialog, which is depicted in the bottom figure. When you are finished adding the Shape Clusters, close the **List of Cluster** dialog by clicking on **Close** at the bottom of the dialog. Leave the **Proposed Cross Sections – Route50** dialog open. Information will be added to it in the next step.



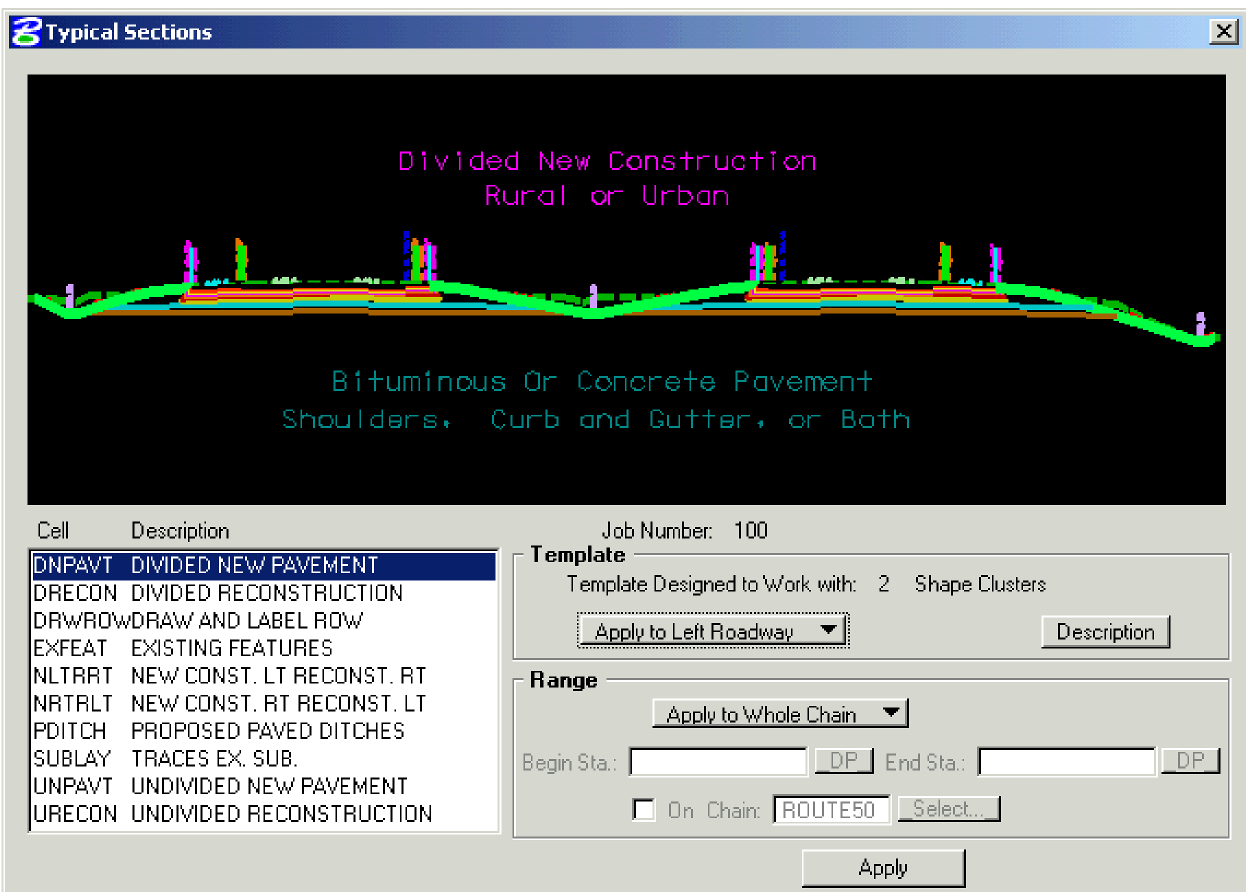


7. **Highlight** the left cluster and click on the **Typical** button.



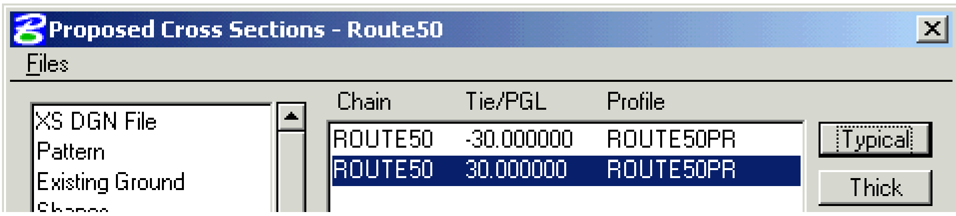
This displays the **Typical Sections** dialog shown below. Select the **Divided New Pavement** template, which is highlighted in the list box in the lower left hand corner, as shown in the figure. In the **Template** section of the dialog, select: **Apply to the Left Roadway**. Clicking on the Description button will launch the help file for this typical section.

Once the dialog is set as shown below, click on the **Apply** button to add the required criteria files to the side slope condition.

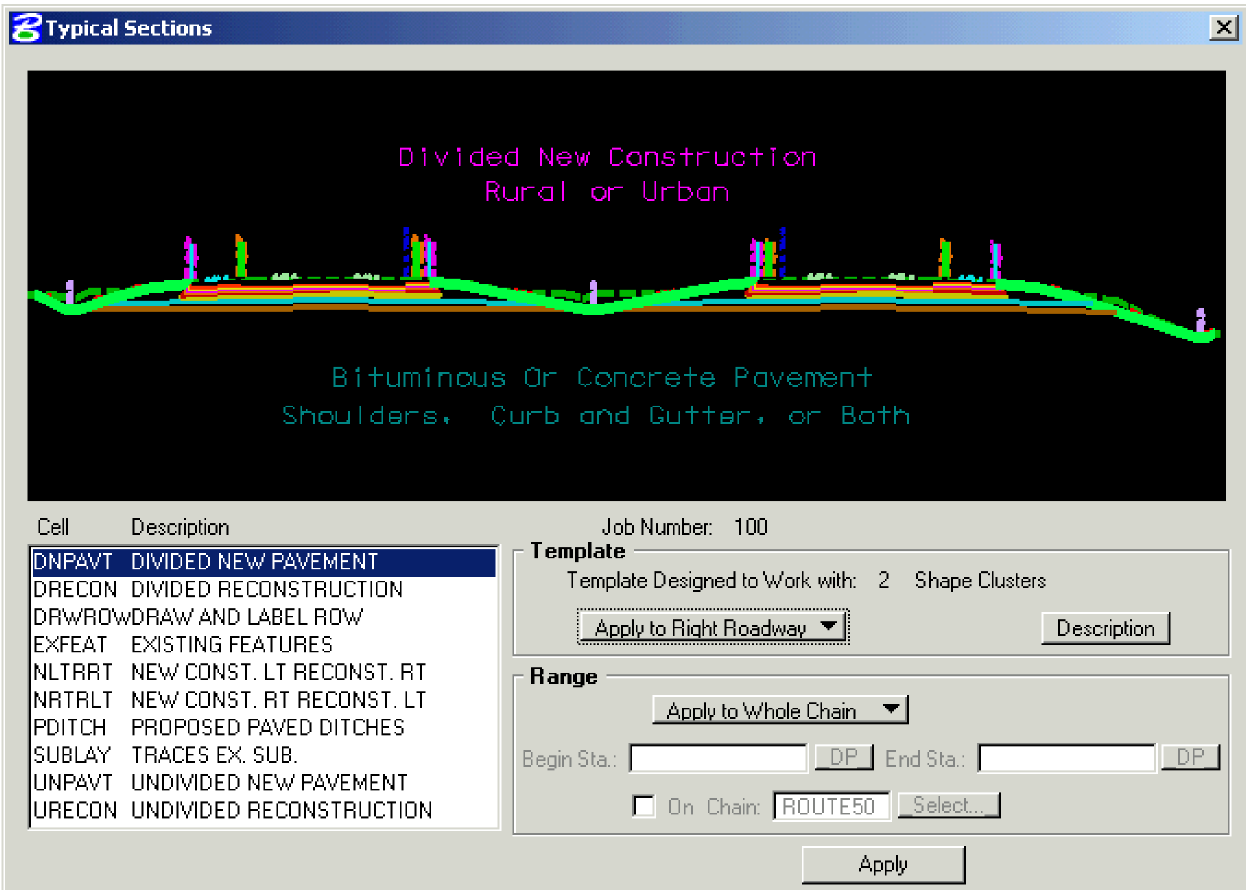


Select **Yes To All** if you are asked if you wish to overwrite any of the criteria files

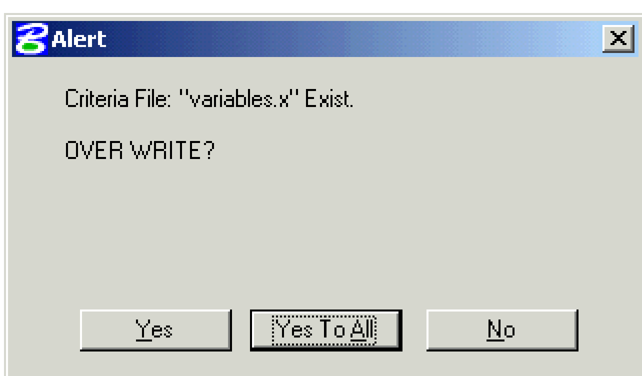
8. **Highlight** the right cluster and click on the **Typical** button.



Select the **Divided New Pavement** template again. Chose **Apply to the Right Roadway** this time and click on **Apply** to add the required criteria files to the side slope condition.



Select **Yes to All** when the following Alert appears.



9. Switch to the **Define Variables** section and change the following variable vales:

   CROSS SECTION DGN ....xs_50_j5p0100.dgn
   PROPOSED PLAN DGN..plan_50_j5p0100.dgn
   GEOPAK LINES DGN ....pattern_shape_J5P0100.dgn
   XS SCALE..10

   Leave the remaining variables set to the defaults.

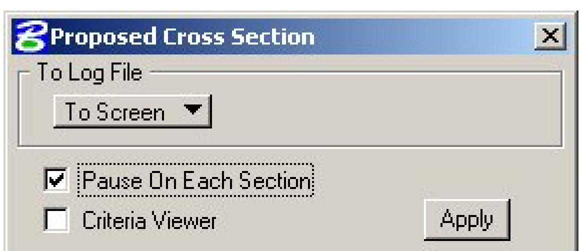
10. In the **Redefinable Variables** set the following values for the given variables.

_s_PavementType	STA >=0+00 R1	^C^
_d_PavementLayer1Thick	STA >=0+00 R1	10/12
_d_NormalOutsideShoulderSlope	STA >=0+00 R1	-2
_d_ShoulderLayer1Thick	STA >=0+00 R1	10/12
_s_MedianType	STA >=0+00 R1	2
_d_DitchBackSlope_Left	STA >=0+00 R1	2:1
_d_DitchBackSlope_Right	STA >=0+00 R1	2:1
_d_FillSlope2_Left	STA >=0+00 R1	2:-1
_d_FillSlope2_Right	STA >=0+00 R1	2:-1

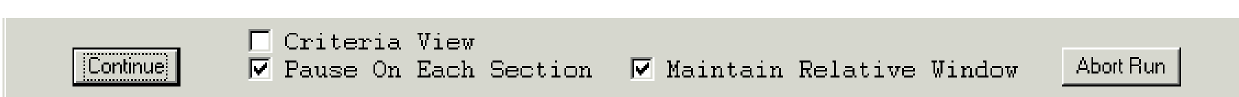
   Leave all other variables with their default values.

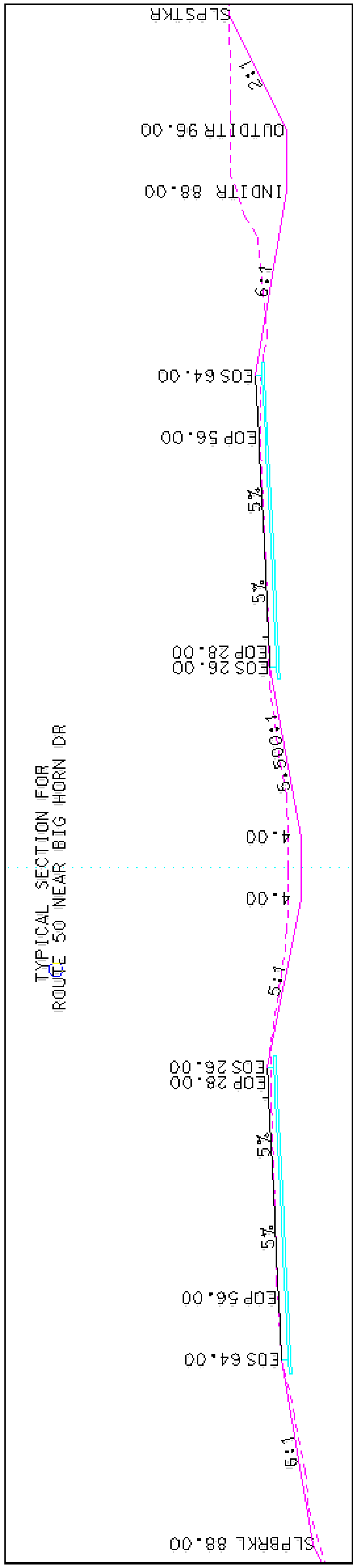
11. **Save** the Proposed Cross Sections run settings (**Files > Save Settings**).

   In the Proposed Cross Sections dialog, go to **Files > Run**. This will bring up the following dialog:



   Set Log File to **Screen Only** and toggle on **Pause on Each Section** as shown above. Press the **Apply** button to start drawing the cross sections. After the first cross section is plotted, zoom in to see if the proposed surfaces are correct. Toggle on **Maintain Relative Window** in the **Process Cross Sections Display**, as shown below if you wish the same zoom for the rest of the sections. If the section plotted correctly, press the **Continue** button to draw the next section. After you are satisfied the cross sections are OK, toggle off Pause on Each Section and press Continue to process the rest of the sections. If the sections are not OK, click on Abort Run to stop the run in order to fix the problem.





TYPICAL SECTION FOR
ROUTE 50 NEAR BIG HORN DR
SLPSTKR
2:1
OUTDITR 96.00
INDITR 88.00
6:1
EOS 64.00
EOP 56.00
5%
5%
EOP 28.00
EOS 26.00
6.500:1
4.00
4.00
5:1
EOS 26.00
EOP 28.00
5%
5%
EOP 56.00
EOS 64.00
6:1
SLPBRKL 88.00

Chapter 16

Port Viewer

16.1 Objectives 16-1
16.2 Definitions.. 16-1
16.3 Accessing 16-2
16.4 Dialog... 16-2

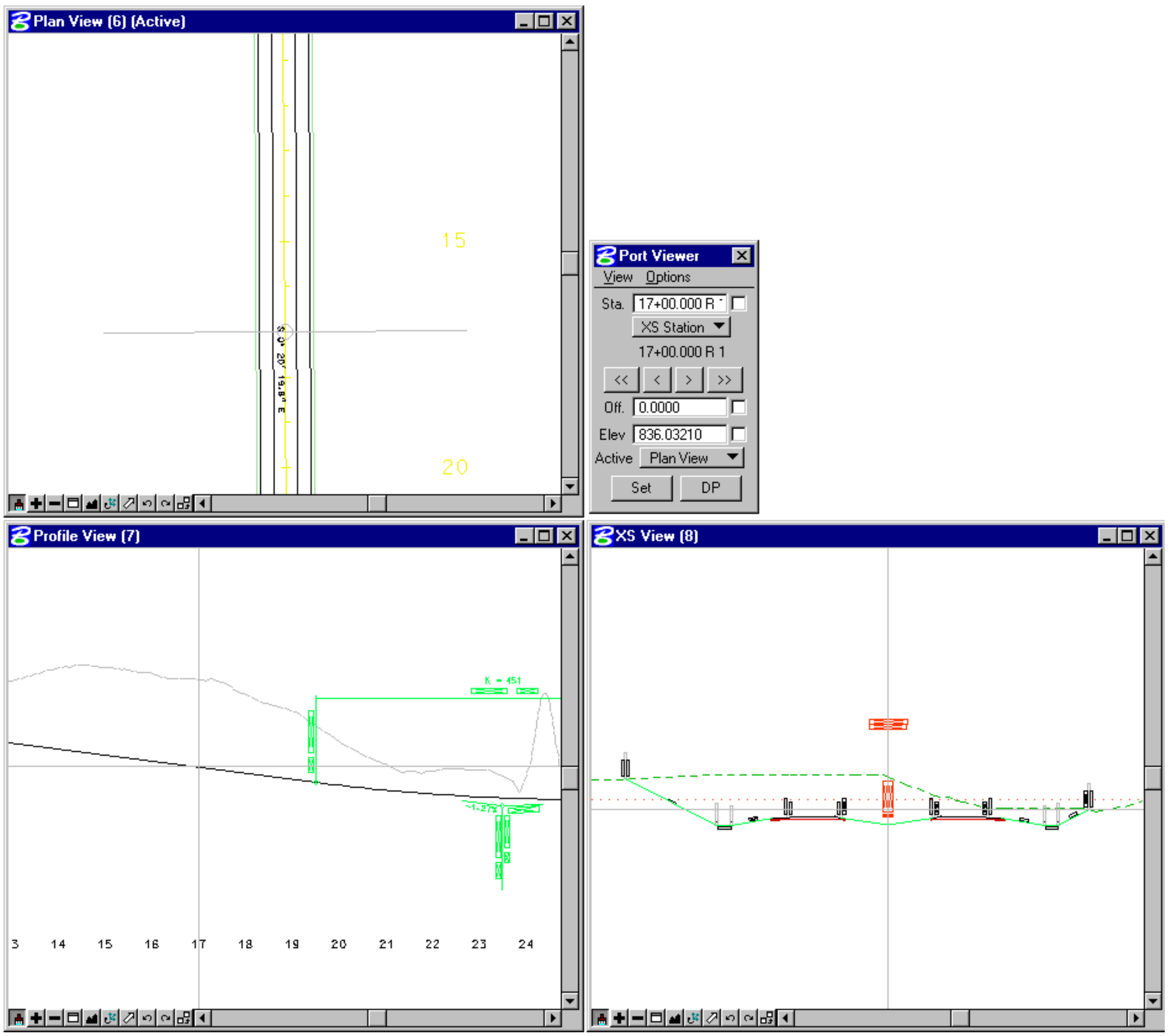
16.1 Objectives

- Learn how to use GEOPAK's **Port Viewer** utility.

16.2 Definitions

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

- Plan
- Profile
- Cross-sections



16.3 Accessing

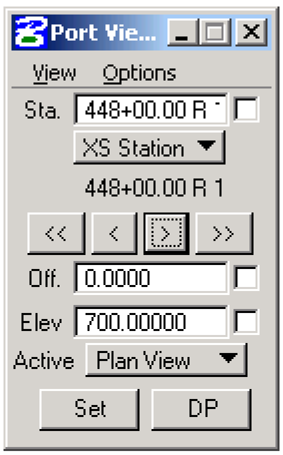
Prior to starting the **Port Viewer** the working alignment must be set up to include the plan view drawing file, centerline chain, profile view file, profile name and location, and cross-section view file.

To access the **Port Viewer,** choose the **Port Viewer** button from the **Road Project** dialog.

16.4 Dialog

The **Port Viewer** dialog box allows the user to manipulate the views several different ways.

16.4.1 Station, Offset, and Elevation Controls



The user is able to key-in the **Station** they want to view. The cross hairs in the plan and profile move to the keyed-in station, and the section view displays the cross-section nearest that station.

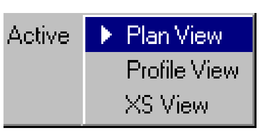
The navigation buttons allow the user to navigate station by station (< or >), or to the beginning (<<) or ending (>>) station.

The **Offset** option controls the location of the circle in the plan view and the vertical cross hair in the cross-section view.

The **Elevation** option controls the location of the horizontal cross hairs in the profile and cross-section views.

If the Portview TIN is defined in the **Working Alignment** definition, the DTM view can be substituted for the cross-section view. The DTM view cuts a section at the location of the cross hairs in the plan view.

16.4.2 Active View Control



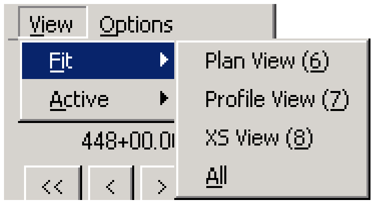
The **Active View** chooses the view to be used as the current file. Any MicroStation drawing commands are executed in that file. For instance, if you want to draw something in the cross sections, switch the **Active View** to XS View.

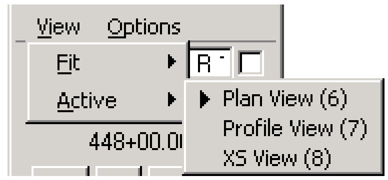
Selecting the **Set** button allows the user to move the cursor to a view and move the cross hairs in that view. As the user moves the cursor along the view, the other two views are updated according to the placement of the cursor in the current view.

The **DP** button allows the user to issue a data point for a MicroStation command. For example, if you wanted to draw a line at the given station and offset listed in the **Port Viewer** dialog, select the line tool, and press the **DP** button. This begins a line at the given station and offset.

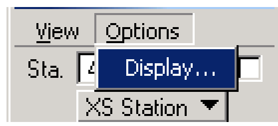
16.4.3 Menus

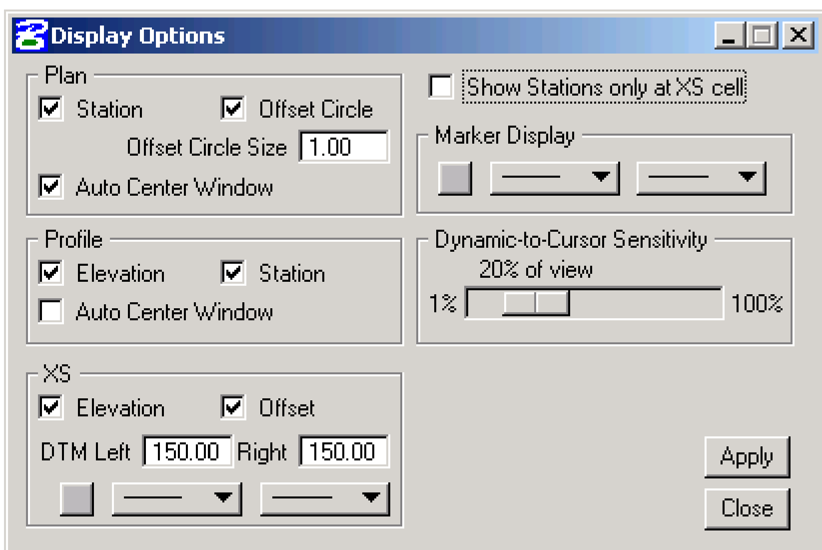
The **View** menu at the top of the dialog box allows the user to fit one or all of the views, or to select the **Active View**.





The **Options** menu has one item, **Display**. The **Display Options** control which cross hairs to display (**Plan**, **Profile**, & **XS**), whether to center the **Plan** and **Profile** views, the symbology and offsets of the **DTM** section view (**XS** section of dialog), whether to **Show Stations only at XS cell**, the cross hair symbology (**Marker Display**), and how close the curser needs to be to the cross hairs to gain dynamic control (**Dynamic-to-Cursor Sensitivity**).





Chapter 17

Earthwork

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17.1 Objectives

- Learn the procedures for calculating earthwork quantities with GEOPAK
- Learn how to use Project Manager to set up and process an earthwork run.

17.2 Definitions

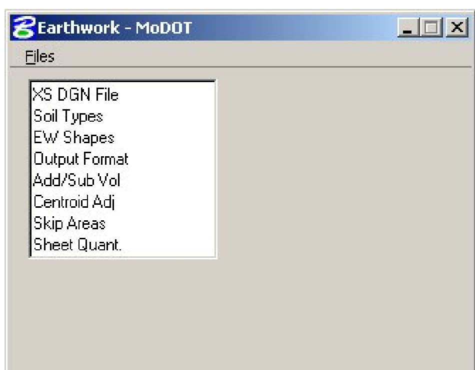
GEOPAK forms **earthwork shapes** in a design cross section .dgn file to represent the end areas used to calculate volumes. These shapes are created when the designer processes an earthwork run in which the existing ground, finished grade, base, etc. are identified by level, color, weight and type, which is covered in this chapter. For additional information, see the *GEOPAK* online help.

17.3 Accessing

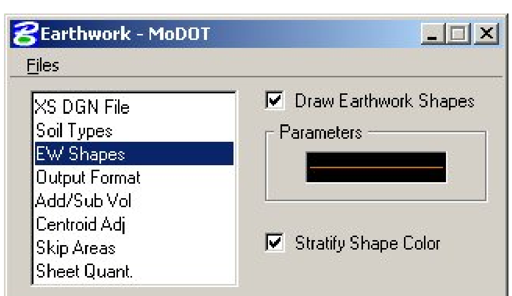
To access the necessary dialogs needed to create and process an earthwork run, select **Project Manager >> Earthwork**.

17.4 Dialog

Once the Earthwork run is chosen, the following dialog box appears.

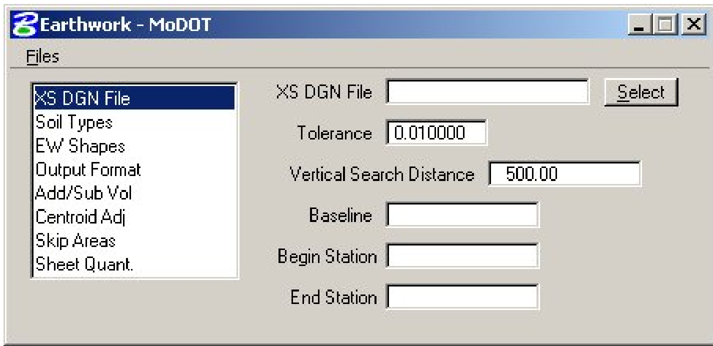


The left side of the dialog contains the list of parameters required to compute earthwork. When each parameter is selected, the dialog changes the keyin fields to reflect the selection. For example, when **EW Shapes** is selected, the dialog changes as illustrated below.



17.4.1 XS DGN File

In **XS DGN File** the user can specify the file name in which to find the cross-sections.



Tolerance specifies the maximum distances between two elements to be considered as adjoining.

Vertical Search Distance specifies the distance above and below the cross-section to look for elements pertaining to that cross-section. **(DO NOT CHANGE!)**

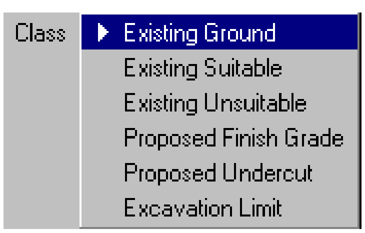
Baseline specifies the Geopak COGO chain the cross-sections are based from.

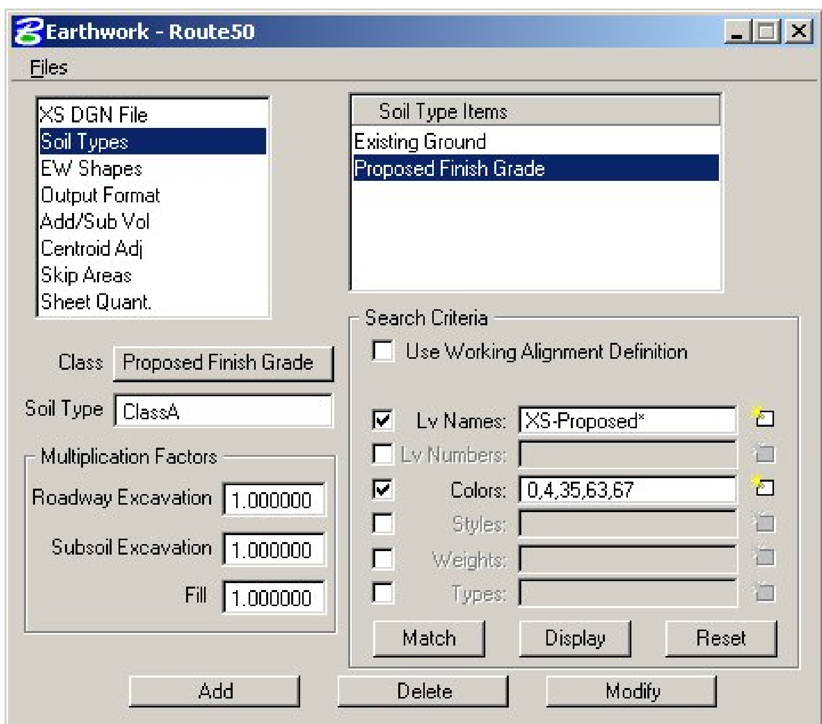
Begin/End Station specifies the beginning and ending stations to perform the earthwork calculations.

17.4.2 Soil Types

The **Soil Types** dialog requires the user to define the symbology and shrinkage/swell factors to be used in defining each soil type.

The user must first select the **Class** of the soil type. The classifications are as follows.





Existing Ground – identifies the surface of the existing ground. This classification is required to calculate earthwork.

Existing Suitable – identifies material that is to be removed, but can be used for fill material. (I.e. rock)

Existing Unsuitable – identifies material that is to be removed, but cannot be used for fill material. (I.e. shale, muck, pavement, etc.)

Proposed Finish Grade – identifies the surface of the proposed roadway. This classification is required to calculate earthwork.

Proposed Undercut – identifies proposed layers that are not part of the finish grade. This soil type is not the material being removed, but what the area will be backfilled with. (I.e. rock blanket)

Excavation Limit –identifies the location to stop removing the existing suitable or unsuitable material. Excavation limits can also be used to separate the areas of earthwork calculations for staged construction, multiple roadway cross sections, etc.

Once the **Classification** is chosen, a **Soil Type**, the element symbology of the material, and the shrinkage/swell factors need to be entered.

Note: Wild cards are supported in this dialog box, so for level name symbology a user can type in XS-Proposed* as a valid level name.

A **Classification**, except **Existing Ground**, can be listed multiple times. The **Soil Type** determines how the cut and fill are calculated. For example, a user creates an earthwork run with a classification of Existing Ground with a soil type of Existing, classification of Proposed Finish Grade with a soil type of Suitable_Grading, and a classification of Proposed Undercut with a soil type of Pavement. The output from the run would look as follows.

Station	Material Name		End Areas (square feet)	Unadjusted Volumes (cubic yards)	Adjusted Volumes (cubic yards)	Mult Factor	Mass Ordinate
449+00.00	SUITABLE_GRADING						
		Excavation	0.00	0	0	1.00	
		Fill	132.61	439	439	1.00	2887
	PAVEMENT						
		Excavation	0.00	0	0	1.00	
		Fill	315.81	960	0	0.00	2887
	EXISTING						
		Excavation	278.57	855	855	1.00	
		Fill	0.00	0	0	1.00	3541

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

Station	Material Name	End Areas (square meters)	Unadjusted Volumes (cubic meters)	Adjusted Volumes (cubic meters)	Mult Factor	Mass Ordinate
449+00.00	SUITABLE_GRADING					
	Excavation	278.57	855	855	1.00	
	Fill	132.61	439	439	1.00	3541
	PAVEMENT					
	Excavation	0.00	0	0	1.00	
	Fill	315.81	960	0	0.00	3541

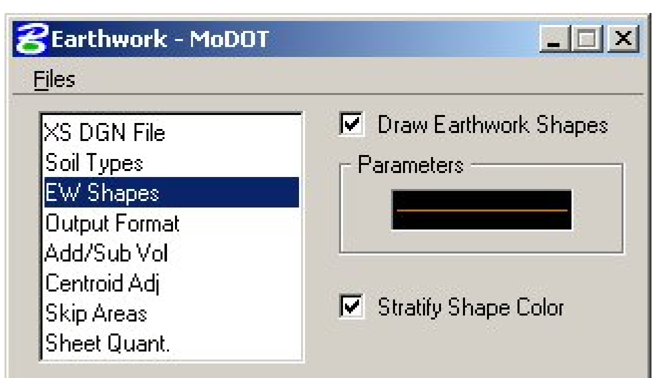
As can be seen from the above examples, when the soil types for the Existing Ground and Proposed Finish Grade classifications were named differently, both soil types appeared in the output. When the soil types for the Existing Ground and Proposed Finish Grade classifications were named the same, the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

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

After the user selects the soil type symbologies, the **Add** button needs to be selected to add this soil type to the **Soil Type Items** list. The items in this list can be modified or deleted by selecting the soil type item, making the changes, then selecting the **Modify** or **Delete** buttons.

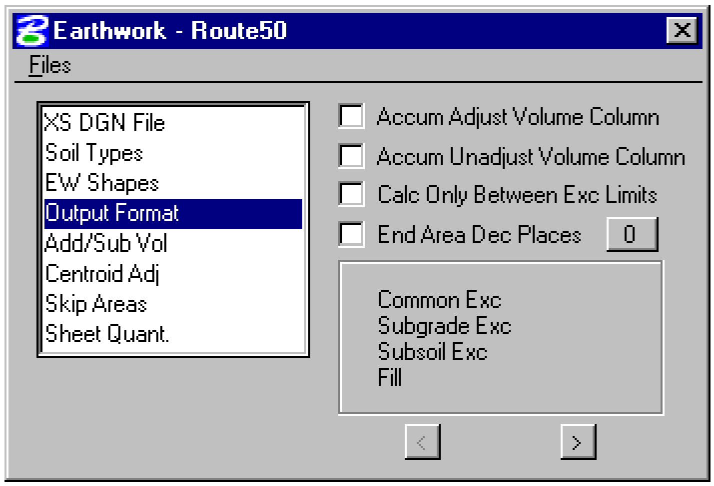
17.4.3 EW Shapes

EW Shapes allows the earthwork shapes to be drawn and specifies the symbology to draw them with. The colors of the earthwork shapes can be stratified, so that each soil type is a different color.



17.4.4 Output Format

Output Format allows the user to specify which items to show in the earthwork report. As the <> buttons are pressed, the Common Excavation, Subgrade Excavation, and Subsoil Excavation are combined into a single quantity.



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

Subgrade excavation volumes are backfilled with an earthwork material.

Subsoil excavation - excavation required to remove unsuitable material down to the bottom of the proposed template.

Accum Adjust Volume Column will add a column to the earthwork quantities report to show the accumulated adjusted volume. This provides a running total for the adjusted volumes.

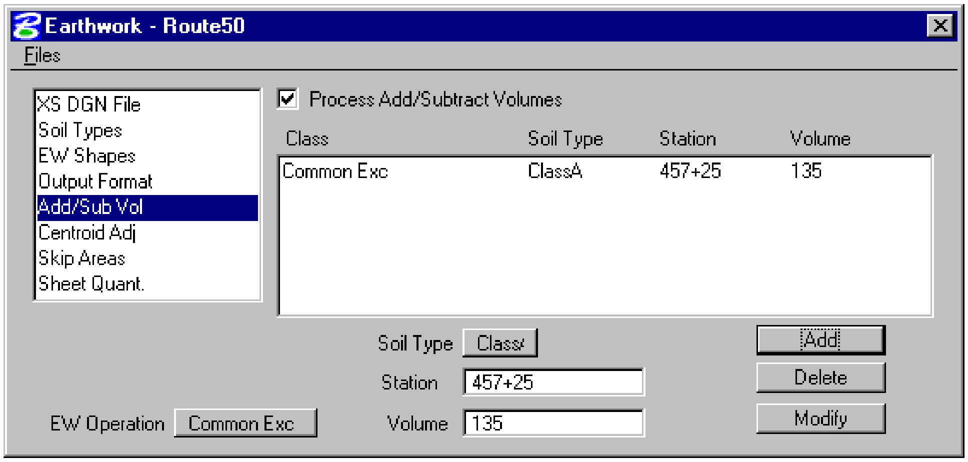
Accum Unadjust Volume Column will add a column to the earthwork quantities report to show the accumulated unadjusted volume. This provides a running total for the unadjusted volumes.

Calc Only Between Exc Limits will calculate the earthwork only between the excavation limit lines as specified in the **Soil Types** section. This can be used to calculate earthwork quantities for staged construction, individual roadbeds in a multiple roadbed section, etc.

End Area Dec Places sets the number of decimal places to display in the earthwork quantities report.

17.4.5 Add/Sub Vol

Add/Sub Volumes allows the user to enter positive or negative add volumes. The user can specify whether to add excavation or fill, the soil type, the station, and the volume to be added.

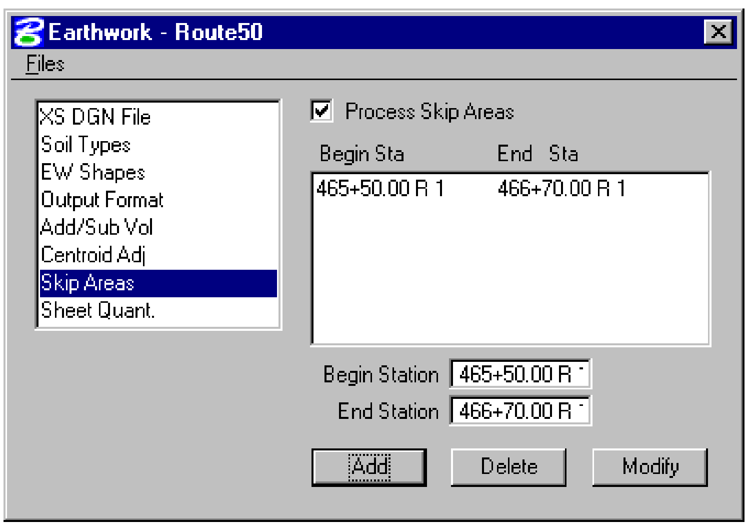


17.4.6 Centroid Adj

Centroid Adjustment allows the user to use the measurement between the centroids of the endarea as the distance between sections instead of the centerline distance. MoDOT does not use the **Centroid Adjustment** method of calculating endarea volumes except in areas where there are extremely deep cuts or high fills.

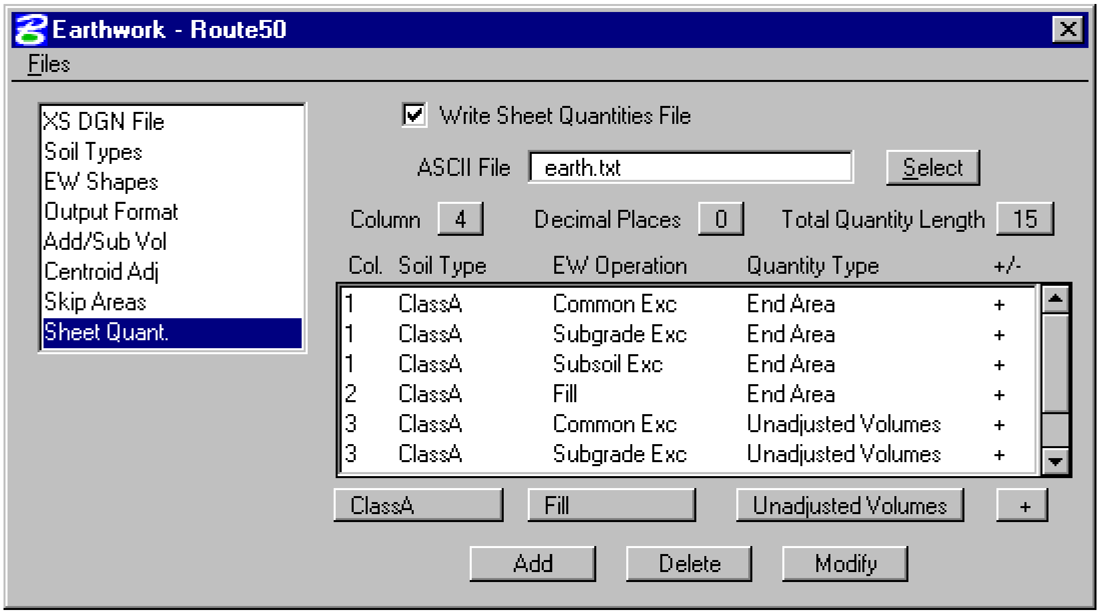
17.4.7 Skip Areas

Skip Areas allows a user to specify an area (i.e. bridge exception) in which to not calculate earthwork volumes. The user needs to specify the **Begin Station** and **End Station** of the **Skip Area**.



17.4.8 Sheet Quant.

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



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

For MoDOT, the cross section sheets are set up to plot the information in the proper location on the cross section sheets, the quantities should be set up as follows.

Column	Soil Type	EW Operation	Quantity Type	+/-
1	ClassA	Common Exc	Endarea	+
1	ClassA	Subgrade Exc	Endarea	+
1	ClassA	Subsoil Exc	Endarea	+
2	ClassA	Fill	Endarea	+
3	ClassA	Common Exc	Unadjusted Volumes	+
3	ClassA	Subgrade Exc	Unadjusted Volumes	+
3	ClassA	Subsoil Exc	Unadjusted Volumes	+
4	ClassA	Fill	Unadjusted Volumes	+

If Class C quantities are being shown on the cross section sheets, the following columns should be added.

Column	Soil Type	EW Operation	Quantity Type	+/-
5	ClassC	Common Exc	Endarea	+
5	ClassC	Subgrade Exc	Endarea	+
5	ClassC	Subsoil Exc	Endarea	+
6	ClassC	Common Exc	Unadjusted Volumes	+
6	ClassC	Subgrade Exc	Unadjusted Volumes	+
6	ClassC	Subsoil Exc	Unadjusted Volumes	+

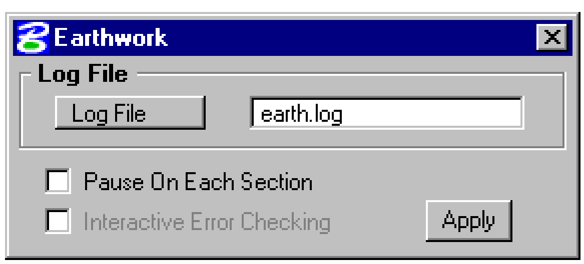
This information is written to the ASCII file, and can be used to plot the quantities on the cross-section sheets. The process of plotting this data on the cross section sheets is covered in more detail in Chapter 18.

17.4.9 File Menu

From the **Files** menu, the **Run** option will process all parameters that have been set in the **Earthwork** dialog box. The **Save Settings** option will save all information in the **Earthwork** dialog box. The **Export** option will allow the user to save the parameters in the **Earthwork** dialog box as an ASCII input file. The **Exit** option will exit the **Earthwork** dialog box.

17.4.10 Process Cross Sections

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



When processing the earthwork quantities, a .log file should be created. This ASCII file will contain the earthwork quantities that the user will use to evaluate the earthwork.

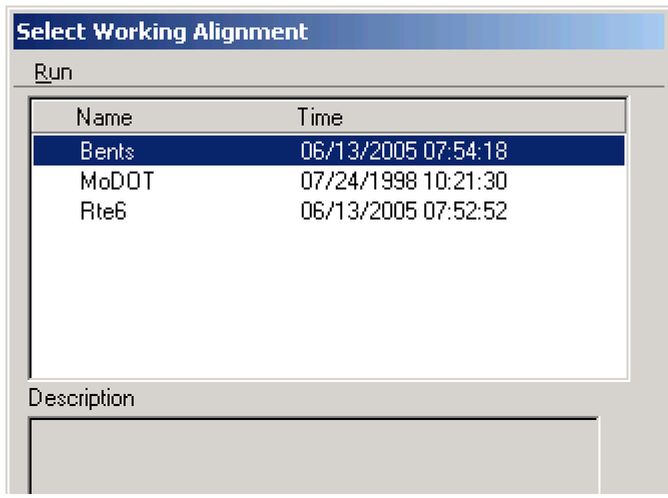
Exercise 17-1

This group exercise calculates the Class 1 and Class 2 excavation for Bents 3 & 4 of one of the Route 6 bridges. The bents are spread footings on rock.

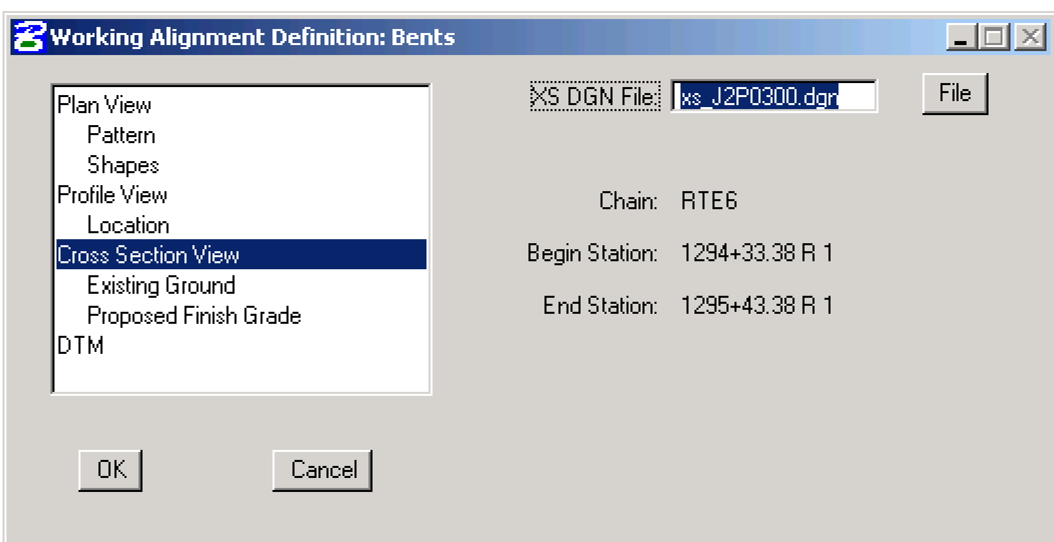
1. Open the MicroStation file **t:\br-proj\a_geopak\d2\j2p0300\data\xs_j2p0300.dgn**.

2. Open the project **t:\br-proj\a_geopak\d2\j2p0300\project\j2p0300.prj**.
   Enter the project as user **userc** and go into **Road**.

3. Copy the **Rte6** working alignment to **Bents** and enter that working alignment.



4. Set the XS DGN File in the Working Alignment Definition (Under Cross Section View) to: **xs_j2p0300.dgn**, as shown in the following figure.



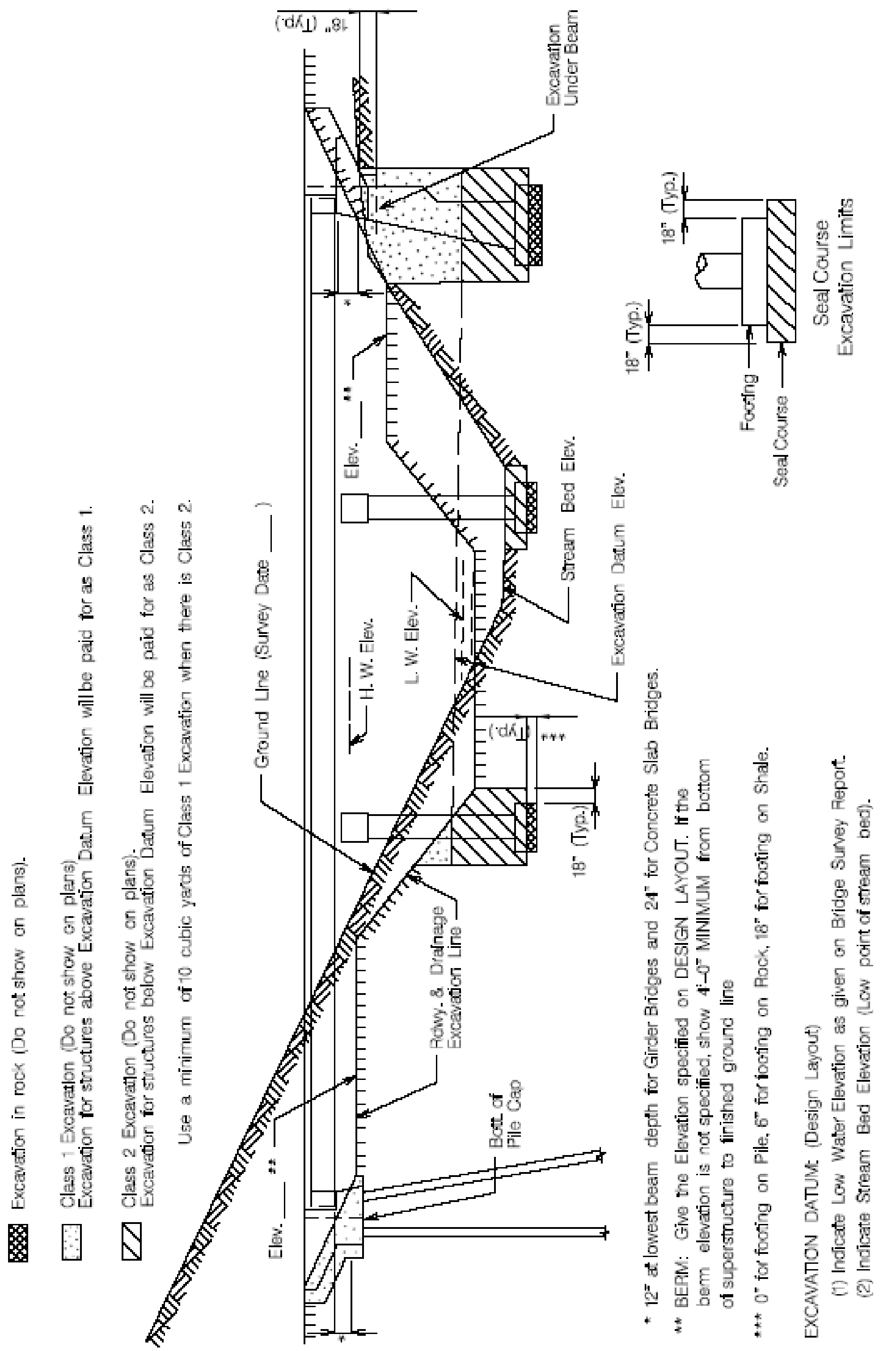
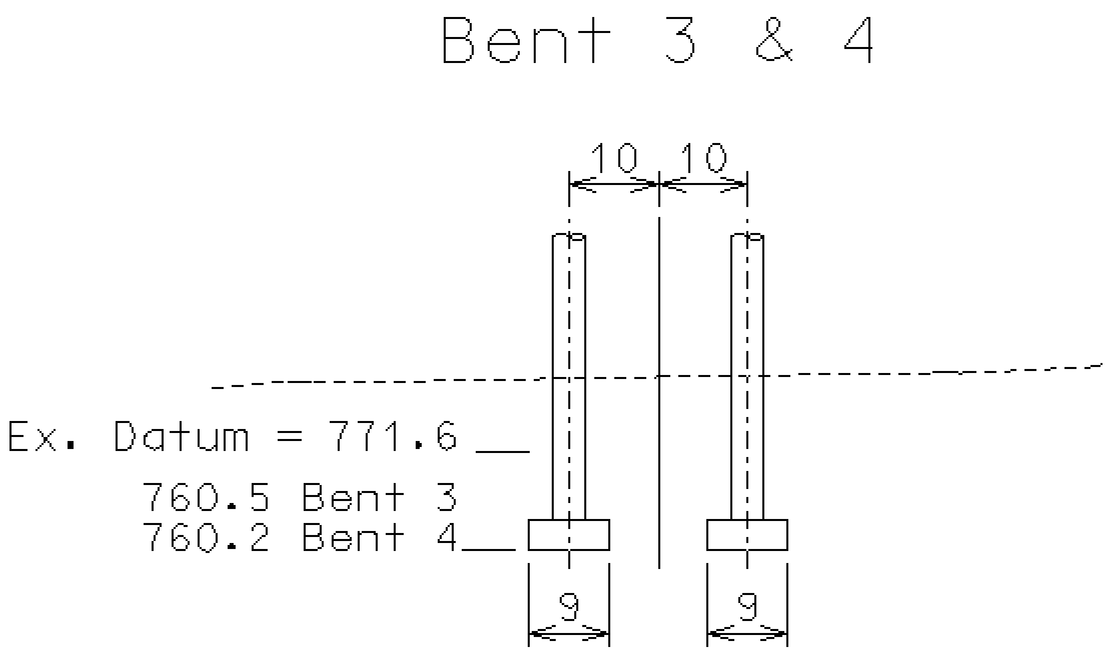


Figure 2.5.2.6 Excavation Limits: Stream Crossings (Typical)

5. The figure from the Bridge Manual on the previous page shows the Class 1 & 2 excavation for footings in a streambed. As noted there, Class 1 excavation covers all material above the excavation datum, and Class 2 is for all excavation below the datum. Also, since the bents have footings on rock, the *** dimension in the figure is 6” (0.5’).

   The following figure shows a typical cross section for Bents 3 & 4. The spacing and size of the square footings is the same for both bents, as is the excavation datum. Only the elevation at the bottom of the footings varies from one bent to the next.



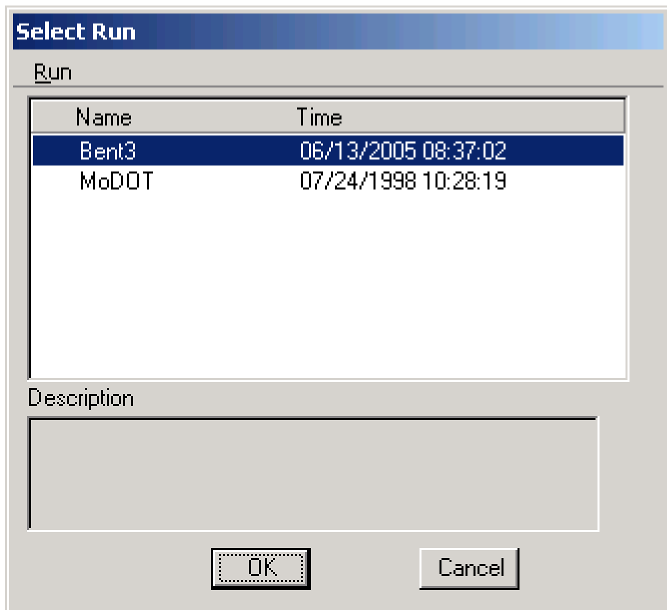
   Based on these figures, excavation will extend out from the footings on all sides by 1.5’ (18”) and stop 0.5’ above the bottom of the footing in this extended area. Directly under the footings, the excavation goes to the bottom of footing elevation. Cross sections starting 1.5’ before each footing and ending 1.5’ after the end of each one have already been created in the MicroStation file. The sections for Bent 3 go from Sta. 1294+33.375 thru Sta. 1294+45.375, while the sections for Bent 4 go from 1295+31.375 thru 1243+43.375.

   Cross sections of the footings have been added to each of the cross sections at the correct elevation. Only the bottom of footing line has been added for the sections before and after the footing. The excavation limits have also been added using a line drawn on level 60 using color 22. This limit line stops 6” above the bottom of footing at Stations 1294+33.375, 1294+34.855, 1294+43.905, & 1294+45.375 for Bent 3 and Stations 1295+31.375, 1295+32.855, 1295+41.905, & 1295+43.375 for Bent 4. The limit traces the bottom of the footing at all of the other sections.

   The excavation datum has been drawn in all cross sections at elevation 771.6 using a line on level “XS-Existing subsurface-sub layer 1” and color 10. The earthwork run will be set up using these drawn elements plus the existing ground line on level “XS-Existing surface-ground” and color 90.

6. Choose **Earthwork** from the **Road Project** dialog.

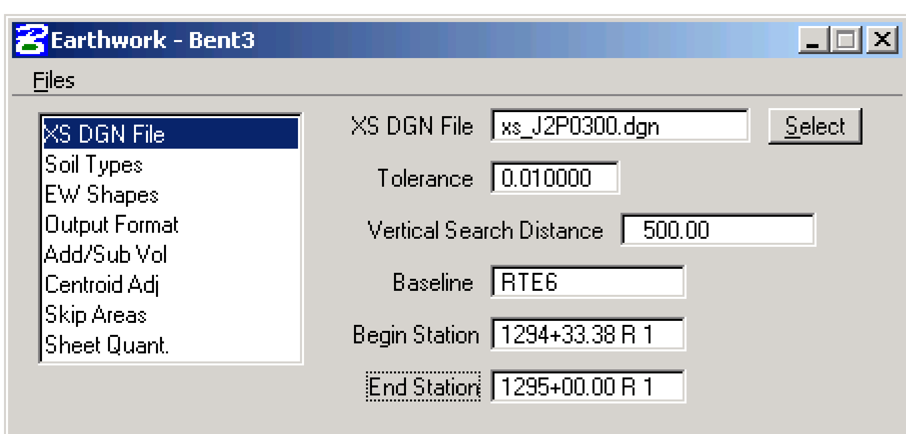
Copy the **MoDOT** run to **Bent3**, and enter the run.



7. In the **XS DGN File** section of the **Earthwork** dialog, set the following items:

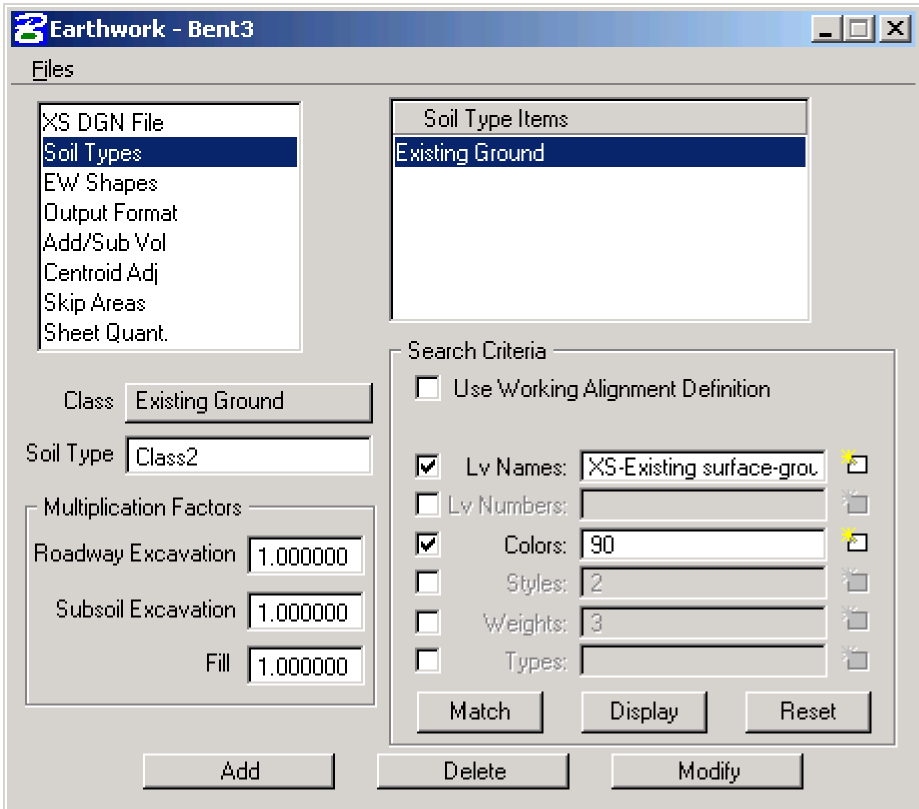
Begin Station	**First Cross Section Station**
End Station	**1295+00 R 1**

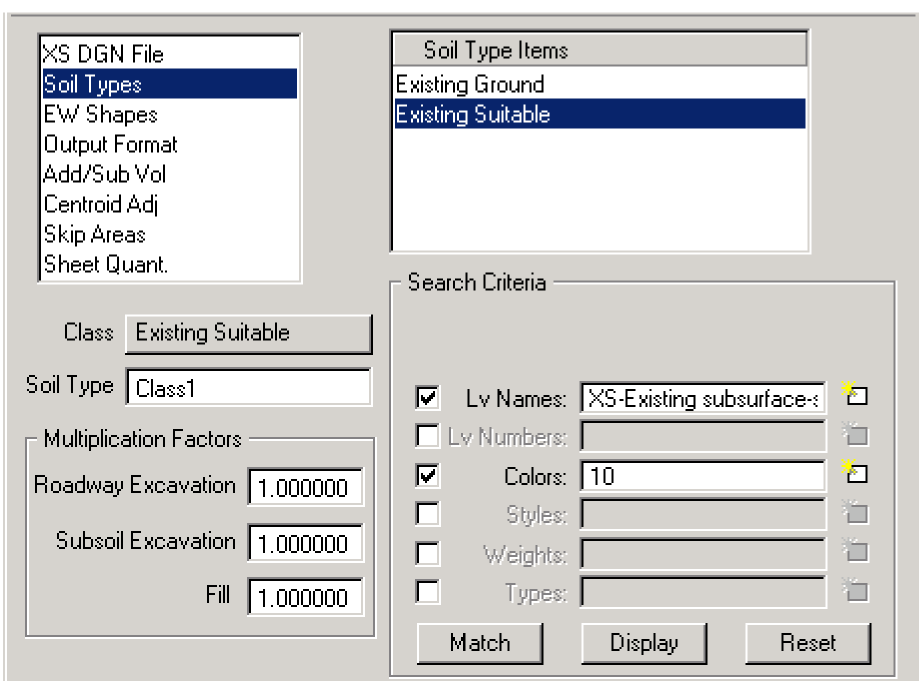
The **XS DGN File** and **Baseline** have already been set by the Working Alignment Definition. The rest of the values are defaults, which do not need to be modified.

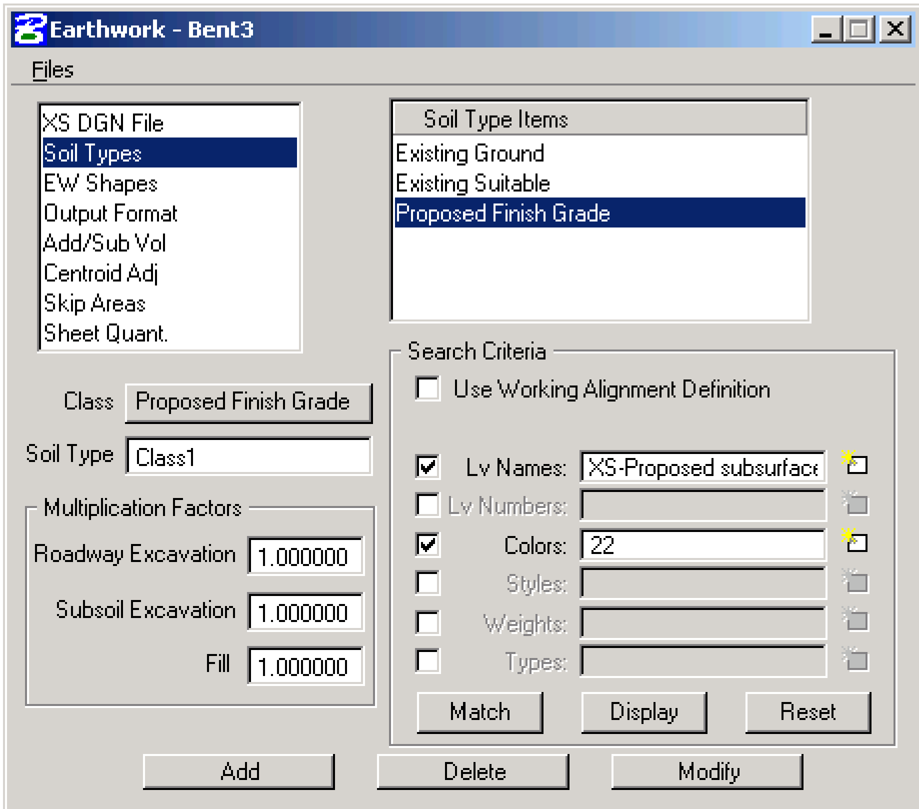


8. In the **Soil Types** section, created the following **Soil Type Items**:

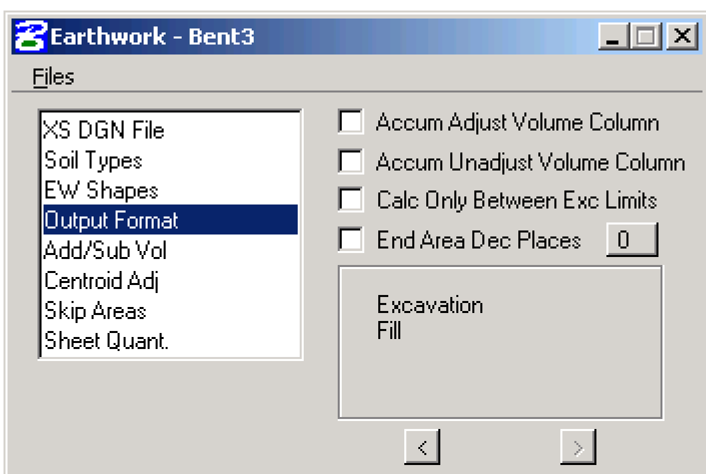
Class	Soil Type	Level	Colors
Existing Ground	**Class2**	**XS-Existing surface-ground**	**90**
Existing Suitable	**Class1**	**XS-Existing subsurface-sub layer 1**	**10**
Proposed Finish Grade	**Class1**	**XS-Proposed subsurface-compensating depth**	**22**







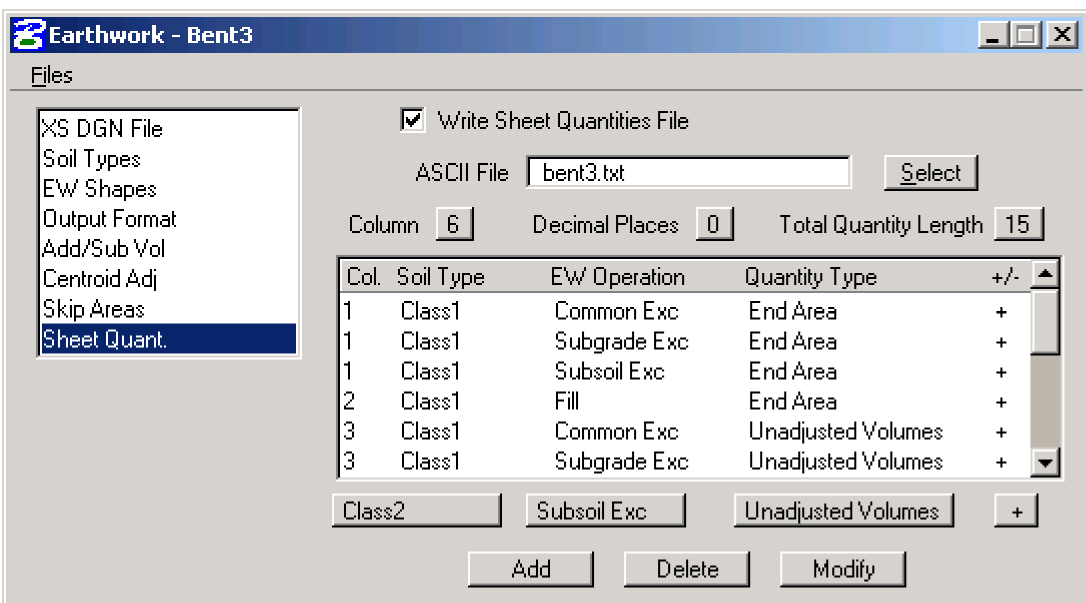
9. Switch to the **Output Format** section of Earthwork and set the format to **Excavation** and **Fill** only, as shown below:



10. In the **Sheet Quant.** Section, toggle on the **Write Sheet Quantities File**.

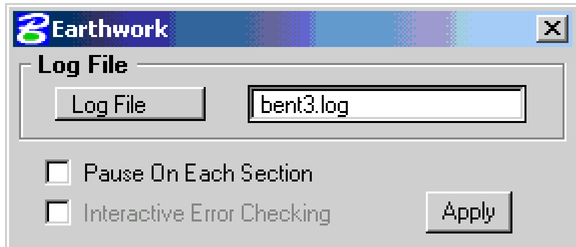
ASCII file:	**bent3.txt**
Decimal Places:	**0**
Total Quantity Length	**15**

Col.	Soil Type	EW Operation	Quantity Type	+/-
1	Class1	Common Exec	End Area	+
1	Class1	Subgrade Exec	End Area	+
1	Class1	Subsoil Exec	End Area	+
2	Class1	Fill	End Area	+
3	Class1	Common Exec	Unadjusted Volumes	+
3	Class1	Subgrade Exec	Unadjusted Volumes	+
3	Class1	Subsoil Exec	Unadjusted Volumes	+
4	Class1	Fill	Unadjusted Volumes	+
5	Class2	Common Exec	End Area	+
5	Class2	Subgrade Exec	End Area	+
5	Class2	Subsoil Exec	End Area	+
6	Class2	Common Exec	Unadjusted Volumes	+
6	Class2	Subgrade Exec	Unadjusted Volumes	+
6	Class2	Subsoil Exec	Unadjusted Volumes	+



11. Save the settings for the run (**Files > Save Settings**).

12. Run the earthwork run (**Files** > **Run**). The following dialog will appear:



Set the **Log File** to **bent3.log**.

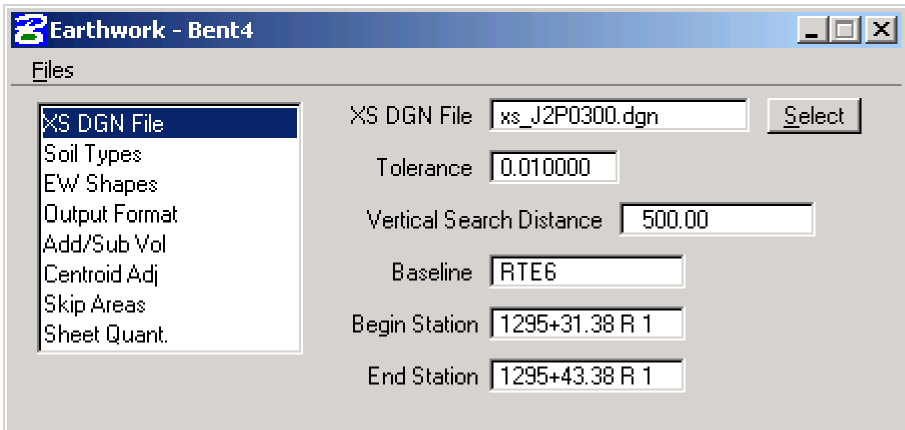
13. The end of the output for Bent 3 is shown below.

```
1294+43.88 CLASS1
    Excavation     168.52        10          10   1.00
        Fill         0.00         0           0   1.00        168
  CLASS2
    Excavation     263.40        15          15   1.00
        Fill         0.00         0           0   1.00        183

1294+43.90 CLASS1
    Excavation     168.37         0           0   1.00
        Fill         0.00         0           0   1.00        183
  CLASS2
    Excavation     254.40         0           0   1.00
        Fill         0.00         0           0   1.00        183

1294+45.38 CLASS1
    Excavation     157.00         9           9   1.00
        Fill         0.00         0           0   1.00        192
  CLASS2
    Excavation     254.40        14          14   1.00
        Fill         0.00         0           0   1.00        206

           G R A N D    S U M M A R Y    T O T A L S
         Material Name          Unadjusted Adjusted   Mult
                                Volumes    Volumes    Factor
                                (cu. yd.)  (cu. yd.)
  ---------------------------- ---------- ---------- ------
  CLASS1
                 Excavation           88         88   1.00
                  Fill                 0          0   1.00
  CLASS2
                 Excavation          118        118   1.00
                  Fill                 0          0   1.00
```

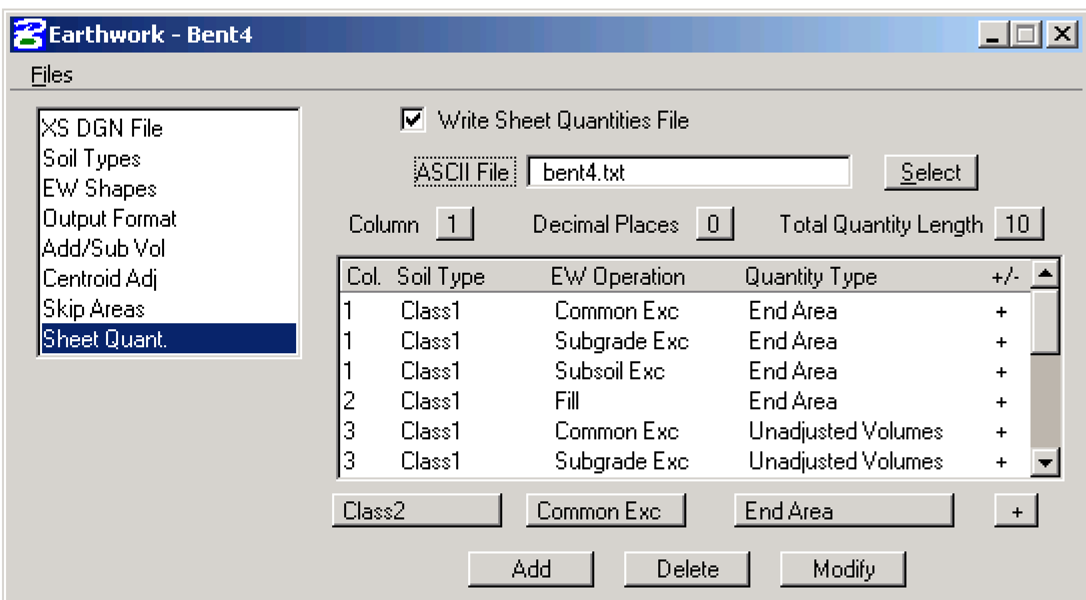
14. Repeat the process for Bent 4, by going back into Earthwork. This time however, copy the **Bent3** run and name it **Bent4**. Go into the new run. By copying the Bent3 run, everything is already set except for the station range and the name of the Sheet Quantity file.

15. Under XS DGN File, change the station range to the following:

Begin Station **1295+31.38 R 1**
End Station **Last Cross Section Station**

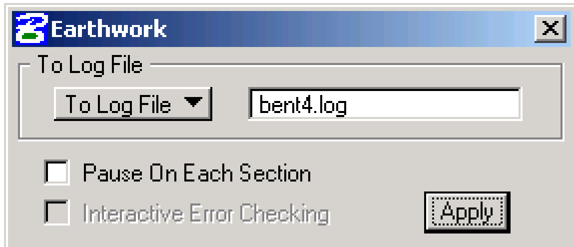


16. In the **Sheet Quant**. section, name the file **bent4.txt**.



17. Save the settings for the run (**Files > Save Settings**).

18. Run the earthwork run (**Files** > **Run**). The following dialog will appear:



Set the **Log File** to **bent4.log**.

19. The end of the output for Bent 4 is shown below.

```
1295+41.88 CLASS1
    Excavation     243.03        13          13    1.00
        Fill         0.00         0           0    1.00       177
  CLASS2
    Excavation     270.60        15          15    1.00
        Fill         0.00         0           0    1.00       192

1295+41.90 CLASS1
    Excavation     243.08         0           0    1.00
        Fill         0.00         0           0    1.00       192
  CLASS2
    Excavation     261.60         0           0    1.00
        Fill         0.00         0           0    1.00       192

1295+43.38 CLASS1
    Excavation     246.77        13          13    1.00
        Fill         0.00         0           0    1.00       205
  CLASS2
    Excavation     254.40        14          14    1.00
        Fill         0.00         0           0    1.00       219

           G R A N D     S U M M A R Y     T O T A L S
          Material Name           Unadjusted Adjusted   Mult
                                  Volumes    Volumes    Factor
                                  (cu. yd.)  (cu. yd.)
  ---------------------------- ---------- ---------- ------
  CLASS1
                Excavation           101        101   1.00
                  Fill                 0          0   1.00
  CLASS2
                Excavation           118        118   1.00
                  Fill                 0          0   1.00
```

Chapter 18

Cross Section Sheets

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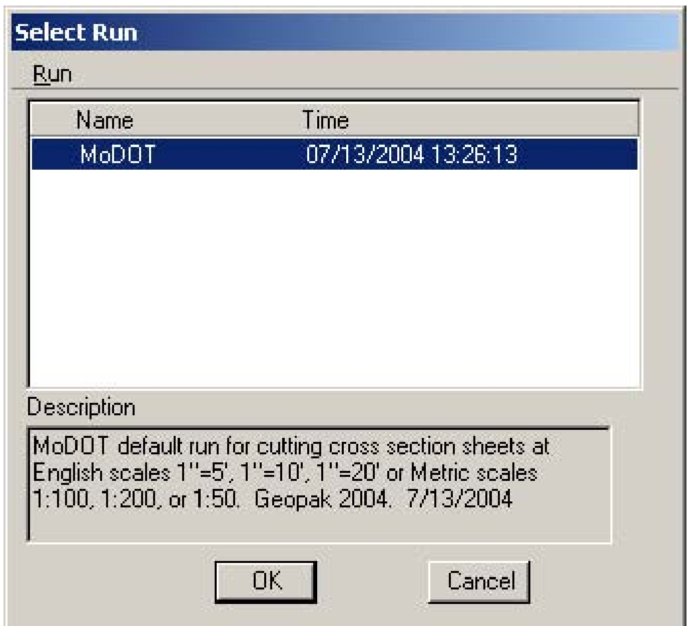
18.1 Objectives

- Learn the procedures for laying out cross-section sheets.

18.2 Accessing

Prior to beginning the cross-section sheet layout process, the user will need to create a cross-section sheet file. There are six seed files the user can choose from when setting up the cross-section sheet file: i_xs_shts_5.dgn, i_xs_shts_10.dgn, i_xs_shts_20.dgn, m_xs_shts_100.dgn, m_xs_shts_200.dgn, and m_xs_shts_50.dgn. The user should choose the seed file that represents the scale the cross-sections will be plotted at.

To access the necessary dialogs needed to process the cross-section sheet layout, select **Project Manager >> Cross Section Sheets**. There is one MoDOT default run set up that users can copy. The wanted sheet scale will be chosen once entering the run.



18.3 Sheet Library

A sheet library must be attached to the current session. CADD Support has set up the runs so the MoDOT sheet library is automatically attached when selecting/copying any MoDOT default runs.

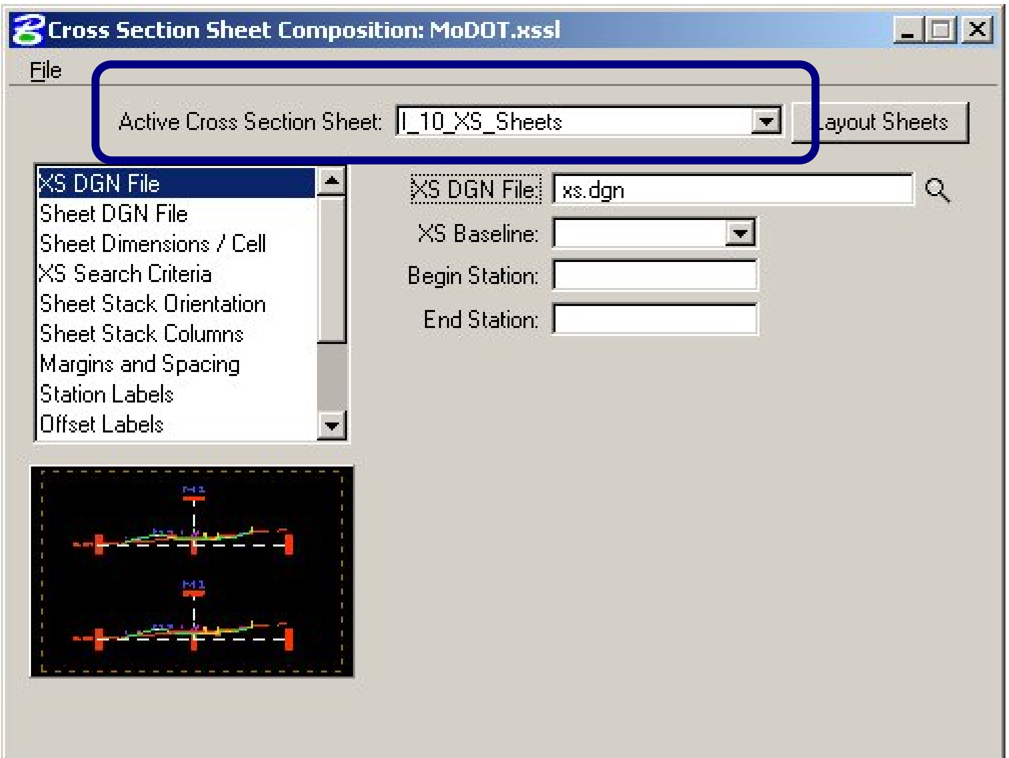
The sheet library supports the following scales:

- 1"=10'
- 1"=20'
- 1"=5'
- 1:100 (Metric)
- 1:200 (Metric)
- 1:50 (Metric)

Only CADD Support is authorized to edit the MoDOT sheet library. Any other sheet libraries will not be supported.

18.4 Dialog

Once entering a run, the dialog below appears.



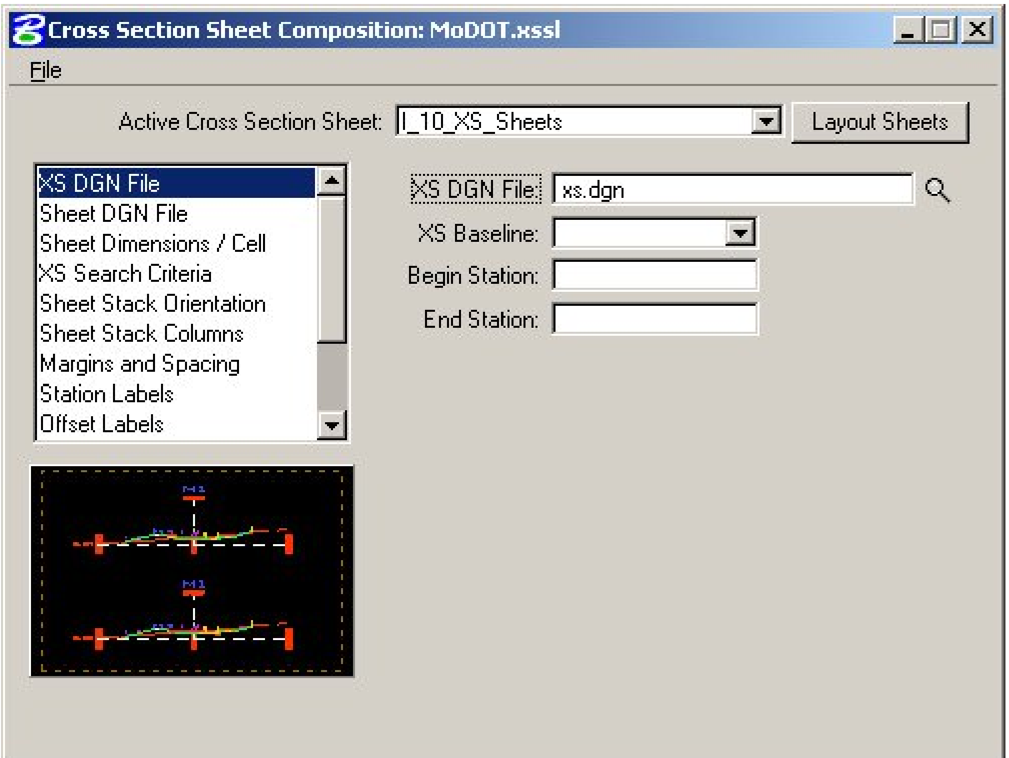
The sheet library contains all the parameters required to set up and cut sheets for the common sheet scales used for MoDOT projects. The user will need to select the sheet scale wanted from **Active Cross Section Sheet** the pull down menu.

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

Most of the parameters should be left alone. They are setup by the CADD Support Center, and are correct for the given scales. Listed below are the items the user will need to change.

18.4.1 XS DGN

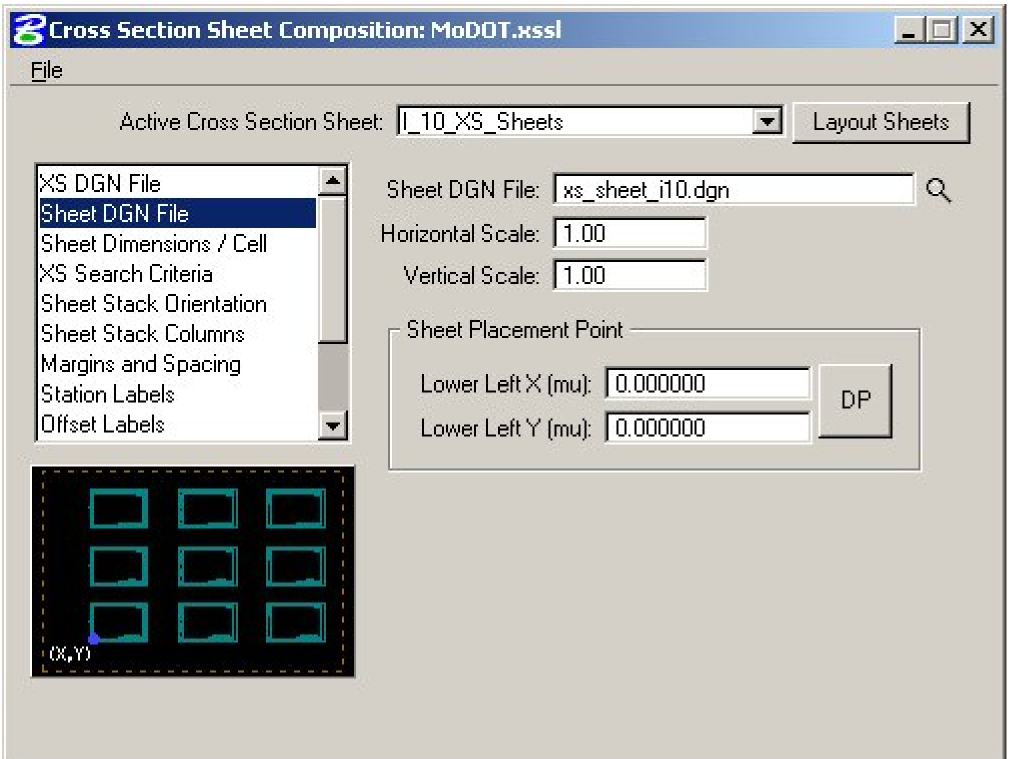
XS DGN defines the file in which the cross-sections are located, the baseline chain, and the station limits.



18.4.2 Sheet DGN File

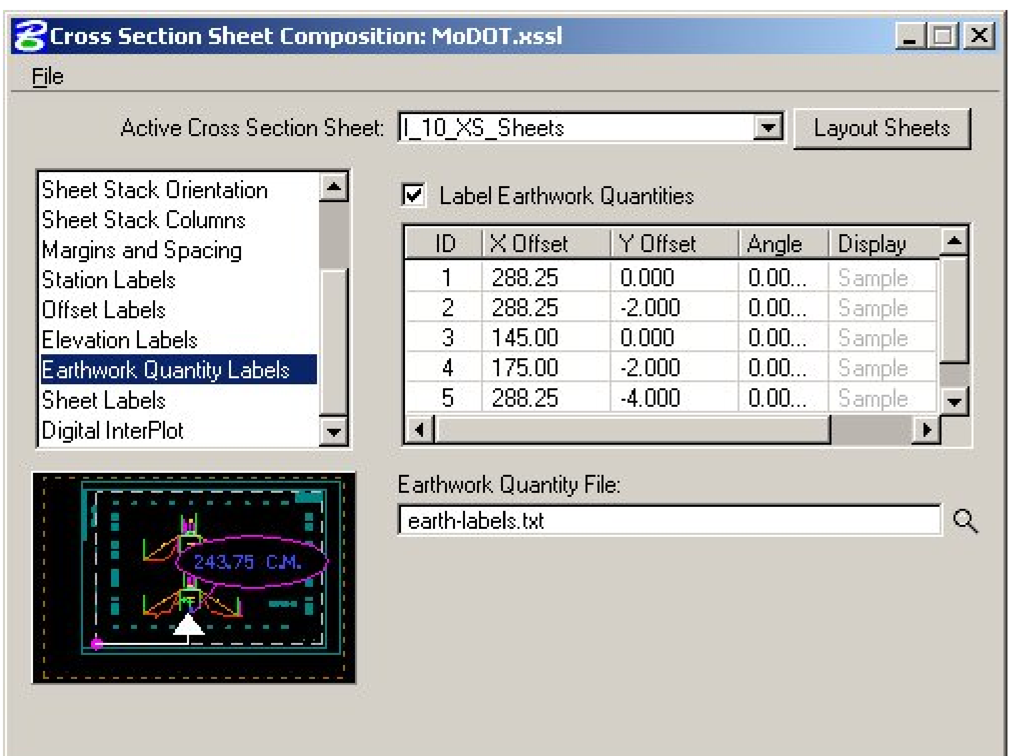
The **Sheet DGN File** specifies which file the cross-section sheets will be placed in. (Currently, the path to the Sheet DGN File including the file name is limited to 40 characters. By using the working directory, the user can specify only the file name in the Sheet DGN File field to increase the length of the file name.)

The Horizontal and Vertical Scales should be left at 1.0 regardless of what scale is being plotted. The Reference Data Point coordinate should be left at 0, 0.



18.4.3 Earthwork Quantity Labels

Earthwork Quantity Labels allows the user define the ASCII file that contains the earthwork quantity information, as well as toggle on/off the plotting of the earthwork quantities. All the parameters are set, the user can type in the name of the Earthwork Quantity File in the field or browse by selecting the icon.

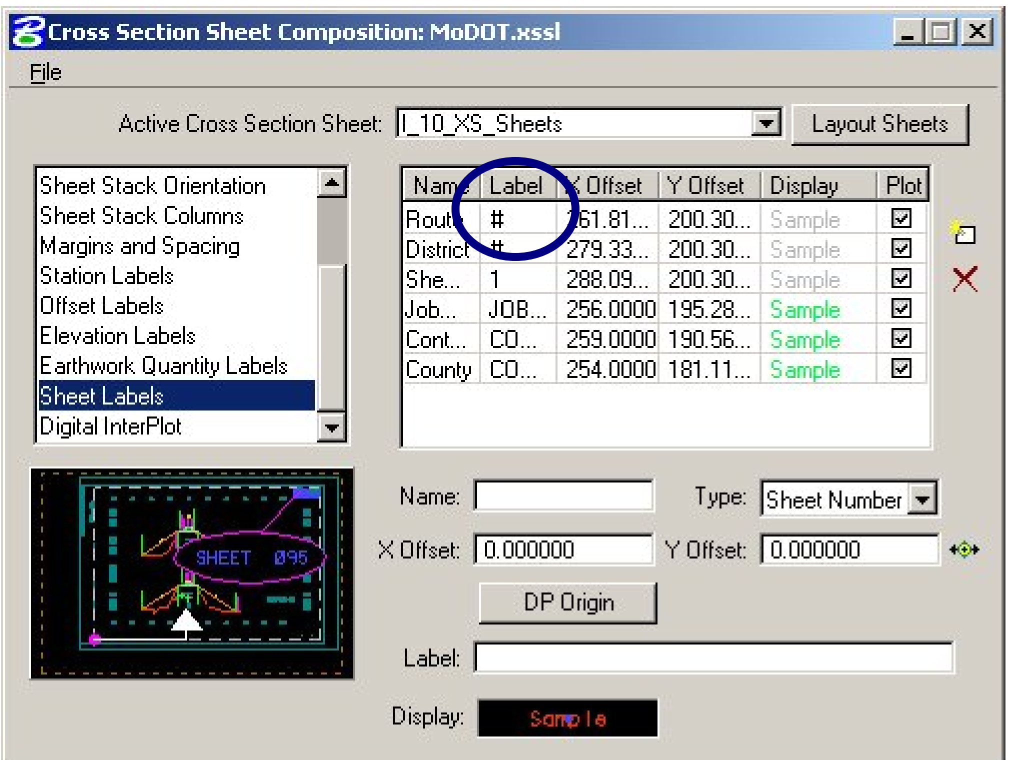


18.4.4 Sheet Labels

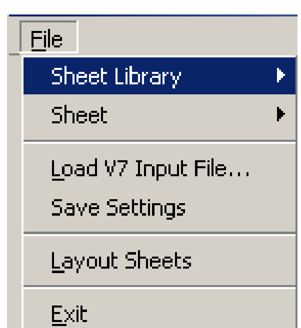
Sheet Labels allow the user place specific labels in the cross section sheet. CADD Support has set up six labels for placing text in the sheet title block. The pre-defined labels include:

- Route No.
- District No.
- Sheet No.
- Job No.
- Contract ID
- County

The user is responsible for entering the appropriate text for each label. To enter text for the pre-defined labels, the user needs to double click in the **Label** field and do a **File** >> **Save Settings**. The pre-defined label must contain text in the label field, therefore, design users should leave the Contract ID as pre-defined so construction can easily replace the text with the appropriate contract number using the **MicroStation Find/Replace** tool.



18.4.5 Files Menu



From the **Files** menu, the user can attach a **Sheet Library**. CADD Support has set up the runs so the MoDOT default sheet library is automatically attached when entering the run. Only the

MoDOT default sheet library will be supported. **The Sheet** option is used to create, delete or update any sheets to the library. Any changes to the Sheet Library must be requested through CADD Support. The **Save Settings** will save all information in the **Cross Sections Sheets** dialog box. The **Layout Sheets** option will process all parameters that have been set in the **Cross Section Sheets** dialog box. The **Exit** option will exit the **Cross Sections Sheets** dialog box.

18.4.6 Layout Sheets

In the Geopak 2004 version of the cross section sheet generator, the Geopak cross sections are not longer copied to sheet. Instead, each cross section is referenced into the sheets, thus eliminating the need to layout sheets after making changes to the original cross sections.

The user can layout new sheets either by selecting the **Layout Sheets** option from the **File** menu or by selecting the **Layout Sheet** button in the cross section sheet composition dialog box.

Exercise 18-1

1. Open the MicroStation file **t:\br-proj\a_geopak\d2\j2p0300\data\xs_j2p0300.dgn**.

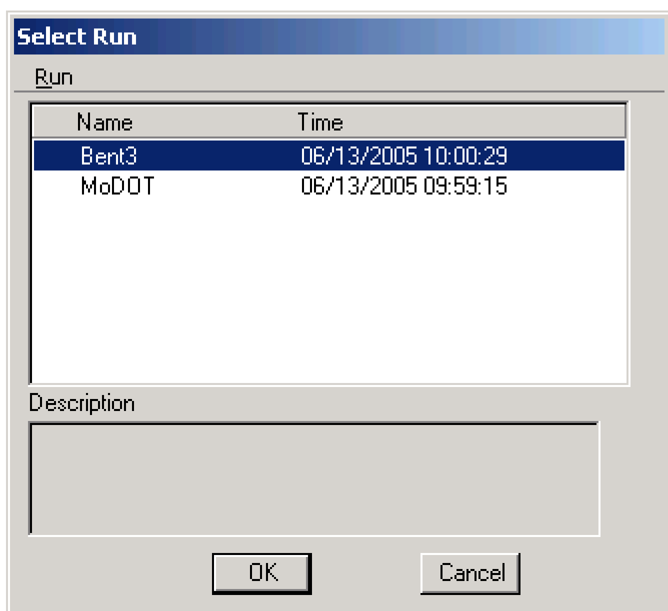
2. Open the project **t:\br-proj\a_geopak\d2\j2p0300\project\j2p0300.prj**.
   Enter the project as user **userc** and go into **Road**.

3. Select the **Bents** working alignment.

4. Choose **Cross Section Sheets** from the **Project Manager** dialog.

   Copy the **MoDOT** run to **Bent3**.

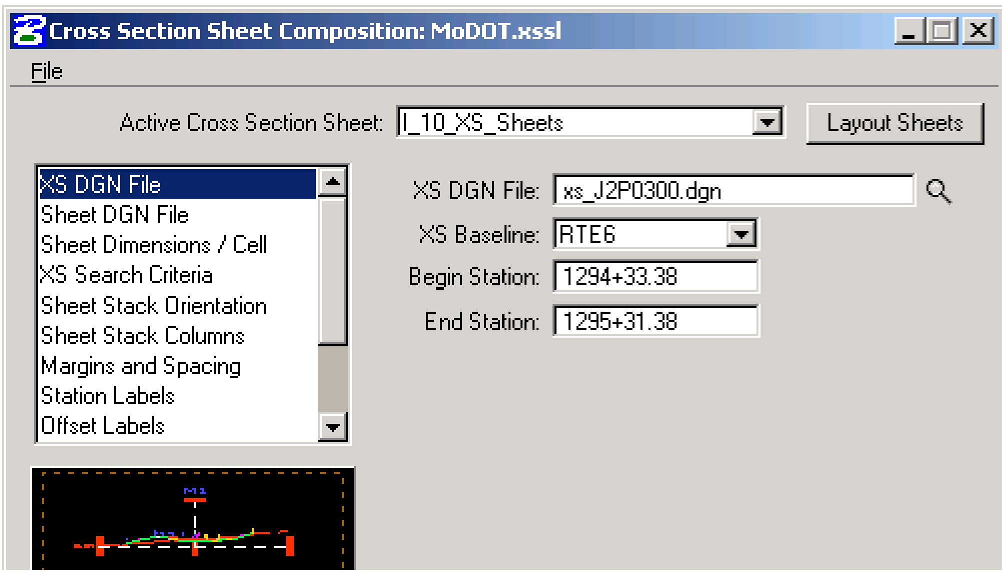
   

   Open the **Bent3** run.

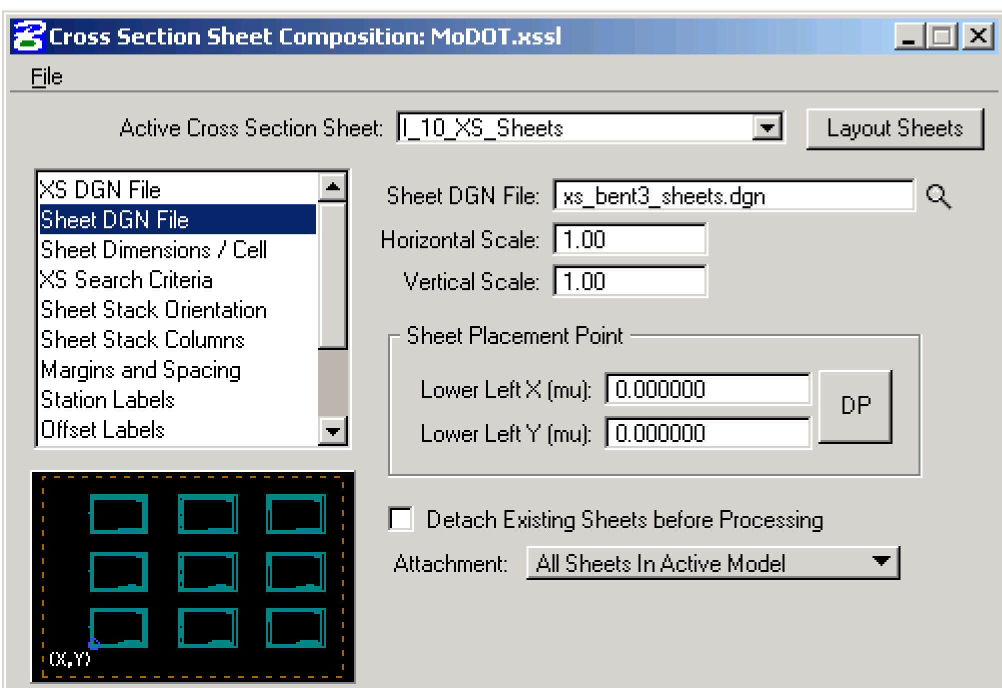
5. Create a new MicroStation file. Name the file **xs_bent3_sheets.dgn**, and put the file in the directory **t:\ br-proj\a_geopak\d2\j2p0300\data** \. Use the seed file **t:\standard\wsmod\design\seed-i\i_10_xs_100_sheets.dgn**.

6. Be sure the following items are set in the **XS DGN File** section of the dialog:

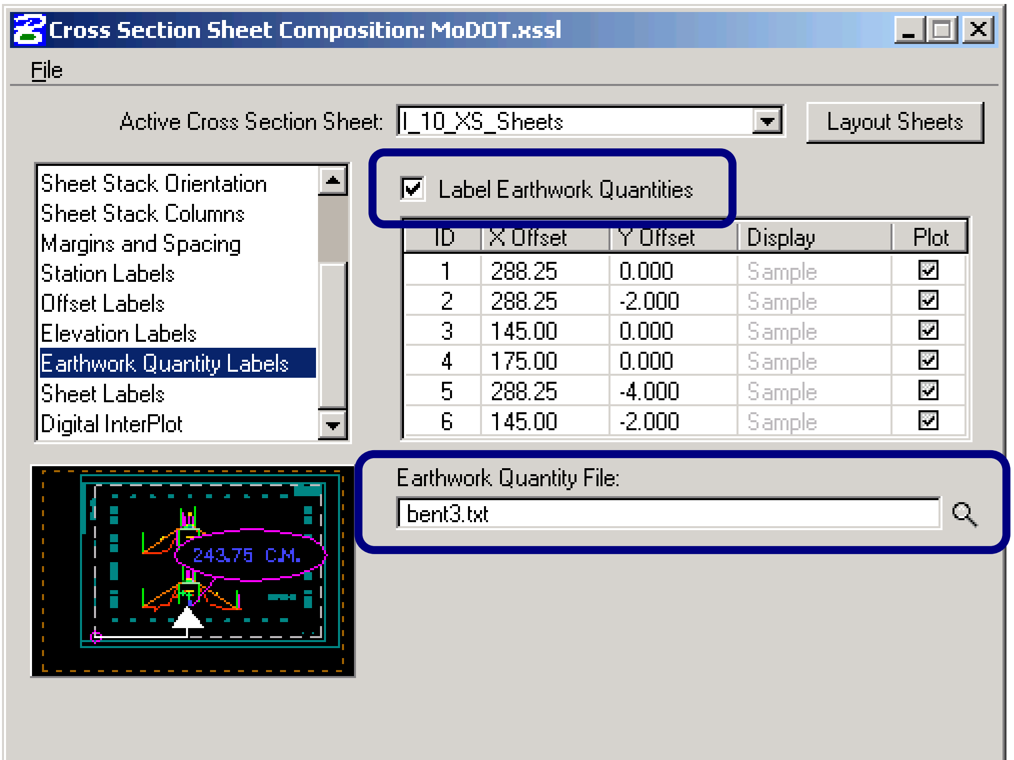
Active Cross Section Sheet	**I_10_XS_Sheets**
XS DGN File	**xs_j2p0300.dgn**
Chain	**RTE6**
Begin Station	**First Cross Section Station**
End Station	**1295+00 R 1**



7. Select the **Sheet DGN File** to be the file **xs_bent3_sheets.dgn** created in step 5.

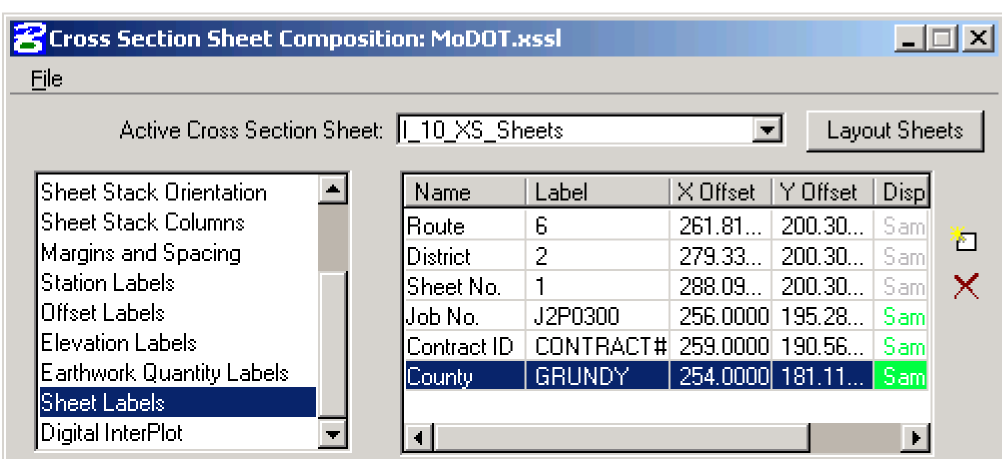


8. In the **Earthwork Quantity Labels** section, turn on the **Earthwork Quant. Define** option, and set the ASCII file to **bent3.txt**.



9. Select the **Sheet Labels** section of the dialog and change the Label column for the following lines (Do not change the values for Sheet No and Contract ID):

Route 6
District 2
Job No. J2P0300
County GRUNDY



10. Save the settings for the run (**File > Save Settings**).

11. Layout the sheets by either going to **File > Layout Sheets** or by clicking on the **Layout Sheets** button.

12. Repeat the process for Bent 4, by going back into Cross Section Sheets. This time however, copy the **Bent3** run and name it **Bent4**. Go into the new run. By copying the Bent3 run, everything is already set except for the station range and the name of the files. Use names relevant to Bent 4. The earthwork quantities file is **bent4.txt**, for instance.

Chapter 19

XS Reports & Limits of Construction

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19.1 Objectives

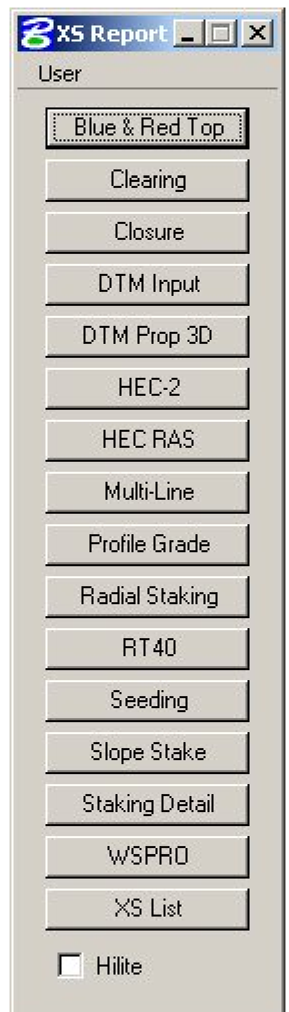
- Create various cross section reports:
  - for plan use (design elements and quantities)
  - as input for other programs and/or applications of GEOPAK
  - for construction layouts
- Create and plot construction limits in the plan view.

19.2 XS Reports Definitions

The GEOPAK Cross Section Report Utility can extract up to sixteen different reports from original and design cross-sections. For each report generated, the user must set the parameters of the existing and/or design cross sections. GEOPAK also provides an option to make custom headers for each of the reports via the **User** pull down menu.

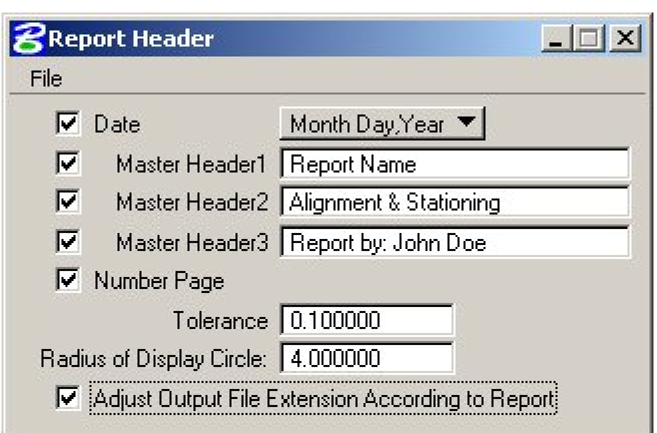
19.3 XS Reports Accessing

To access the **XS Report** select **Project Manager** >> **Reports & XS Quantities**.



19.4 XS Reports Dialog

From the **XS Report** dialog box select **User** >> **Preferences**; a **Report Header** dialog box will appear with all options ghosted out. To activate the individual fields simply toggle on the box next to the desired field. Once you have completed the dialog box, the information will be saved as an **.hdr** file. This allows for the creation of a separate header for each type of report. The tolerance field determines the maximum gap allowed between cross section elements.



19.5 Reports

19.5.1 Blue and Red Top

Based on the dialog box settings, GEOPAK determines the offset and elevation of a slope and its breakpoints. **Blue** refers to the top of pavement and **Red** is the top of subgrade. The user must determine this by indicating the level, color, weight and style for each surface.

19.5.2 Clearing

The **Clearing Report** is useful for obtaining clearing and grubbing quantities. For each station, GEOPAK will list the clearing distance on each side of the chain and the width of any exception. You can obtain the results in meters squared and/or hectares. Toggle boxes for Cut Slope Rounding, Additional Clearing in Cut and Fill, and Minimum Clearing Width are provided for increased control over the output.

GEOPAK can also generate quantity sub-totals based on the value specified in **Sub Every**.

To use the **Except Width** option, you must have an existing ASCII file that includes the Beginning and Ending Station and Exception Width.

Once everything is set, you can output the information to an ASCII file

19.5.3 Closure

The **Closure Report** provides information on the intersection point between the user defined proposed finish grade and existing ground. In addition to the ASCII report, the designer may instruct GEOPAK to close any gap either by drawing a vertical line between the endpoint of the proposed finish element and the existing ground or extending the slope of the last proposed element to intersect existing ground. The procedure will not extend existing ground. The **Closure Report** can be accessed within any Microstation cross section file by selecting Closure from the main XS Reports dialog

19.5.4 DTM Input

This process generates XYZ coordinates from cross section elements and places this information into an ASCII file for use in Geopak's DTM package. To use this dialog box simply enter the .gpk job number, chain name and station range. GEOPAK will read the cross section elements based on level, weight, color and style.

19.5.5 DTM Proposed 3D

This report is similar to DTM Input except that you can set both original and proposed cross sections at the same time. This report also differs in that it makes breaklines across the cross sections. This report is mainly useful when making 3-D cross sections for modeling purposes.

19.5.6 HEC-2

This process reads cross section elements and formats the information in an ASCII text file suitable for use in the HEC-2 hydraulic program.

19.5.7 HEC RAS

This process reads cross section elements and formats the information in an ASCII text file suitable for use in the HEC RAS hydraulic program.

19.5.8 Multi-Line

This report is useful in creating cross-sections for staged construction. Begin by entering the job number, chain name and station limits. Primary cross section element parameters must be completed before secondary element parameters. This is important due to the order in which GEOPAK reads the information. Once all the parameters have been entered, the new cross sections may be drawn to the design file or you may choose the display only option. An ASCII text file will be generated.

19.5.9 Profile Grade

The **Profile Grade Repor**t is one of the most versatile reports available. It prints existing ground and design grade elevations and low point elevations for each cross section. Additionally, this report has the ability to create horizontal and vertical alignments along the low points and store them directly into the .gpk. Horizontal alignments created from this report will start with station 0+000 and have no curves.

19.5.10 Radial Staking

The **Radial Staking Report** is a specialized report created for the U.S. Federal Highway Administration (FHWA).

19.5.11 RT 40

The **RT 40 Report** produces RDS based RT40 data. To use this dialog box simply fill in the job chain name, stationing range and the parameters of the cross section elements you wish to use.

19.5.12 Seeding

Other than the usual entries, the user must enter the parameters of the elements to be seeded.

This dialog box includes slope and subtotal options as well as a way to limit the number of segments read (**By-Pass Segments**). The user may also establish additional seeding specifications (**Additional Distance**).

Once all of the settings are complete, the report is written to an ASCII output file for use in plan quantities.

19.5.13 Slope Stake

The **Slope Stake Report** is a special format report developed for the FHWA. This report generates offsets, elevations and superelevation information for each cross section. To generate this report fill in the usual cross section parameters plus Subgrade and Hub Staking information. When complete, push Apply and the report is written into an ASCII file.

19.5.14 Staking Detail

The **Staking Detail Report** determines the tie down point between the proposed finished grade and the existing ground. GEOPAK will list the right and left offset, elevation, slope of the finish grade and superelevation rate for each cross section. To create this report, fill in the project information and desired cross section elements' parameters. Once complete, you have the choice between two formats, a FHWA ASCII report or a Montana DOT report (includes ditch elevations).

19.5.15 WSPRO

This report takes the cross section elements and turns them into an ASCII file in the WSPRO format for use as input in the WSPRO hydraulic analysis program.

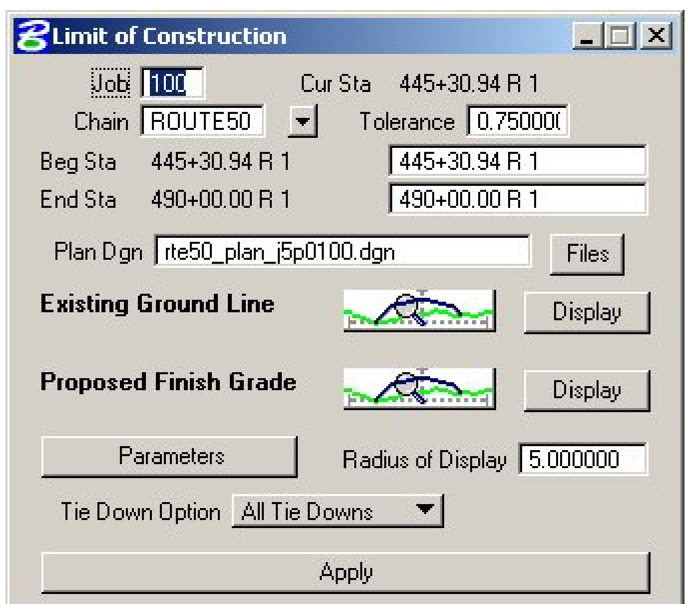
19.5.16 XS List

This report creates a listing of elevations and offsets for each cross section element according to user defined parameters. You have the option of creating either an original cross section list or a design cross section list. These reports are very similar to RDS cross section lists.

Note: For more information on the various reports and the dialogs, see the Geopak online help.

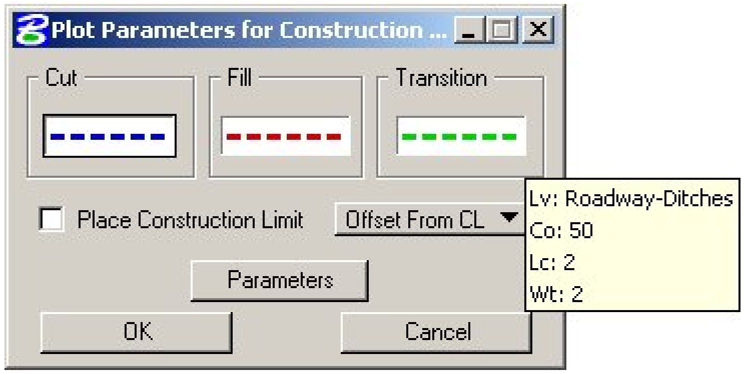
19.6 Accessing Limits of Construction

To access the **Limits of Construction** dialog, go to **Project Manager >> Limits of Construction**. After the run is chosen, the following dialog opens.



19.7 Processing Limits of Construction

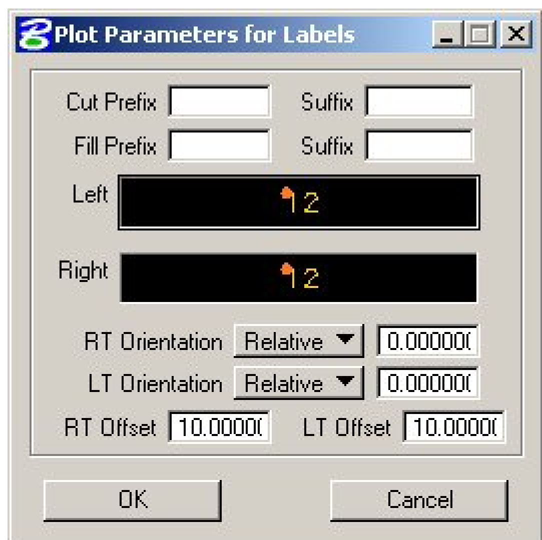
The user can specify the .gpk job number, the centerline, and the file containing the plan view information. The **Working Alignment** should fill the **Existing Ground** and the **Proposed Finish Grade** sections.



The **Parameters** button opens the dialog box below. The symbology for the cut, fill, and transition construction limits can be set in this dialog.

The **Place Construction Limit** toggle allows the user to place various text strings along the construction limits. Selecting the Parameters button, and making the desired changes in the dialog box shown below will set the symbology for these text strings.

The **Radius of Display** field is the size of the display circle when Geopak is scanning the cross-sections. The last option in the main **Limits of Construction** dialog is the **Tie Down Option**. There are two **Tie Down Options**. If the **All Tie Down** option is set, all tie downs within a section are plotted. (I.e. wide medians, outer roadways, ramps, etc. may have tie downs in between the limits of the main roadway, and the outer roadway or ramp.) If the **Outer Tie Down** option is selected, then only the outmost tie downs are plotted.



Once the **Apply** button is chosen, the limits of construction and the optional text are drawn into the plan view file.

Exercise 19-1

This is a group exercise to demonstrate how stream cross sections can be plotted from both a digital terrain model (DTM) and the field surveyed survey chains. Once the cross sections are plotted, the HEC-RAS cross-section report is used to create a data file that can be imported in to HEC-RAS.

The minimum electronic information that the district contact needs to provide is the DTM stored as a TIN file and the survey points stored in a GPK file. In most cases the district should be able to provide chains and profiles created from the survey information along with plots the chains and profiles in MicroStation.

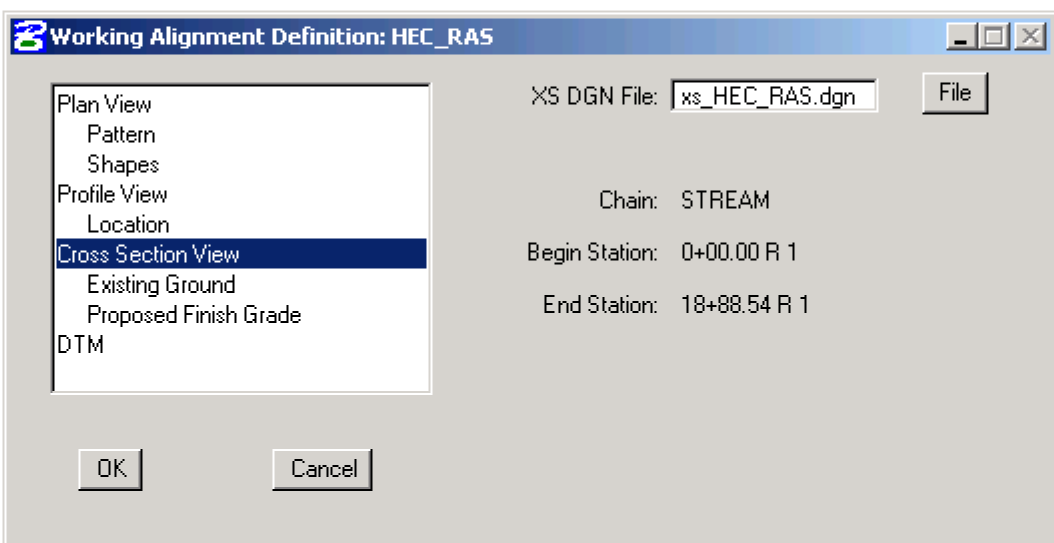
1. Open the MicroStation file:
   t:\br-proj\a_geopak\d2\j2p0300\data\xs_HEC_RAS.dgn.
   Review the cross sections.

2. Open the project **t:\br-proj\a_geopak\d2\j2p0300\project\j2p0300.prj** and enter it as **userc**.

3. Copy the J2P0300 working alignment to **HEC_RAS** and enter that working alignment.

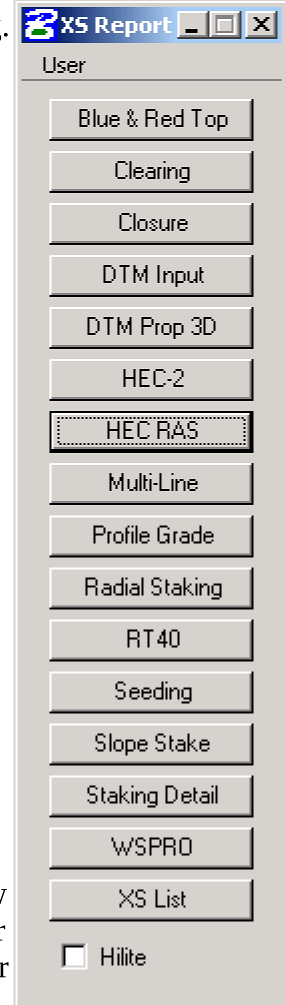
4. Enter the Working Alignment Definition for **HEC_RAS** and change the following:

Section	Item	Value
Plan View	**Chain:**	**Stream**
Cross Section View	**XS DGN File:**	**xs_HEC_RAS.dgn**



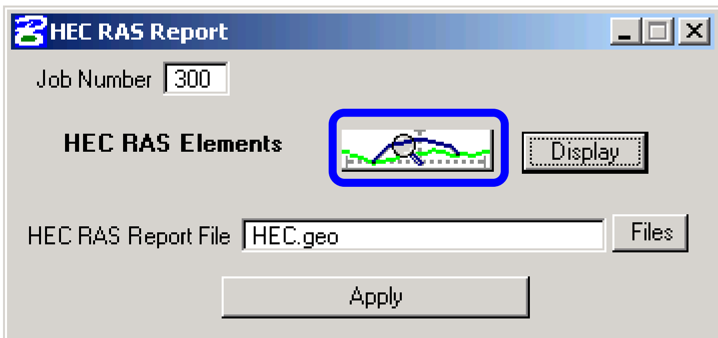
Click **OK** to save the changes to the working alignment definition.

5. Choose **Reports and XS Quantities** from the **Project Manager** dialog.



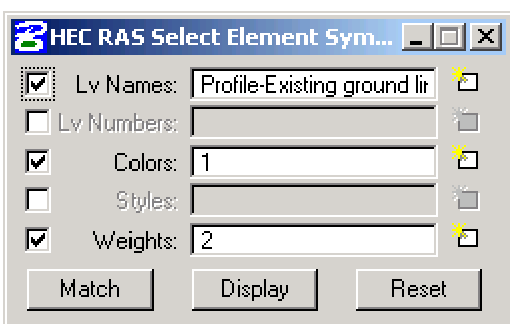
This will bring up the XS Report dialog shown to the right. Select the **HEC RAS** report.

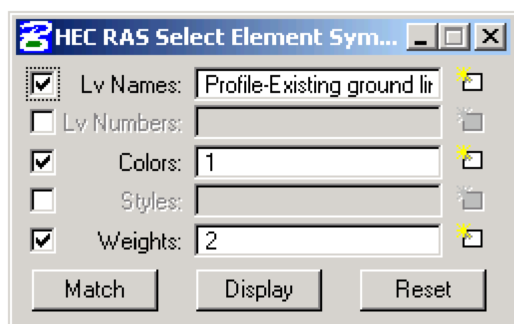
The dialog shown below will appear. Enter the information as shown:



Double Click on the button outlined above to bring up the HEC RAS Select Element Symbology dialog.

To extract the survey profiles, use the setting shown in the dialog below and on the left. The settings in the dialog below and on the right are for the sections created from the TIN file. Click the X in upper right corner of the dialog to close the dialog and accept the settings.





Select **Apply** to generate the report.

The report will be written to the working directory. Open the report in Ultra Edit. It is:
t:\br-proj\a_geopak\d2\j2p0300\data\HEC.geo.

To import the data into HEC RAS, start the HEC RAS project and go to **Edit > Geometric Data…** in HEC RAS. In the Geometric Data dialog, go to **File > Import Geometry Data > GIS Format…** and load the HEC.geo report.

Chapter 20

3D Modeling

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20.4 3D Modeling Tools 20-2
20.5 3D Modeling Process 20-2
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20.1 Objectives

- Create 3D cross sections from 2D cross sections
- Interpolate between 3D cross sections to create B-spline surfaces
- Use Drive Through to view the model
- Place pavement markings on the 3D model

20.2 Definitions

Geopak 3D Modeling is a process of deriving three-dimensional cross sections from two-dimensional cross sections and interpolating between the three-dimensional cross sections to create b-spline surfaces that represent the design.

20.3 Prerequisites

Before a 3D model can be extracted from 2D cross sections, there are a few prerequisites that must be met. They are:

- 2D design cross sections
- Plan view graphics
- 3D design file

2D Design Cross Sections

The user should have an existing design file where 2D cross sections are stored. The user will need to know which levels contain the existing ground line and the proposed finished grade.

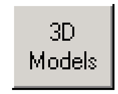
Plan View Graphics

The user must also have another 2D-design file containing plan view graphics. The plan view graphics should include the elements specified in the **Run**. For example, it should contain edge of pavement, chains, and pavement markings.

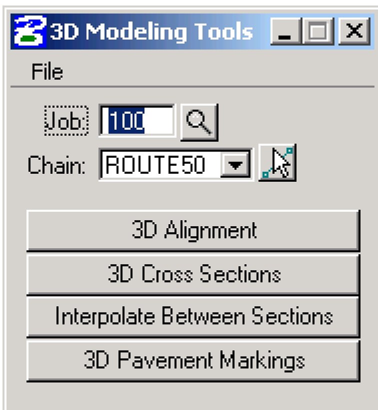
3D Design File

A blank 3D-design file must exist to store the 3D cross sections as they are generated. Enter the 3D-design file and attach the 2D-plan file as a reference file. Save the settings of this file with only the Top View displayed.

20.4 3D Modeling Tools



From a 3D-design file, access the 3D modeling tools by selecting **3D Models** in **Road Project** dialog (shown to the right) or by selecting the **3D Models** icon, which is the middle icon in the 3D Tools box shown below.



The dialog box shown to the left will appear requiring a job number and chain name. It contains the following tools:

3D Alignment - draws elements into a 3D file at the correct coordinates, using the specified alignment and profile.

3D Cross Sections - references your 2D cross section file and creates a 3D complex chain to represent the 3D cross sections.

Interpolate Between Sections - interpolates between the 3D cross sections to create B-spline surfaces.

Pavement Markings - adds pavement markings to a 3D model. The pavement-marking tool scans pavement markings in a 2D file and draws the markings in the 3D file based on user defined parameters.

20.5 3D Modeling Process

1. Plot the 3D alignment in the MicroStation 3D file, and attach the plan view as a reference file.

2. To add the 3D Cross Sections, GEOPAK opens the 2D cross section file, scans the cross sections and creates a complex line-string in the 3D-design file based on the cross sections in the 2D file.

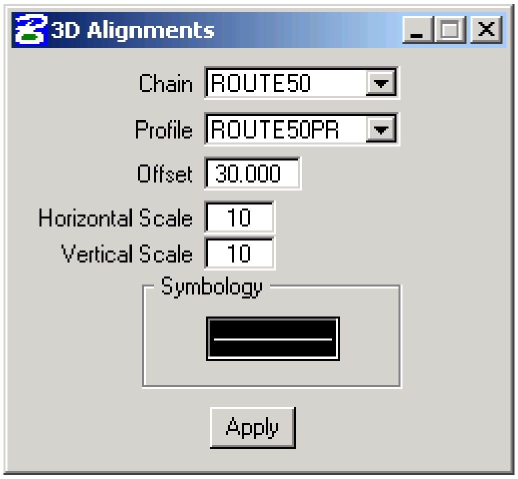
3. B-spline surfaces must be created using **Interpolate Between Sections**. For a complete rendering, the model needs to be refined by adding additional surfaces to the model.

4. Add the 3D Pavement Markings.

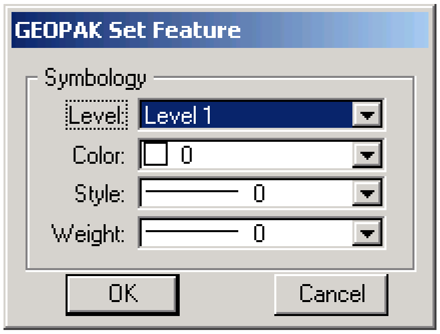
The following subsections looks at each of these steps in more detail.

20.5.1 3D Alignment

The first step is to plot a 3D alignment, which is a representation of the combined chain and profile. To active this tool, click on 3D Alignment in the 3D Modeling Tools dialog. This brings up the following dialog. An offset from the chain can be specified as well as the horizontal and vertical scales and the symbology of the 3D alignment. If the scales are not distorted, the alignment is plotted using true x, y, and z coordinates. If the **Vertical Scale** differs from the **Horizontal Scale**, true x and y coordinates are used and the elevations are distorted.



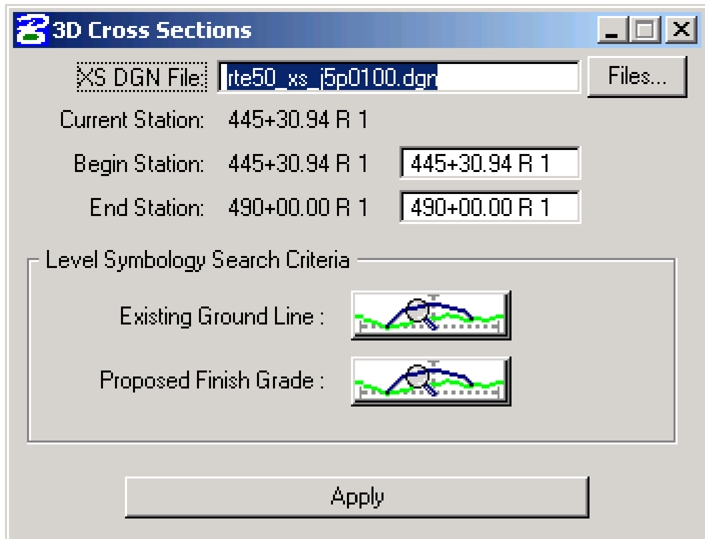
To complete step 3, the 3D alignment must touch each of the 3D cross sections. The easiest way to make this happen is to plot the string at one of the profile grade alignment ties. To set the symbology, double click in the **Symbology** preview to bring up the following dialog.



Change the attributes by picking the desired option from list that appears when you click in one of the fields. Click **OK** to save the changes and close the dialog or click **Cancel** to close the dialog without saving any changes.

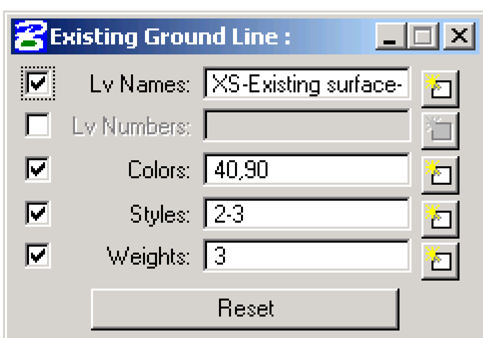
20.5.2 3D Cross Sections

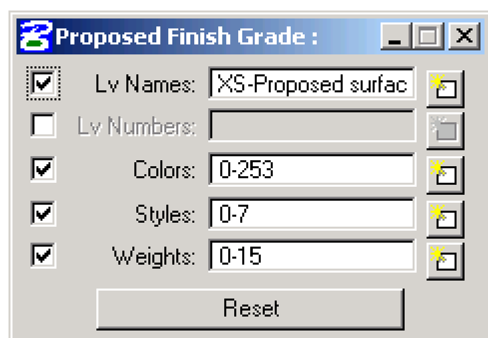
The second step is to generate 3D Cross Sections: To do this click on the **3D Cross Sections** button in the 3D Modeling Tools dialog.



- Enter the 2D cross-section file containing design cross-sections; GEOPAK reads the file to determine the beginning and ending station of the cross-sections. These stations are automatically displayed in the dialog box; however, the user may key in a different range.

- Define the attribute information for Existing Ground Line and Proposed Finished Grade. You can check the **Level Symbology Search Criteria** by holding your cursor over the icon for the **Existing Ground Line** and **Proposed Finish Grade**. Click on the icon to open the following dialogs, which allow you to change the settings.





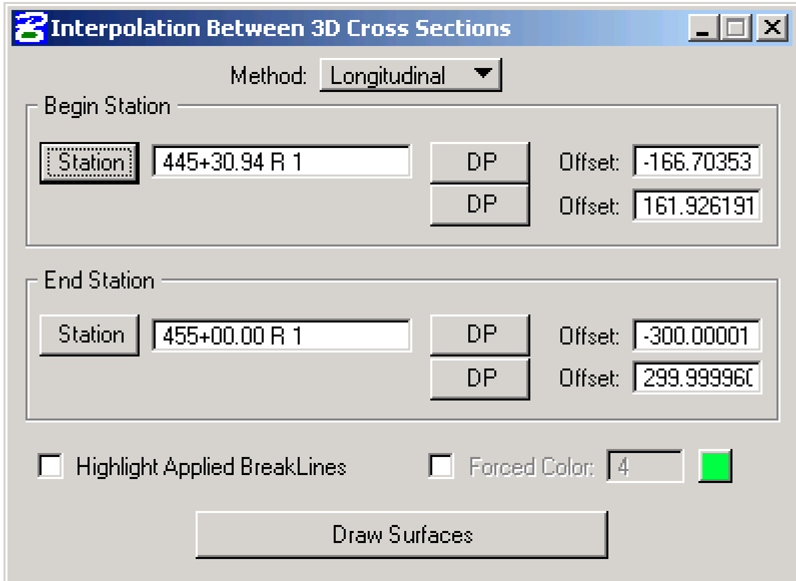
- Select **Apply**

GEOPAK opens the 2D cross-section file and begins creating 3D complex line-strings from each cross-section. Each 2D cross-section is highlighted as the line string is formed. This gives the user a brief opportunity to check for errors. When the process is complete, Geopak returns to the 3D file to draw the cross-sections.

A visual inspection of the 3D cross-sections should be performed to verify their integrity. The colors of the 3D-line string should reflect the same colors as shown in the 2D-design cross section. If an error has occurred, the user should return to the 2D-design cross-section file and fix the appropriate cross section(s) using GEOPAK and/or MicroStation. Repeat the 3D cross-section process for any revised cross-sections and review.

20.5.3 Interpolation Between Sections

The third step is to interpolate between the 3D cross sections.



The only **Method** supported for interpolating between cross-sections is **Longitudinal**. It uses the attached 2D-plan view drawing is used for the longitudinal references.

Beginning Station and **Ending Station** – These values which cross sections are used to create the b-spline surfaces. The easiest way to set the values is to click on the Station button and data point (and accept) any where on the cross section for the desired beginning and ending stations. This will automatically fill the station values and the their offsets. If surfaces are not to be created for the whole cross section, the **DP** buttons may be used to limit the width of the interpolation..

Highlight Applied Breaklines – This will highlight the breaklines used in the interpolation when activated.

Select the **Draw Surfaces** bar at the bottom of the dialog box to begin the interpolation process. The user is encouraged to process a small range of cross sections until the entire project has been done. When GEOPAK interpolates 3D cross sections, it projects *like color* to *like color* between cross-sections. All MicroStation elements should maintain a consistent color scheme throughout the project. For example, within a 2D file, all ditch slopes should be drawn using the same color, paved roadway with another color, etc. If colors do not correspond, you will get a “Color Mismatch” error and the process will terminate. There are two ways to correct this error:

- Check the cross sections for an inconsistent color scheme, correct any errors, then regenerate the necessary cross sections, or
- Activate the **Force Color** toggle; this will allow Geopak to ignore the color of the cross section elements and interpolate using only the specified color. For this to work the DP buttons need to be used since each surface type (pavement, shoulder, curb face, foreslope, ditch, backslope, existing ground, etc.) needs to build separately.

20.5.4 Pavement Markings

The fourth step is to place pavement markings in the 3D file by extracting graphic information from the plan view of a 2D file. (Pavement markings created by *copying parallel* a complex element must be dropped before they can be included in a 3D model.). This is an optional step and is not required to create the model.

Enter the name of the 2D graphics file containing pavement markings.

Provide **Search Criteria** by entering the graphic attributes of the pavement markings.

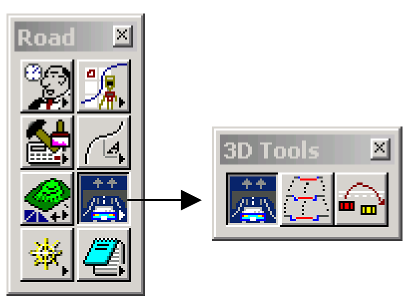
Stripe Width reflects the actual width of the plan view stripe you want to create.

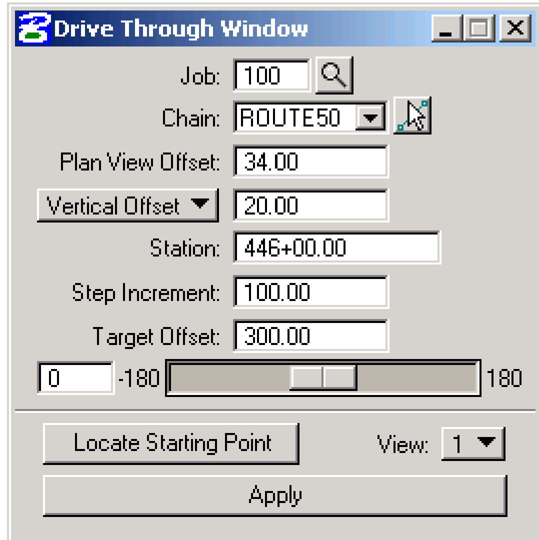
Surface Elevation Offset is the distance from the B-spline surface the stripe shape is drawn. Special attention needs to be applied to this value. If the distance is too low, the stripe may fade into the roadway; if the distance is too high, the stripe may cast a shadow on the road surface when the model is moved to a visualization software package. It is desirable to place the stripe just above the surface. Begin by using a value of 0.10; if adjustments are necessary, use small increments.

Pavement Markings may be applied to an entire view or a fenced area by selecting the appropriate option. If view is chosen, be sure to *fit the view* before processing.

20.6 GEOPAK Drive Through

GEOPAK Drive Through provides the user realistic visualization of 3D surfaces. Select **Applications >> Geopak Road >> 3D Tools >> Drive Through** or choose the **Drive Through** icon shown below.





This brings up the Drive Through Window.

The user must enter the **Job Number** and a **Chain** name. The drive through will follow this chain with the applied **Plan View Offset**.

Two options are available to define the distance the driver is from the roadway vertically:

- **Constant Elevation** places the driver at a fixed elevation, as defined by the user, throughout the drive through process.
- **Vertical Offset** places the driver at a specified distance above the model, meaning the elevation of the view changes with the elevation of the model.

The **Station** value automatically displays the beginning station of the selected chain, which may be changed by user key-in.

Step Increment defines the distance traveled between each camera view.

Target Offset defines how far down the road the viewer is looking (the focal point).

Pressing the **Locate Starting Point** button finds the first station on the alignment where a 3D graphic element is present. This is a convenient way to locate the start of a model.

View indicates the MicroStation view to be processed.

Press the **Apply** bar to update the camera view to any changes in the settings or to apply the step increment. Once the first view is displayed, the user may *pan* the view by moving the slide bar to the desired angle and pressing the Apply button.

After viewing the model:

- Restore the view by rotating to the top view.
- Access the **Settings >> View Attributes** dialog box from the Microstation command window and toggle **Camera** off (automatically toggled on during drive through process).