# *GEOPAK 2001*

## *Road*

## Introduction

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# Introduction

# I.1 Introduction

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 will help 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.**

# I.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.iho** |
| fname###.**o**oc | ASCII output file created by GEOPAK during a COGO session. Variables are the same as defined above. Example: **align999.oho** |
| 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)

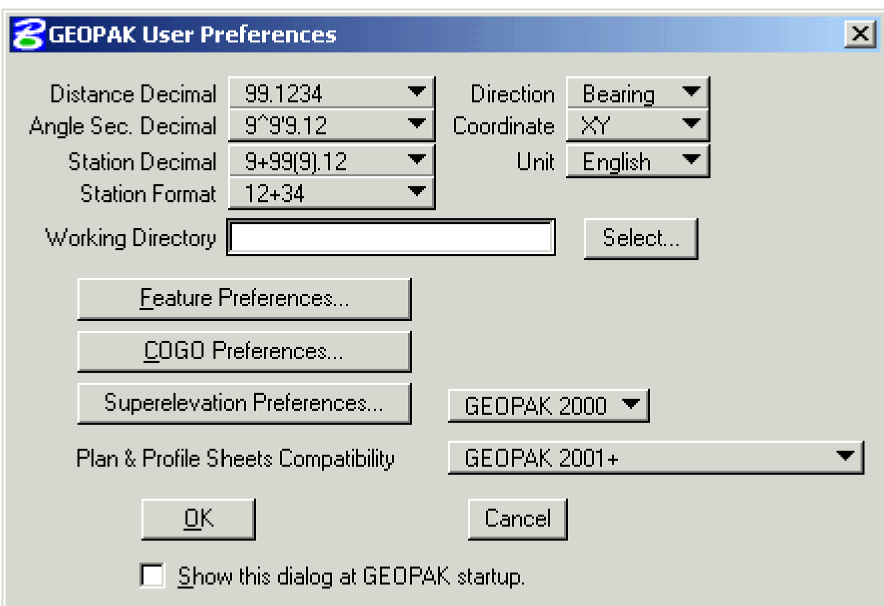
project.**prj** Binary file resulting from the creation of a new project.

## I.3 Accessing GEOPAK

GEOPAK is started upon entering a MicroStation File. To verify that GEOPAK is active, scan the MicroStation menu bar where the Applications menu appears. Simply pull down **Applications > GEOPAK Road**. When each GEOPAK tool is selected, the corresponding dialog will appear. To utilize the full potential of GEOPAK, usage of the GEOPAK dialogs may be interspersed with generic MicroStation commands. In addition, 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.

## I.4 User Preferences



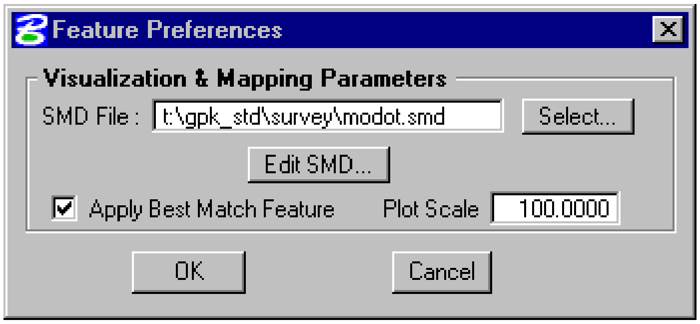

The **User Preferences** dialog is used to set items that determine how distances, directions, and stationing is displayed and calculated, as well as the units that are used. The **User Preferences** dialog can be accessed from **Applications>>GEOPAK Road>>User Preferences**. The following dialog appears.

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.

### I.4.1 Feature Preferences

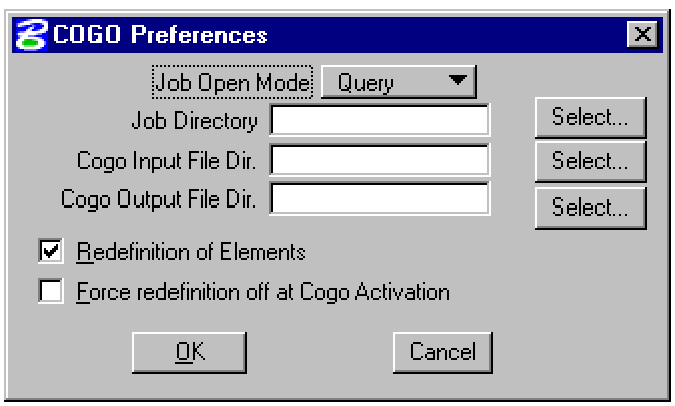
The **Feature Preferences** button will activate the following dialog.




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.

### I.4.2 COGO Preferences

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




The **Job Directory** can be set to indicate the location of the coordinate geometry database (.gpk). If this field is not set, GEOPAK will look for the coordinate geometry database (.gpk) in the **Working Directory**. The **COGO Input File Dir.** and **COGO Output File Dir.** 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**.

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.

### I.4.3 Superelevation Preferences

There are two options for using GEOPAK Superelevation, **GEOPAK 2000** and **Classic**. **GEOPAK 2000** will use the tools made available in GEOPAK 2000 and later versions. The **Classic** option will bring up the tools available prior to GEOPAK 2000.

****Note:** The **Classic** option will not be supported within MoDOT. Only the **GEOPAK 2000** option will be supported.

The **Superelevation Preferences** have been set by CADD Support and do not need to be modified by the user.

### I.4.4 Plan & Profile Sheets Compatibility

Three options are available for creating Plan & Profile Sheets, **Classic**, **GEOPAK 2001+**, and **GEOPAK 2001+ with Raster Manager**. MoDOT has adopted the **GEOPAK 2001+** Plan & Profile Sheets tool in preparation for GEOPAK 2004. The Classic tool is not supported in GEOPAK 2004 and will no longer be used in training, although it is permissible to use the Classic tool for jobs that will be let before December 31, 2004.

# Chapter 1

# Start Job

## 1.1 Objectives

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

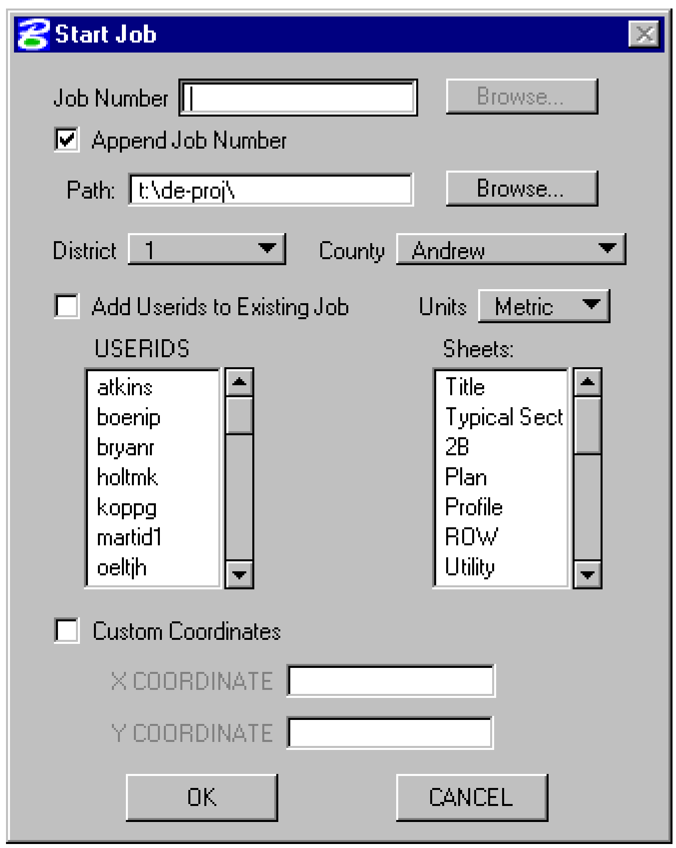
## 1.2 Definition

**Start Job** is a tool that will set up a GEOPAK job for a user, or add users to an existing job. **Start Job** will create the job directories, copy default Microstation files to the directories, and set the global origin in the Microstation files. **Start Job** will also append the job number to the end of the copied Microstation files. Once a job has been created, **Start Job** will add a user to the job.

## 1.3 Accessing

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

## 1.4 Start Job Dialog




Once the user has accessed the **Start Job** dialog box, shown right, they will need to fill in or choose the **Job Number** and the **Path** in which to place the job directory. Once the job number and path have been chosen, the **District** and **County** can be chosen.

If the user is creating a new job, do not check the **Add Users to Existing Job** toggle, just choose the userids of the people that will be working on the job. If a job already exists, and the users are being added to the job, check the **Add Users to Existing Job** toggle.

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 the job is not based on the modified state plane or the state plane coordinate systems, **Custom Coordinates** must be set to shift the global origin. If the modified state plane or state plane coordinate systems were used for the project, the **County** selected will determine the global origin shift.

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

```
T:\
 └── de-proj\
       └── county
             └── job number
                    ├── data
                    │     ├── dtm.dgn
                    │     ├── pattern_shape.dgn
                    │     ├── plan.dgn
                    │     ├── profile.dgn
                    │     ├── topo.dgn
                    │     └── xs.dgn
                    ├── plan_sheets
                    │     ├── 1000_m
                    │     └── 200_m
                    └── projects
                          └── projdbs
                                 ├── userid1
                                 └── userid2
```

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 **Sheet** directories contain the plan and profile sheets, cross section sheets, and any other sheets 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 2

# Project Manager

## 2.1 Objectives

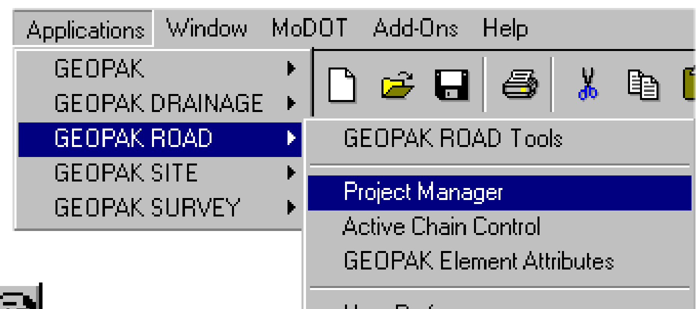
- Learn how to set up a project using **Project Manager**.
- Learn how to utilize **Project Manager** as a workflow guide.
- Learn how to access GEOPAK dialogs from the **Project Manager**.

## 2.2 Definitions

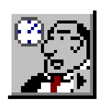
Project Manager is a GEOPAK tool that associates a project with its respective **gpk** job number, users, working directories and project files. Project Manager provides the user with an easy workflow system that keeps records of processes run throughout the design of a project.

## 2.3 Accessing

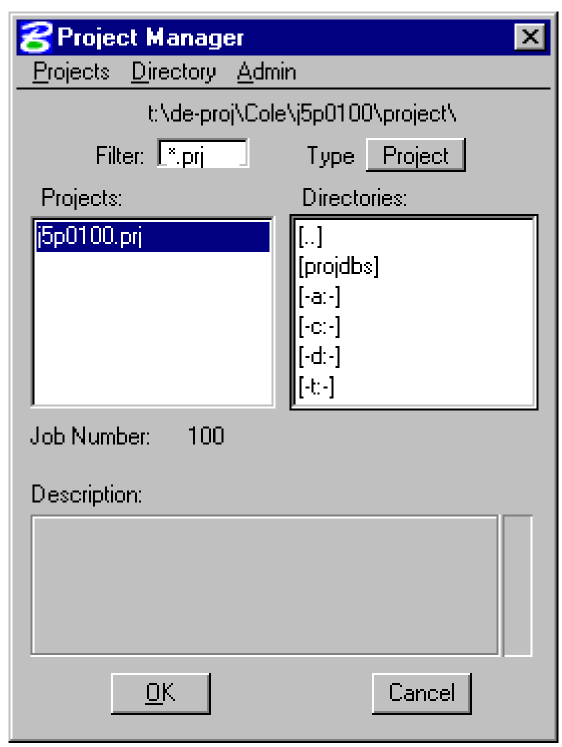
To access Project Manager, select **Applications >> GEOPAK Road >> Project Manager**




or select the Project Manager icon.



The following dialog appears:



# 2.4 Project Manager Dialog

## 2.4.1 General Description

The current directory is displayed at the top of the dialog box. This can be modified by traversing to a different directory in the **Directories** list box. Project files (.prj) are displayed in the **Projects** list box. The project files should be located in the t:\de-proj\county\jobnumber**project** directory.

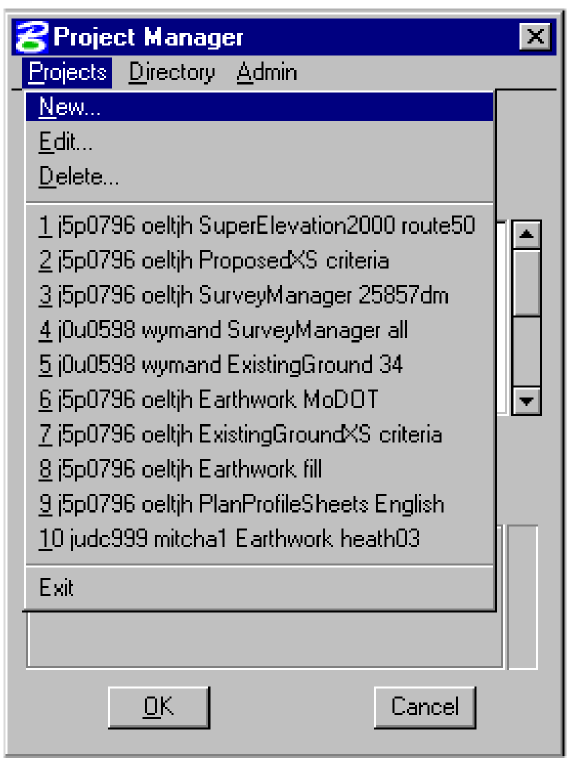
The remainder of the Project Manager dialog box displays information after a project has been selected from the **Projects** list box. At the bottom of the dialog are the **OK** and **Cancel** buttons. If the user wishes to exit Project Manager, the **Cancel** button should be selected. To continue in the Project Manager process, the **OK** button should be selected.

## 2.4.2 Project Manager Menu Bar

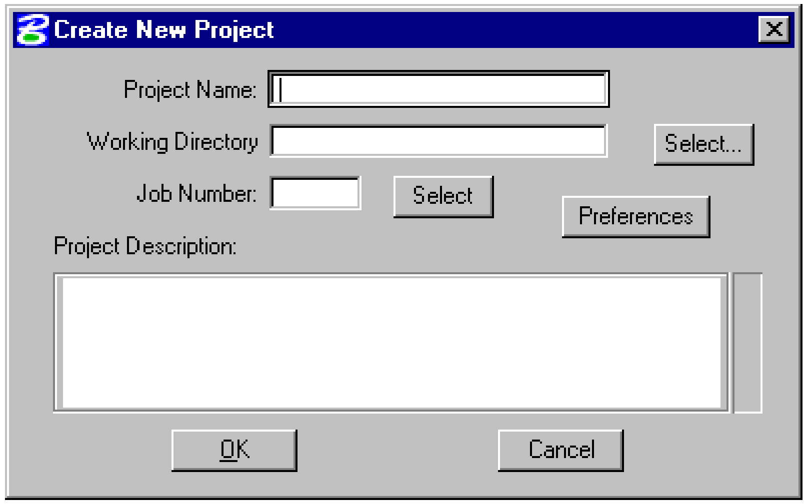
There is three pull down choices on the Menu Bar: **Projects**, **Directory**, and **Admin**. Each of these choices has options contained in the pull down.

#### 2.4.2.1 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.



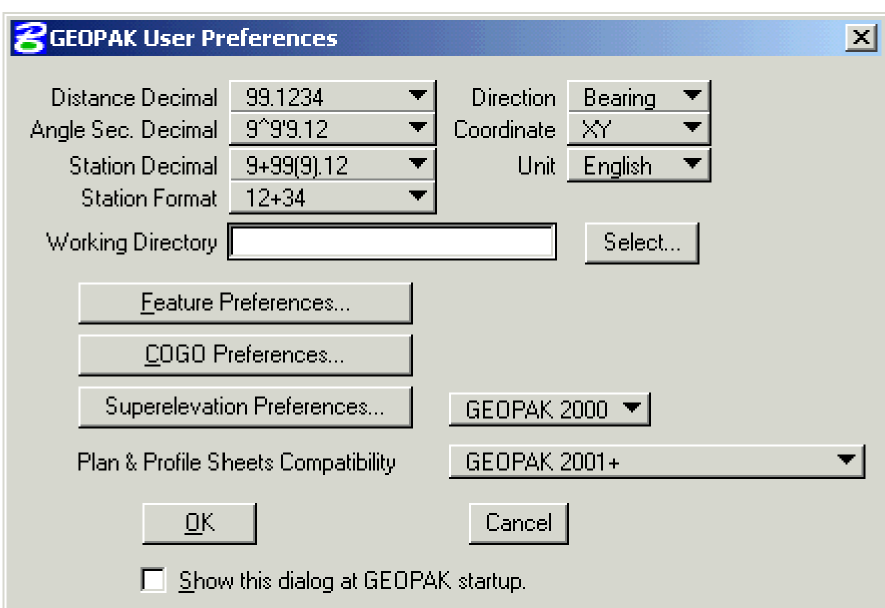

The **New** menu option is used to create a new project. The .prj file will be stored in the directory shown in the Directory path at the top of the Project Manager dialog box. When the **New** menu option is selected, the following **Create New Project** dialog appears.

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, the **Working Directory** should be set to t:\de-proj\county\jobnumber**data**.

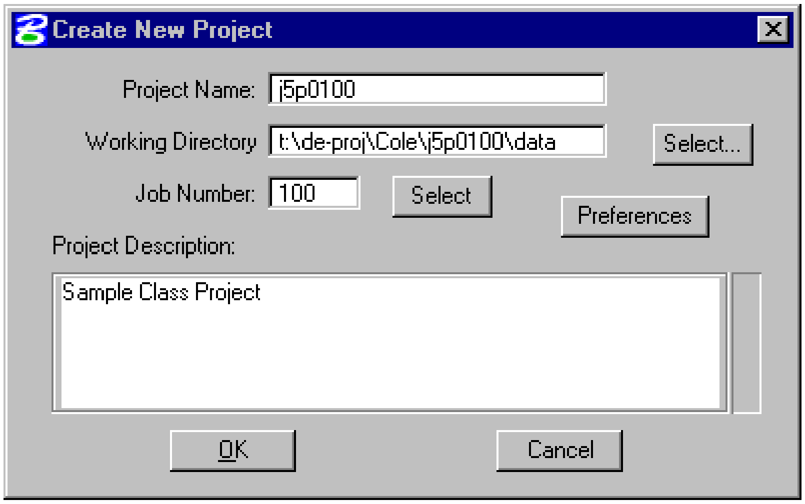
The next field is for typing in the cogo job number, or the **Select** button may be chosen and the appropriate cogo job number selected.

Next the **Preferences** button should be chosen and the following **Project Preferences** dialog appears.

The user may set the particular parameters for each project as well as the **Working Directory**. By setting these parameters for the project, the user does not need to re-set these parameters as they change projects. The preferences set with that project are recalled when the project is recalled. After all of the information is entered, the **OK** button is selected, or if the user wishes to abort, the **Cancel** button may be selected. For more information on the **User Preferences** dialog, see section I.3 in the Introduction.



Shown below is a sample project that includes a project description, which may be keyed in at the bottom of the **Create New Project** dialog box.



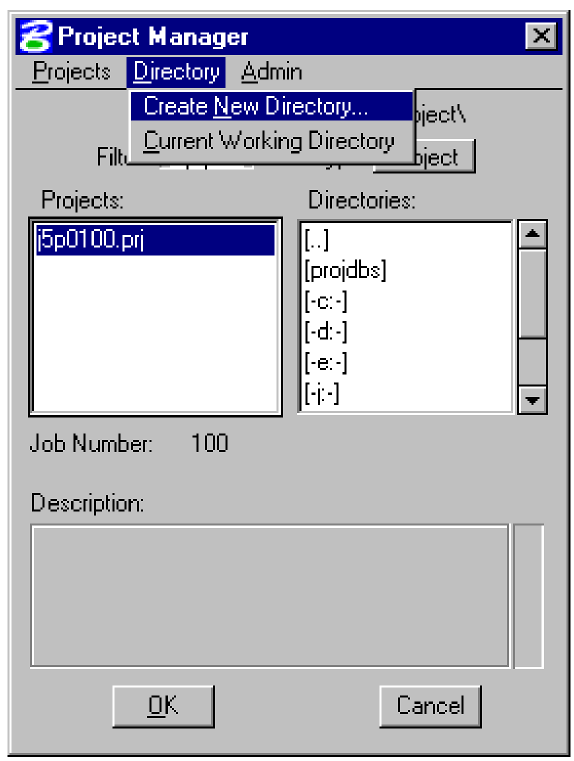

The **Edit** menu option is used to change any settings associated with the currently selected project. When chosen, the **Project Info Edit** dialog box appears.

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**.

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

### 2.4.2.2 DIRECTORY TOOLS

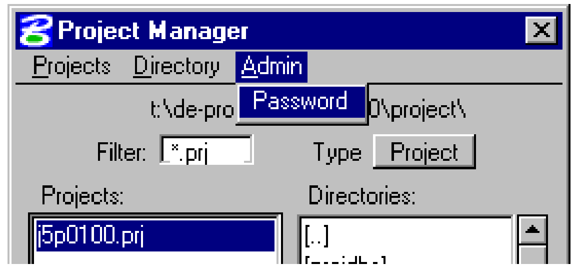
There are two options under the **Directory** pull down, **Create New Directory** and **Current Working Directory** as shown.




The **Create New Directory** option will create 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.

#### 2.4.2.3 ADMINISTRATION TOOLS

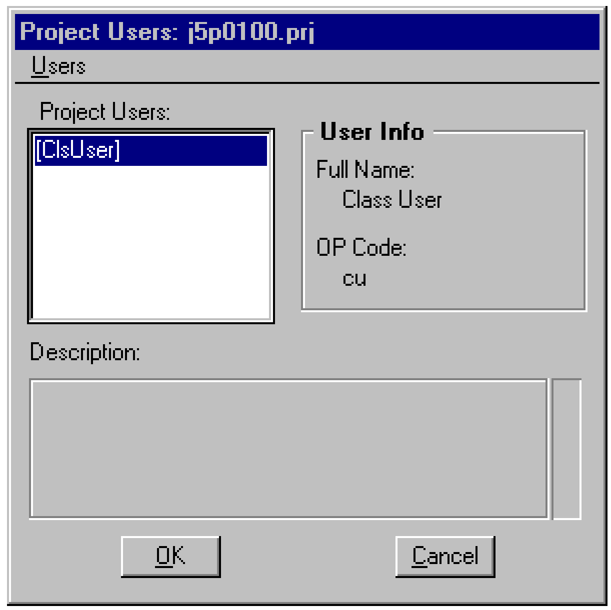
The **Administration** menu option is used to set a password on a project. It is recommended that a password ***not be used*** since the project will need to be accessed by more than one user.




## 2.5 Project Users Dialog

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

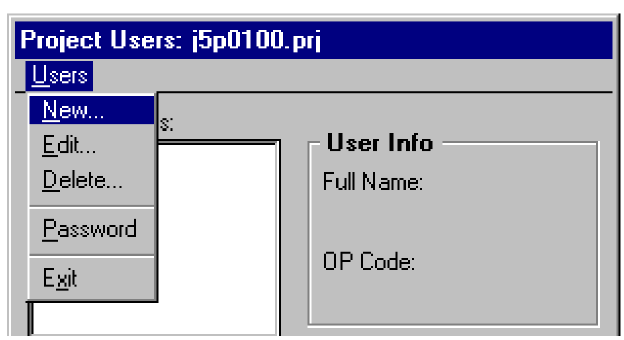
This dialog has three sections: **Project Users**, **User Info**, and **Description**. The **Project Users** list displays a list of users that have been created to work with any project that resides in the current projects home directory. The names shown in **Project Users** will be the userid's of 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 initial. 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 below.

### 2.5.1 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. This is the only way the user will have the default MoDOT runs.



### 2.5.2 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.)

### 2.5.3 Password

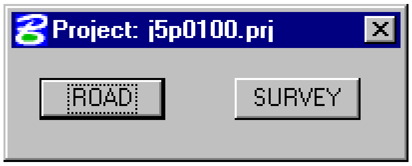
The **Password** tool creates or modifies a password for the selected user. If the selected user already has a password, the user will be prompted to enter the current password before continuing.

### 2.5.4 Exit

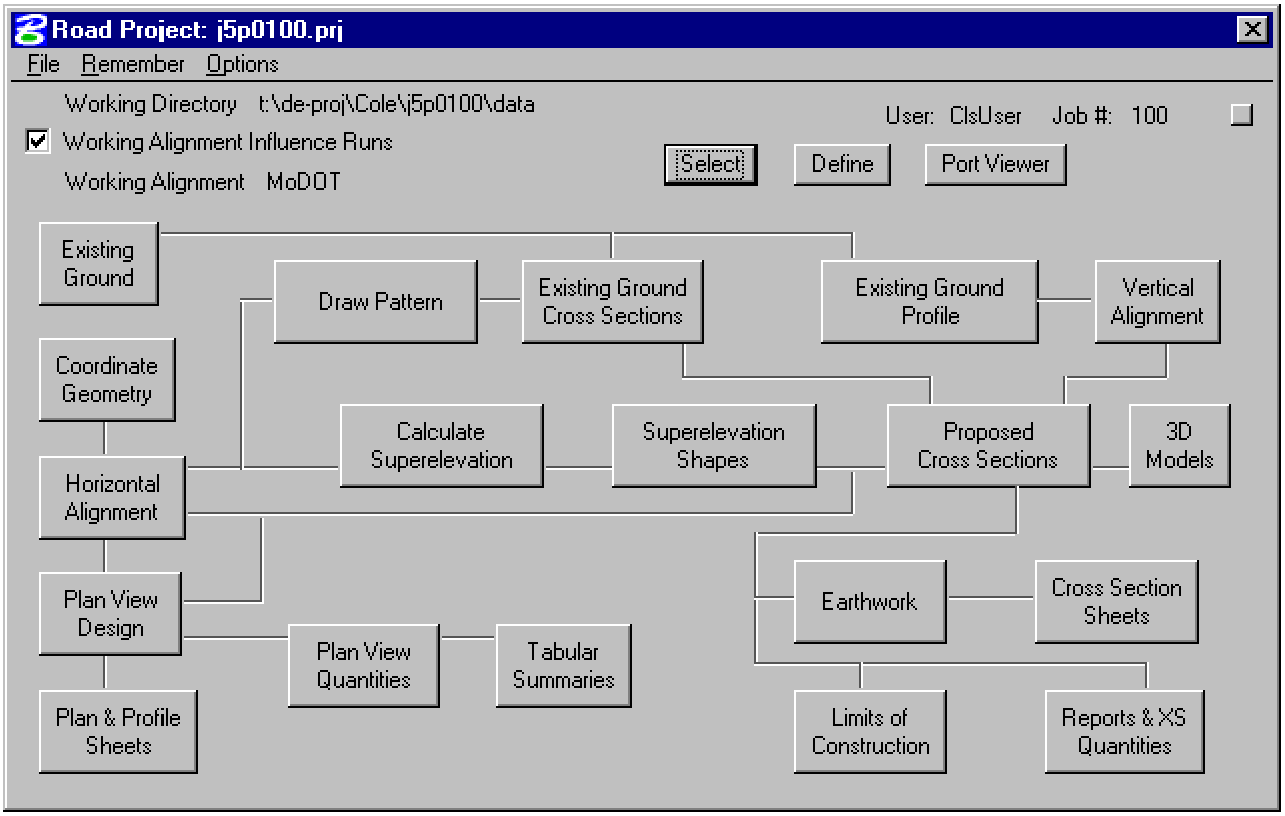
The **Exit** option closes the User dialog and returns back to the Project Manager dialog.

## 2.6 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 Applications dialog as depicted.



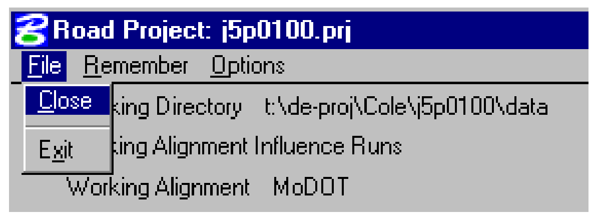

When the Road option is selected, the following dialog appears.



### 2.6.1 General Description

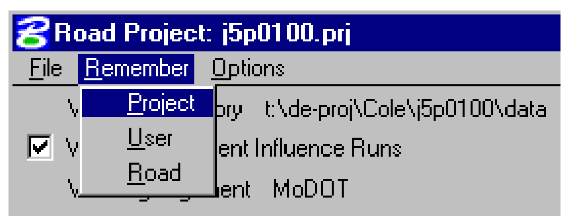
The top of the dialog displays the **Working Directory**, **Working Alignment** (if defined), **User** and **GEOPAK Job Number**. In addition, a toggle for **Working Alignment Influence Runs** is also supported. The bottom portion of the dialog box displays the various processes supported during the 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.


### 2.6.2 Road Project Dialog Menu Bar

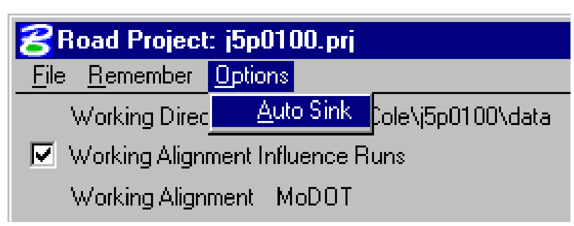



There is three pull down menu bar options: **File**, **Remember**, and **Options**. When the **File** option is selected, the choices are **Close** and **Exit**.

If the **Close** option is selected, the user is returned to the **Applications** 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**, **User**, or **Road** in subsequent sessions. For example, if all three 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** and **User** toggles are activated, the user is returned to the Applications dialog in later sessions. If only the **Project** toggle is activated, the user is returned to the Project Users dialog in subsequent sessions. This option is particularly useful when numerous users are working on one project.




The **Options** menu allows the user to toggle on the **Autosink** option. When toggled on, this option will sink (move behind the open drawing views) the Road Project dialog when a tool is chosen from the Road Project. When a tool is closed, the Road Road Project dialog will become the active dialog.

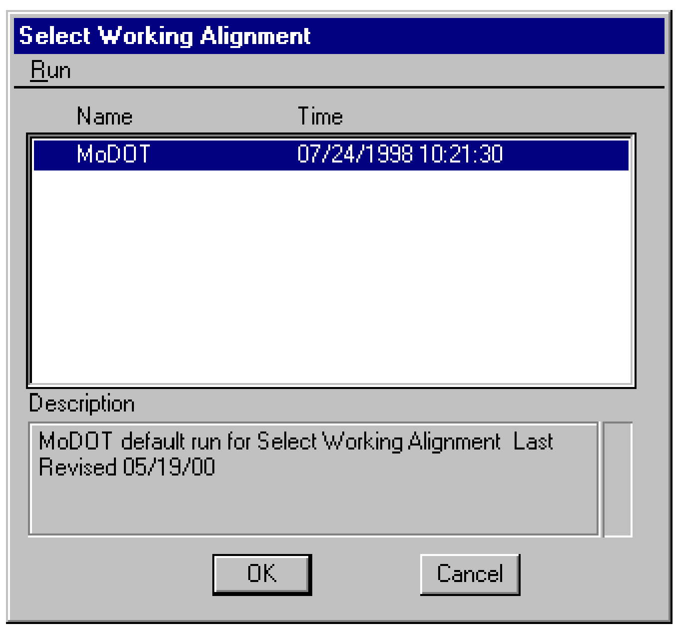
### 2.6.3 Working Alignment

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)


### 2.6.4 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 will close 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.**

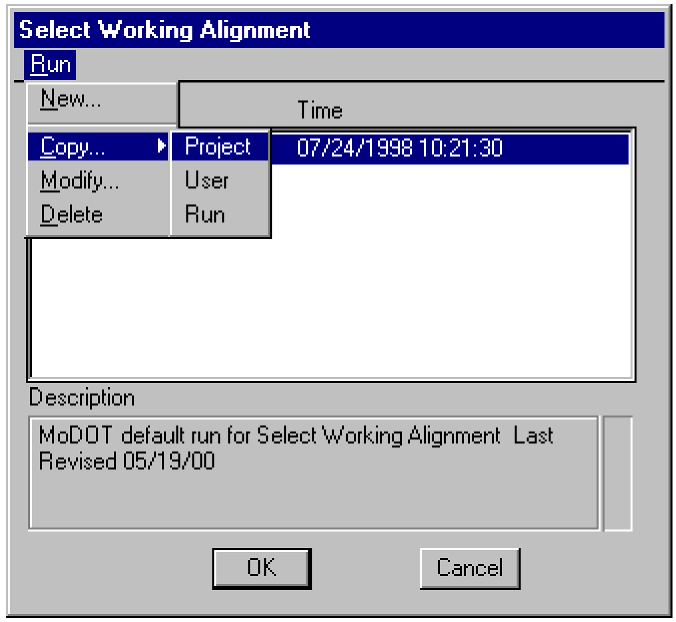


- **File>>New** – allows the user to create a new working alignment. (Do not use this option as it will not copy the default MoDOT settings for the working alignment. Instead, use Run>>Copy>>Run to copy the MoDOT run.)

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

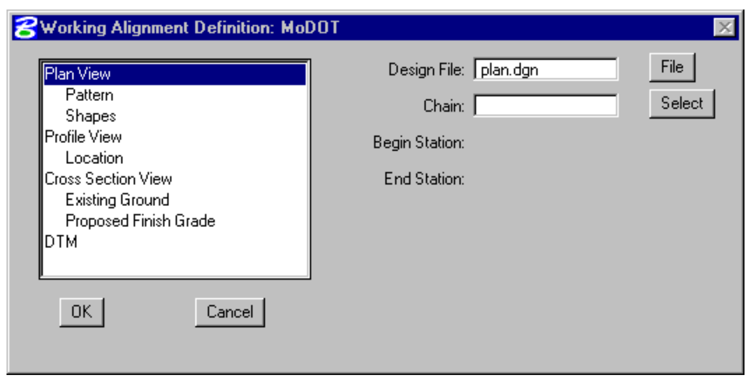
- **File>>Rename** – allows the user to change the name of the existing working alignment.

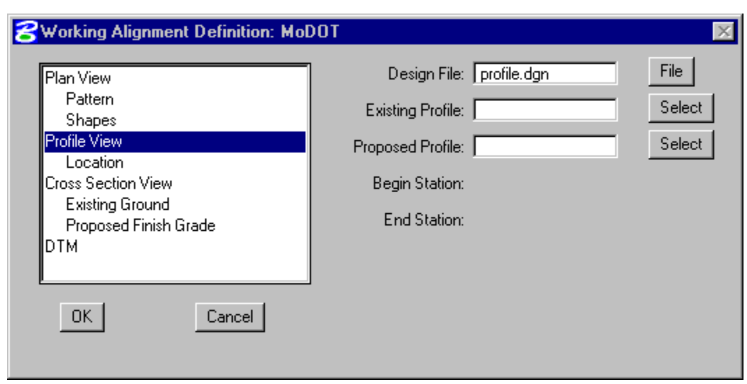
- **File>>Delete** – allows the user to delete an existing working alignment.




## 2.6.5 Define Option

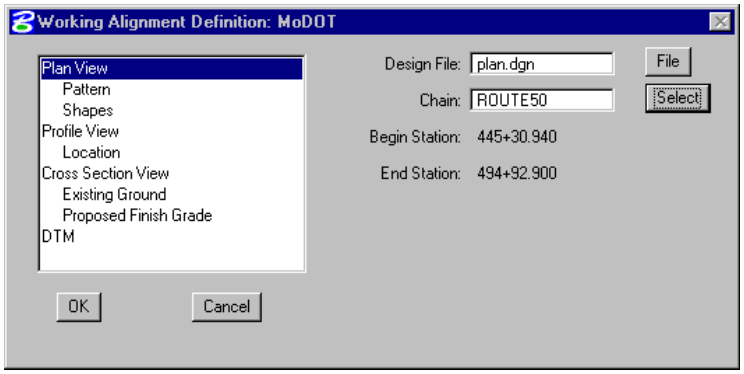
Once a Working Alignment has been selected, pressing the **Define** button invokes the dialog depicted to the right. The information that can be associated with a working alignment is listed in the left portion of the dialog box. As each option is chosen, the right side of the dialog box will change 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 the Road Project Manager. In the beginning of a project, much of this information will not be known but, as the user goes through the deign 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 *GEOPAK Manual*.




## 2.6.6 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**

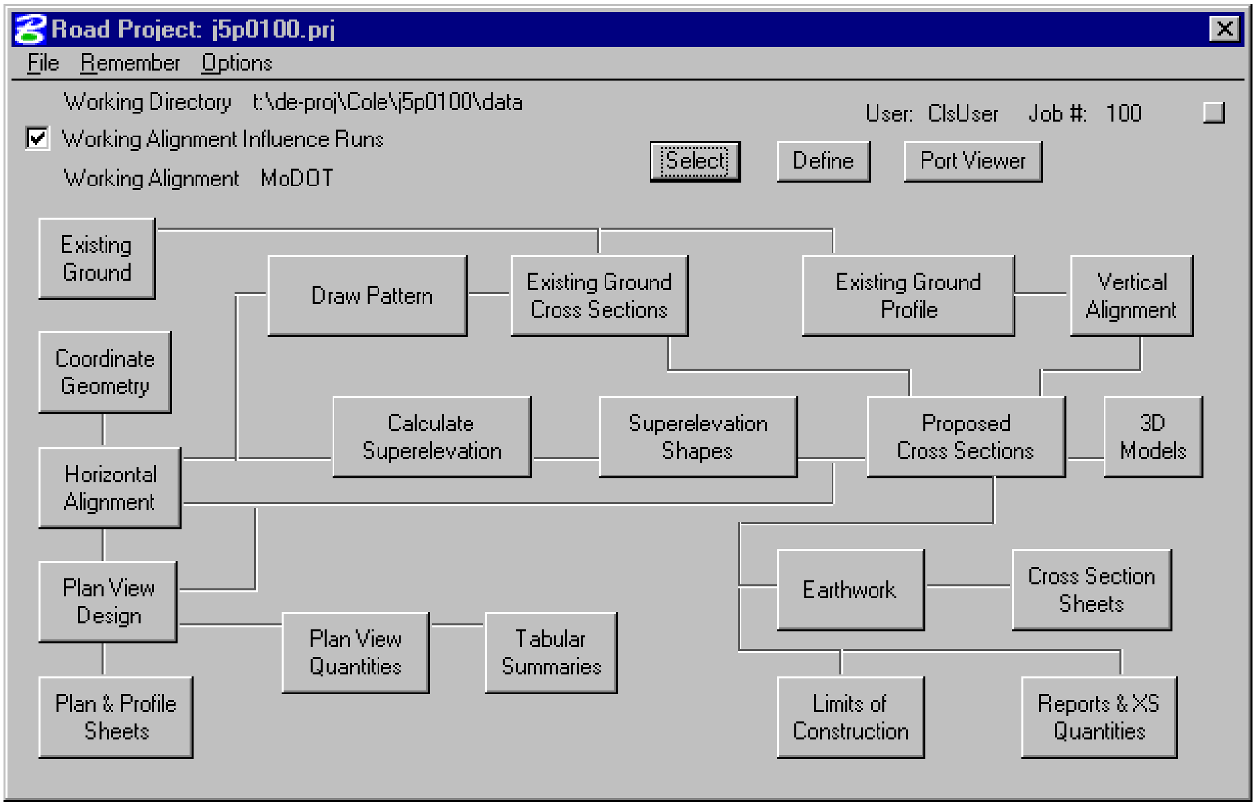
As a prerequisite to invoking the **Port Viewer**, a working alignment must be defined with the following information.

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

The **Port Viewer** will be covered in more detail in GEOPAK Road 2.

## 2.7 Road Project Process

The **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 **Road Project** 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, if the user chooses to change the fields, they have that option.

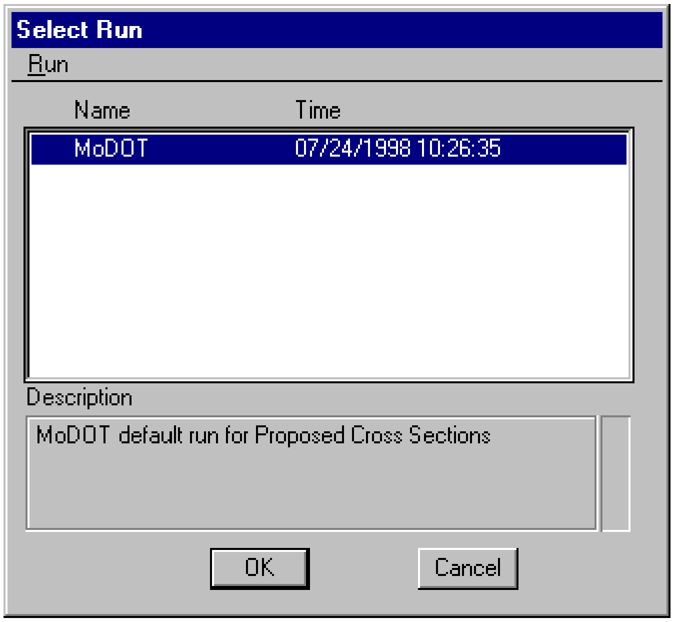



Many of the **Road Project** processes function identically to their corresponding dialog's invocation from the Road menu. However, some of the procedures will invoke the **Select Run** dialog prior to invoking the actual dialog. The **Select Run** dialog allows the user to set up different options to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

Each of the Road Project dialog processes will be covered individually in the separate remaining chapters.

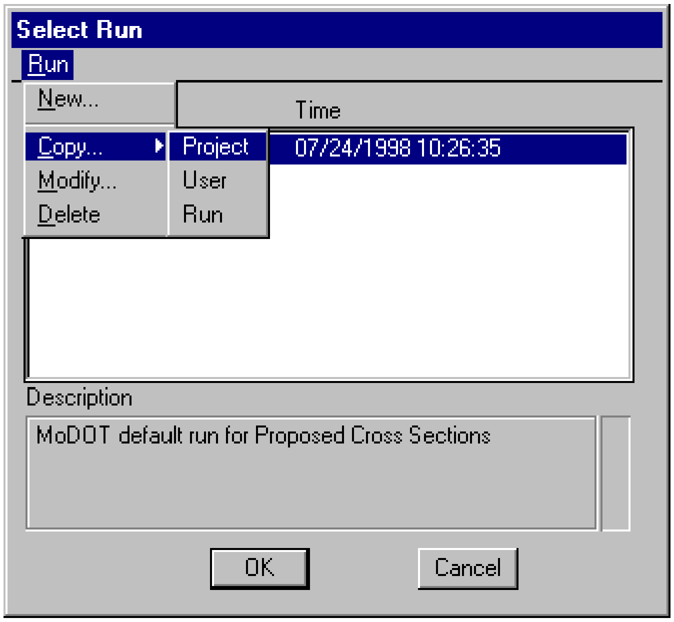
### 2.7.1 Select Run Option

When certain procedures are selected from the **Road Project** dialog, the **Select Run** dialog will be 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 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, I_XS_10, 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 will close 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 and existing Project, User or Run.

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

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

# Starting a New GEOPAK Job

1) Start Microstation and open a Microstation drawing.

2) Go to the menu item MoDOT>>Start Geopak Job/Add User.

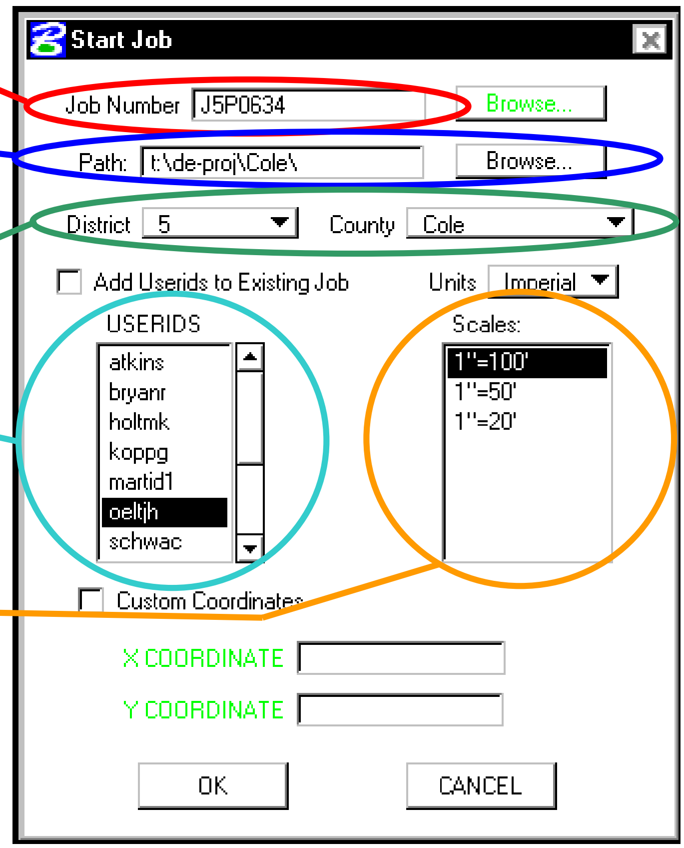

3) In the **Job Number** field, key-in the job number.

4) In the **Path** field, either key-in the path, or browse for the path in which to place the jobnumber directory.

5) Choose the District and County the project is in.

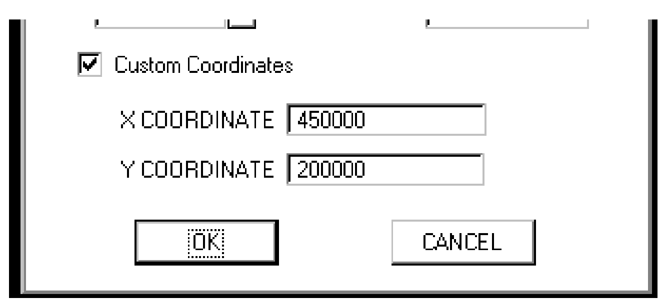
6) Choose the users that will be working on the project. (Additional users can be added at a later date.)

7) Choose the plan sheet scales that will be utilized on the project. (Additional scales can be added in Windows Explorer.)




8) If the job is not located using 1983 State Plane or 1983 Modified State Plane Coordinates, the custom coordinate will need to be set. To determine the custom coordinates, look at the coordinates for the survey/photogrammetry data. The coordinates you choose need to be less than these coordinate values. For example the coordinate for the following sample of survey data could be X = 450000, Y = 200000.

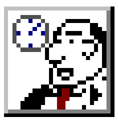
| | | |
|---|---|---|
| 519054.328 | 304992.070 | 215.72 |
| 519048.327 | 304987.083 | 215.72 |
| 519040.579 | 304980.262 | 215.33 |
| 519027.463 | 304968.924 | 215.33 |

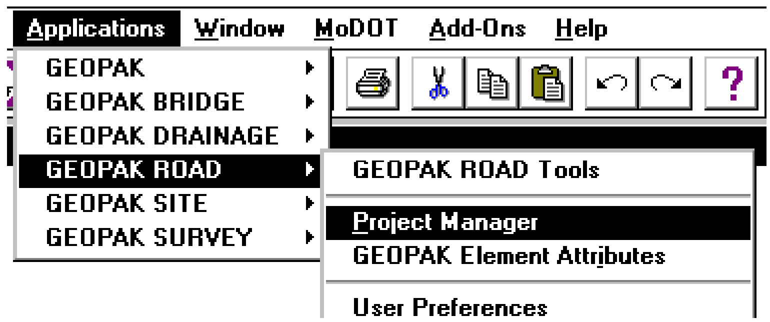


9) Press the OK Button. The Start Job dialog will close when the process is finished.

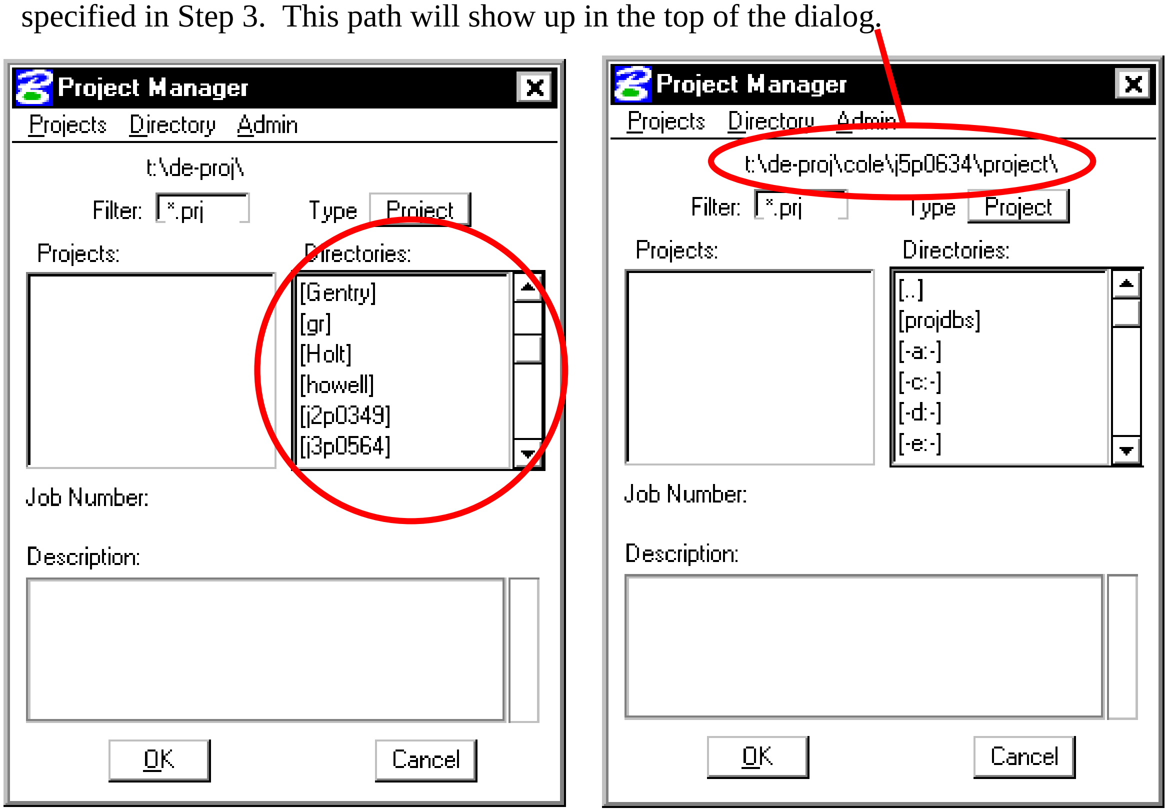
10) In Microstation go to File>>Open.
Open the file t:\de-proj\county\jobnumber\data\plan.dgn where t:\de-proj\county\ is the path to your project directory as specified in Step 4, and jobnumber is the job number as specified in Step 3.

11) Start Geopak's Project Manager by either selecting the Project Manager icon or selecting it from the menu Applications>>GEOPAK Road>>Project Manager.

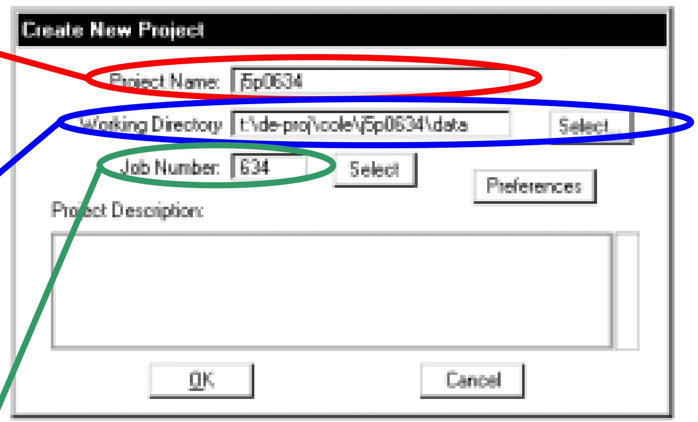





12) On the right side of the dialog in the Directories section, navigate to the ***t:\de-proj\county\jobnumber*\project** directory where *t:\de-proj\county*\ is the path to your project directory as specified in Step 4, and *jobnumber*\ is the job number as specified in Step 3. This path will show up in the top of the dialog.



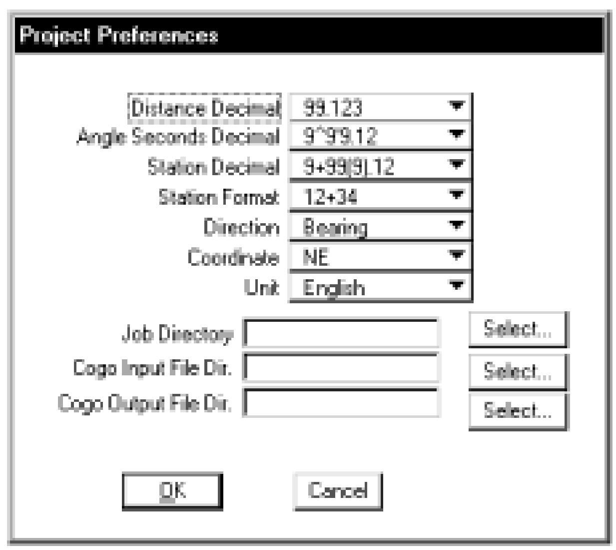
13) In the Project Manager dialog, select Projects>>New.


14) In the **Project Name** field, key-in the job number as specified in Step 3.

15) Choose the **Select** button next to the **Working Directory** field. Navigate to the ***t:\de-proj\county\jobnumber*\data** directory where *t:\de-proj\county* is the path to your project directory as specified in Step 4, and *jobnumber* is the job number as specified in Step 3.

16) Key-in the 3-character name for the .gpk file into the **Job Number** field. The suggested characters is the last 3 digits of the job number. (i.e. for job j5p0634a, use 634)




17) Select the Preferences button.

18) Set the accuracy you would like information to be displayed at for Distance Decimal, Angle Seconds Decimal, and Station Decimal.

19) Set the Station format to 12+34 for an English job, and 1+234 for a metric job.

20) Set the Direction to Bearing.

21) Set Coordinate to NE or XY.

22) Set Unit to English or Metric.

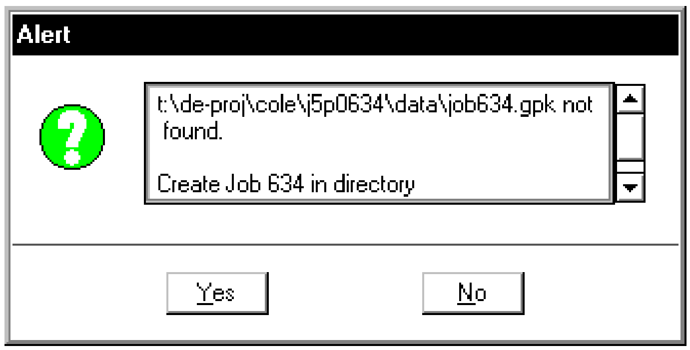
23) If the .gpk file is to reside in a directory other than the working directory as set in step 15, then choose the Select button next to the Job Directory field, and navigate to the directory of the .gpk file.  If no directory is set, the .gpk file will be placed in the working directory.  (Most of the time this field will be blank.)

24) Press the OK button to the Project Preferences button to accept the preferences set.

25) In the Create New Project dialog, type in a description for the project if desired.

26) Press the OK button to the Create New Project dialog.

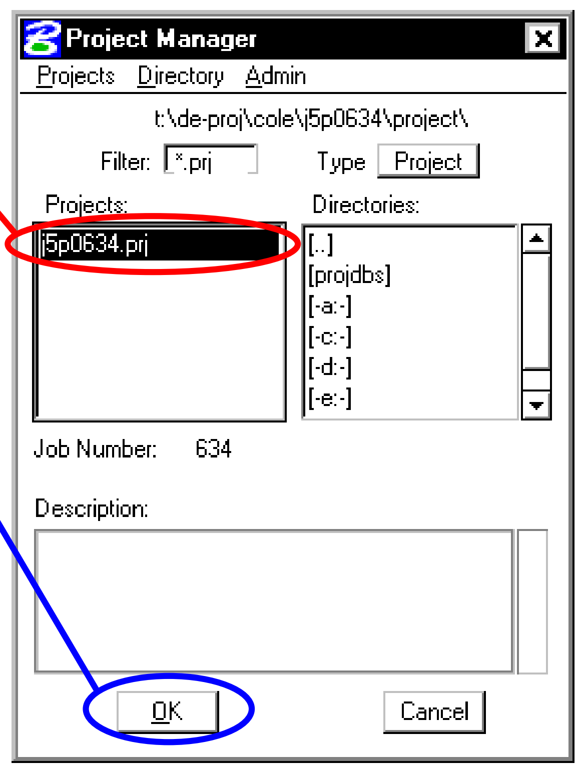
27) If the .gpk file does not exist, the following dialog will appear.




Press the Yes button to create the .gpk file.

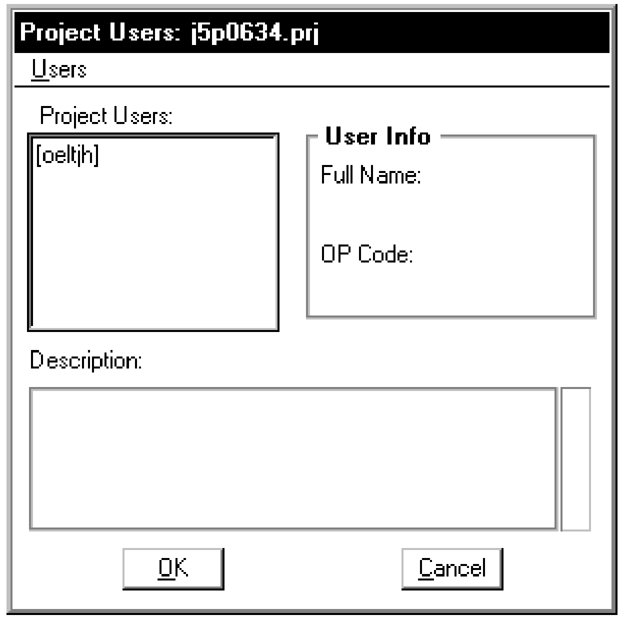
28) Make sure the .prj file is selected.

29) Press OK to enter Project Manager.



30) The User dialog will appear. All users selected in Step 6 should appear under Project Users.

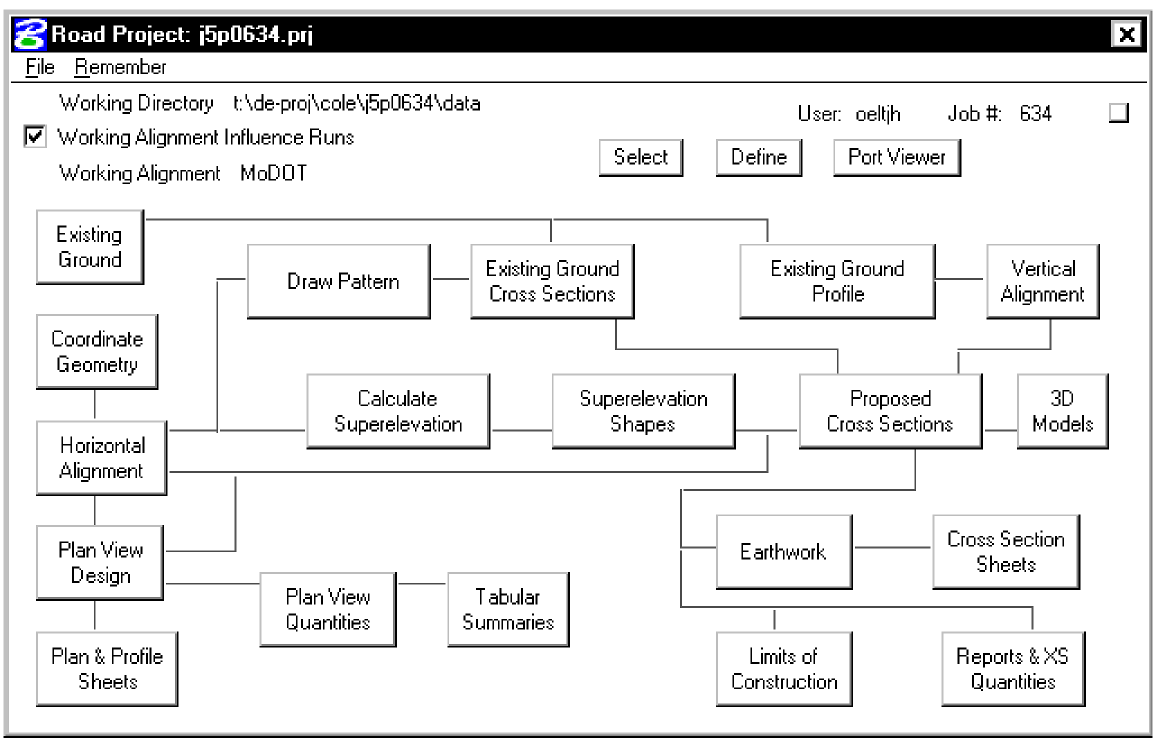
31) Select the userid, and press the OK button.




32) The Road/Survey button will appear.

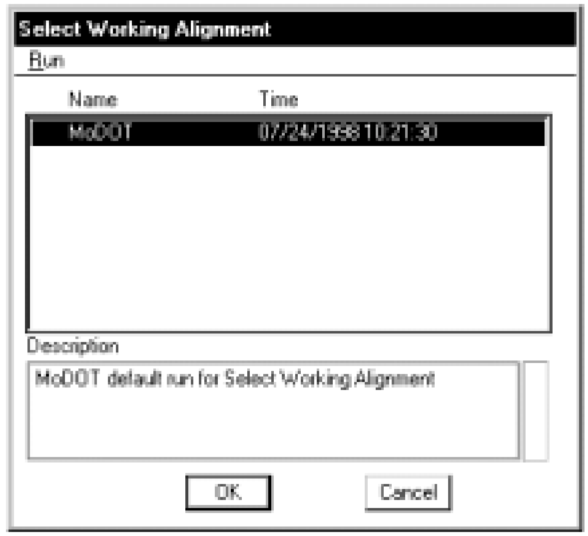
Select the Road button.


33) The Road Project Manager dialog will appear.



34) When one of the tool buttons is selected, a MoDOT run should be listed in the dialog box.

If a run called Untitled is listed, one of the steps above was not followed correctly. Make sure the .prj file is in the correct location (Step 12), and that the .prj file is spelled correctly (Step 14).



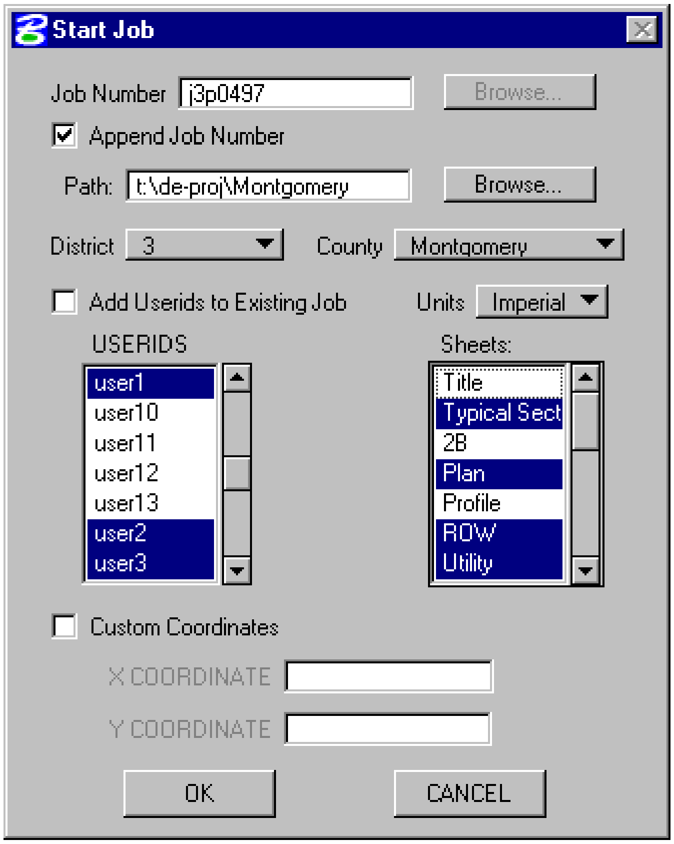

35) When completed, the following directory structure and files should exist for your project.

```
t:\
└── de-proj
    └── county
        └── job_number
            ├── data
            │   └── dtm.dgn
            │       plan.dgn
            │       pattern_shape.dgn
            │       profile.dgn
            │       topo.dgn
            │       xs.dgn
            │       job###.gpk
            ├── plan_sheets
            │   └── scale_directories
            └── project
                ├── job_number.prj
                └── projdbs
                    └── userid
                        └── job_number.002
                            job_number.003
                            job_number.004
                            job_number.005
                            job_number.006
                            job_number.008
                            job_number.009
                            job_number.00a
                            job_number.00b
                            job_number.00c
                            job_number.00d
                            job_number.00e
                            job_number.011
                            job_number.106
                            job_number.ifo
                            user.ifo
```

# Exercise 2-1

| | |
|---|---|
| 1. | Open any MicroStation file. |

| | |
|---|---|
| 2. | Create the following job with the **Start Job** dialog. |




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

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

Start Project Manager

Go to the directory t:\de-proj\montgomery\j3p0497\project\

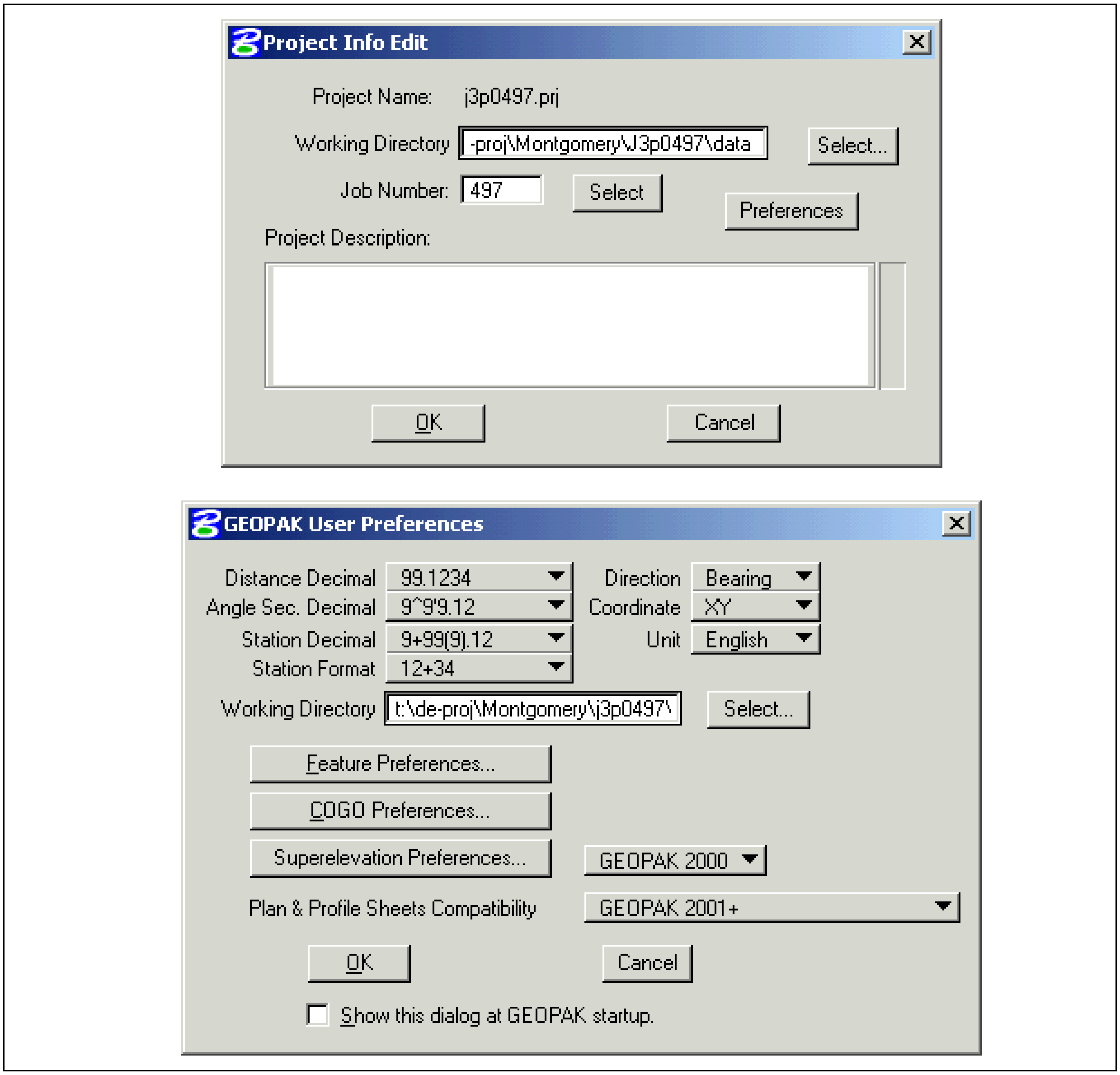

Choose **Projects>>New**

Project name: j3p0497

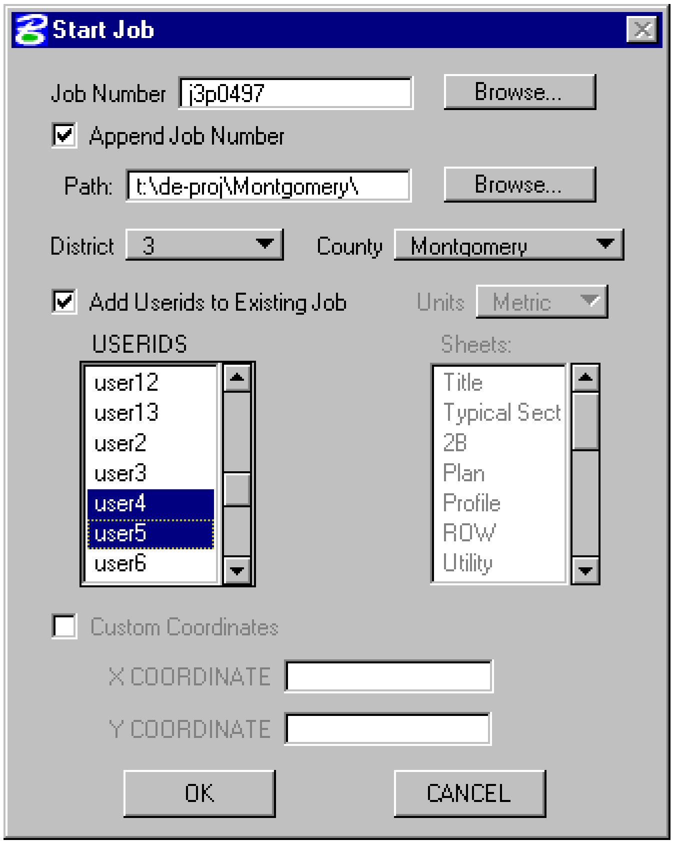
Working Directory: t:\de-proj\montgomery\j3p0497\data\

Job Number: 497

Set up the **Preferences** as shown on the next page.


Project Info Edit
Project Name: j3p0497.prj
Working Directory -proj\Montgomery\J3p0497\data
Select...
Job Number: 497
Select
Preferences
Project Description:
OK
Cancel
GEOPAK User Preferences
Distance Decimal 99.1234
Angle Sec. Decimal 9^9'9.12
Station Decimal 9+99(9).12
Station Format 12+34
Direction Bearing
Coordinate XY
Unit English
Working Directory t:\de-proj\Montgomery\j3p0497\
Select...
Feature Preferences...
COGO Preferences...
Superelevation Preferences...
GEOPAK 2000
Plan & Profile Sheets Compatibility
GEOPAK 2001+
OK
Cancel
Show this dialog at GEOPAK startup.

5. Add User4 and User5 as users to the project.



## Chapter 3

# Importing Data

## 3.1 Objectives

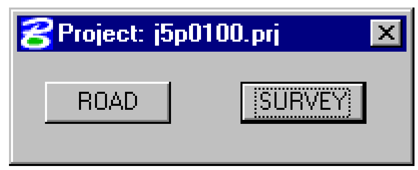
- Learn how to import photogrammetric data and survey data into Geopak.
- Learn how to map photogrammetric and survey data into a .dgn file.
- Learn how to create a digital terrain model from photogrammetric and survey data.

## 3.2 Definitions

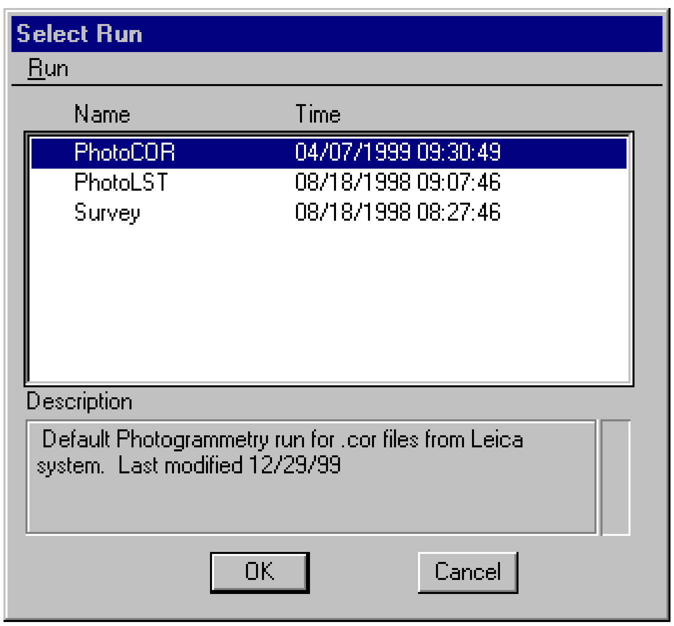
Geopak Survey is a tool for importing survey data into Geopak to be used in the design process. The information from either field surveys or aerial surveys is used to create a digital terrain model of the existing conditions as well as for showing the existing planimetric features.

## 3.3 Accessing

Geopak Survey can be accessed from the **Project** dialog as shown to the right.




When **Survey** is chosen the following **Run** box is opened.

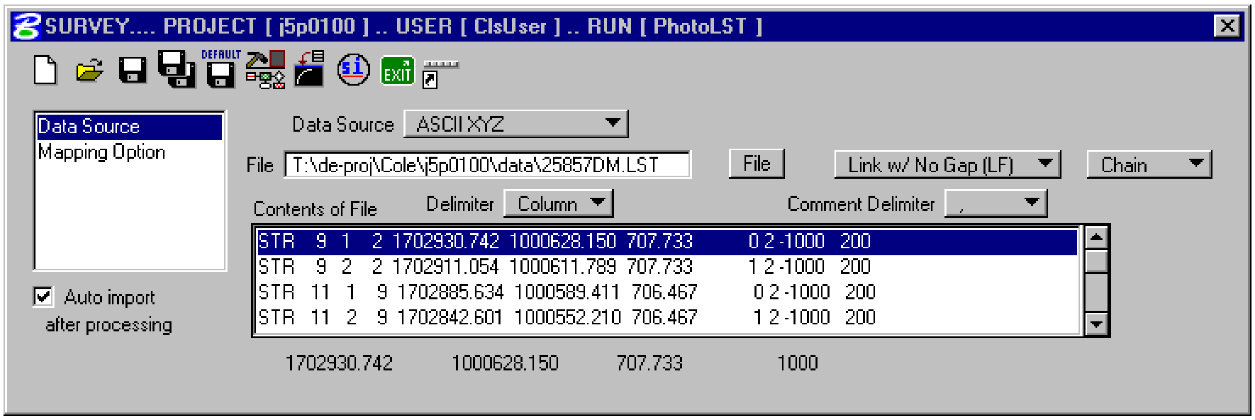


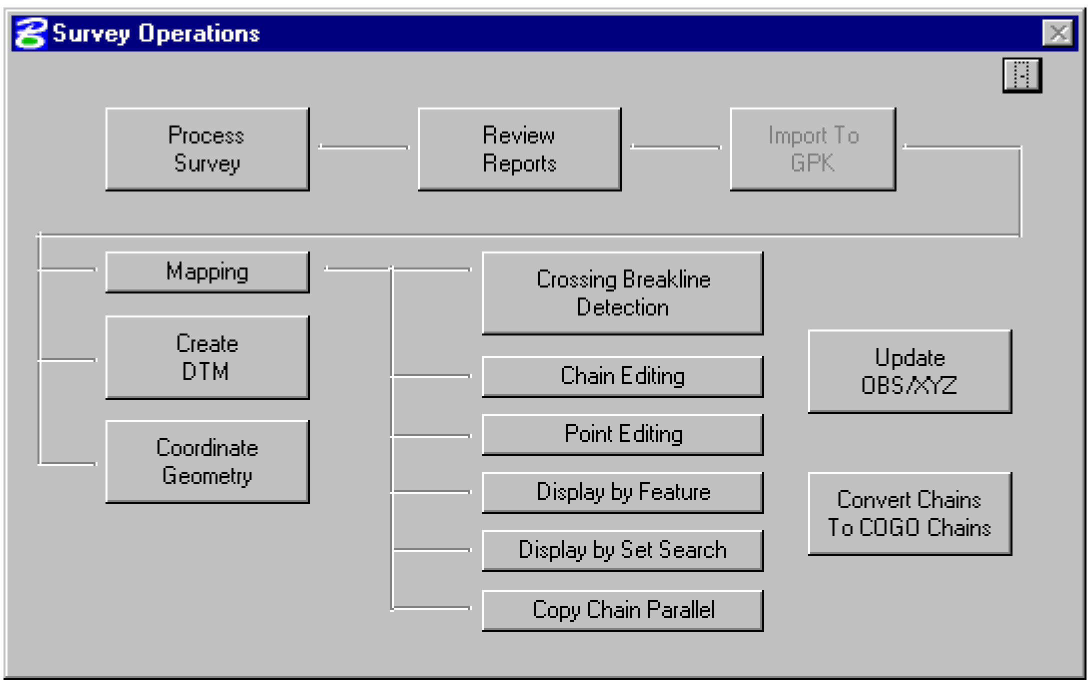

There are three runs to choose from. It is suggested to always copy a run so there will always be a default run available for future runs.

Then three runs available to the user are **PhotoCOR**, **PhotoLST**, and **Survey**. The **PhotoCOR** run is for importing Leica photogrammetric data files (.cor). The **PhotoLST** run is for importing KORK photogrammetric data files (.lst). The **Survey** run is set up to import ASCII XYZ files in the format of point number, X coordinate, Y coordinate, Z coordinate, and point code. If the data file to be imported is in a different format, the **Survey** run will serve as a good starting point for the import process.

## 3.4 Importing Photogrammetric Data

Once the one of the runs has been chosen, the following dialogs will open. (When the PhotoLST run has been chosen, a columns dialog will also open. **DO NOT** change this dialog. It is set up for importing KORK photogrammetric data.)

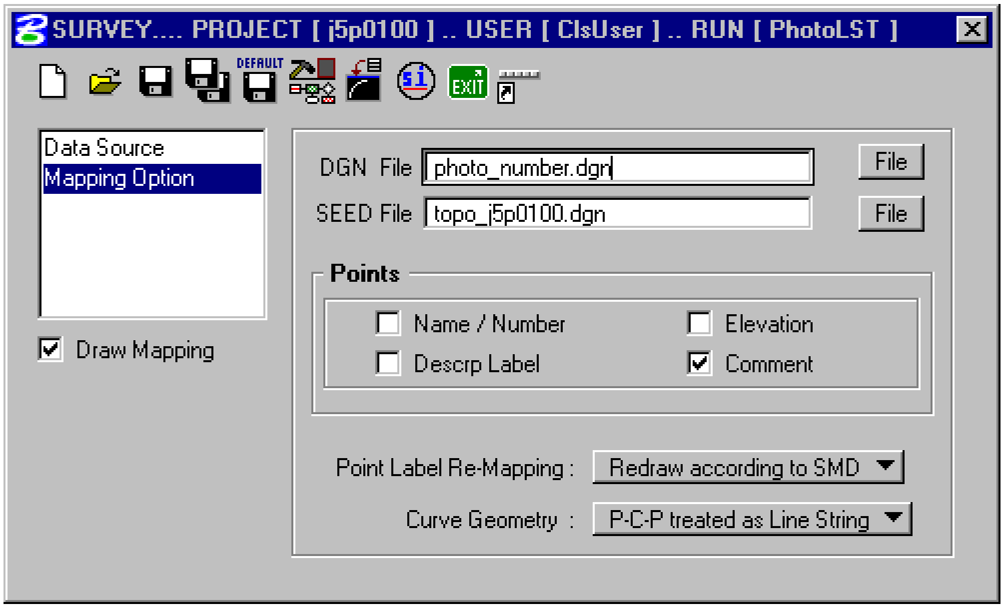



The user can either search for the file to be imported by pressing the **File** button or key-in the file name. On the search box, be sure to change the filter to **All Files [*.*]**.

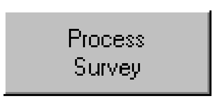
After the file is selected, the data will appear in the **Contents of File** box. If the file contains any header information, the user will need to remove this header information, then select the file again. The user needs to select a line of data from the **Contents of File** box.

From the box on the left side of the dialog select the **Mapping Option** and the following dialog will appear.




Enter the name of the **DGN File** to be created. Be sure the **SEED File** is set to **topo_*jobnumber*.dgn**.. The **topo_*jobnumber*.dgn file** file is a 2D file that has the global origin shifted for the project.

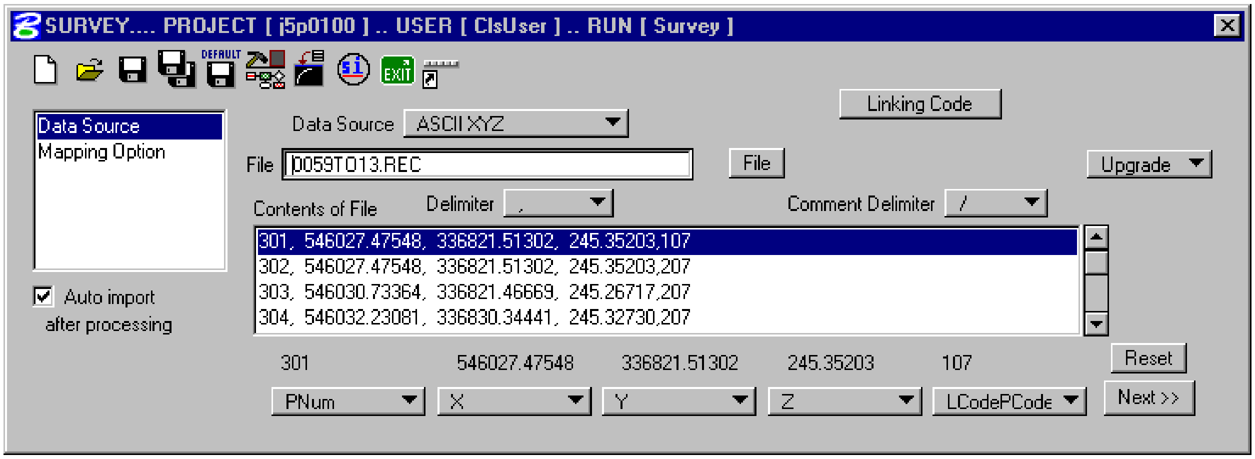
A user can turn on the information about the **Points** to be drawn with the map.




Once the data file is selected, and the DGN File is specified, the user can choose the **Process Survey** button on the **Survey Operations** flow chart. This will import the data to the Geopak database (.gpk) and map the data to the specified drawing.

## 3.5 Importing Survey Data

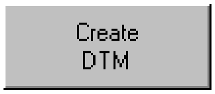
The process for importing survey data is the same as it was for importing the photogrammetry data. When the user chooses the **Survey** run, the **Survey** dialog appears as shown below.




The user needs to select a line of data, specify the name of the DGN file to import to, and select the **Process Survey** button.

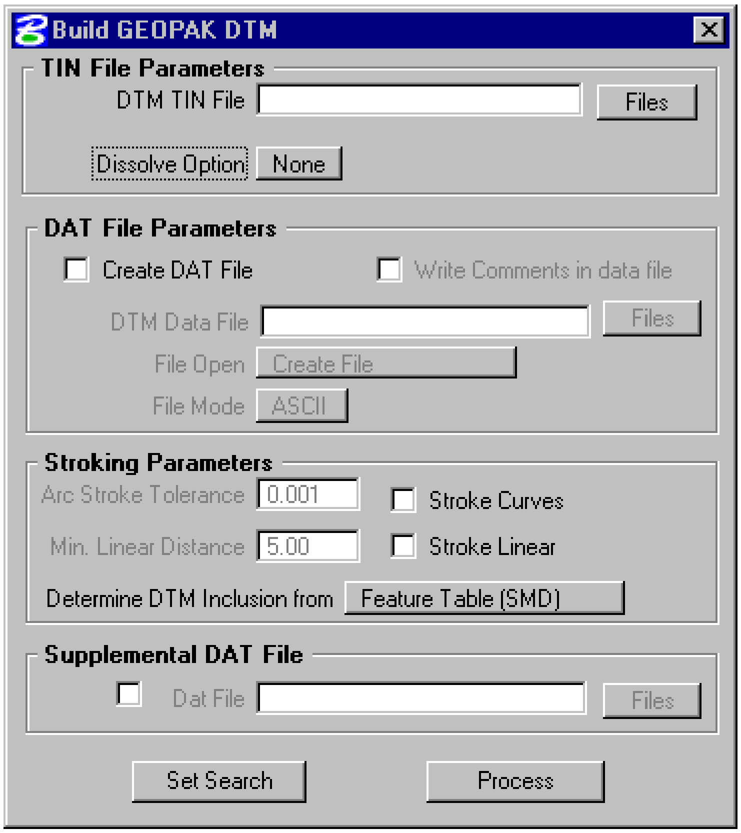
If the file to be imported is not in the format of point number, X coordinate, Y coordinate, Z coordinate, point code, the user can assign the proper columns after selecting a line of data.

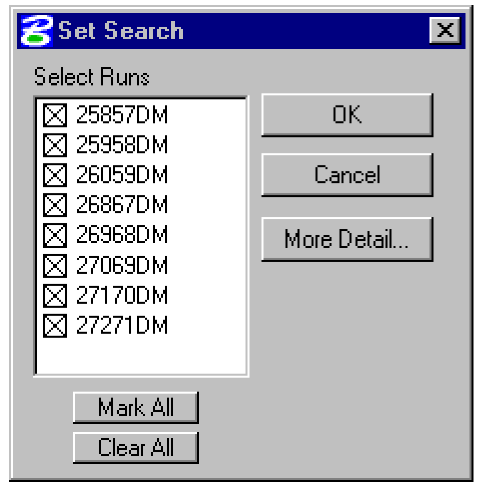
## 3.6 Creating the Digital Terrain Model




Once the import of all the survey files is complete, the user is ready to build the digital terrain model (DTM). To begin this process, the user should select the **Create DTM** button from the **Survey Project Manager** flow chart.

The user can specify the file name of the .tin file to create, and then select the runs to include in the DTM by selecting the **Set Search** button and selecting from the list of available runs.

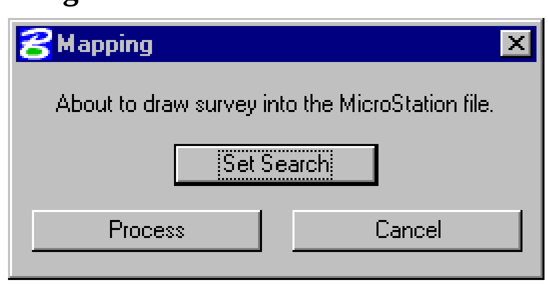



Digital Terrain Models are discussed in further detail in Chapter 4.

## 3.7 Mapping

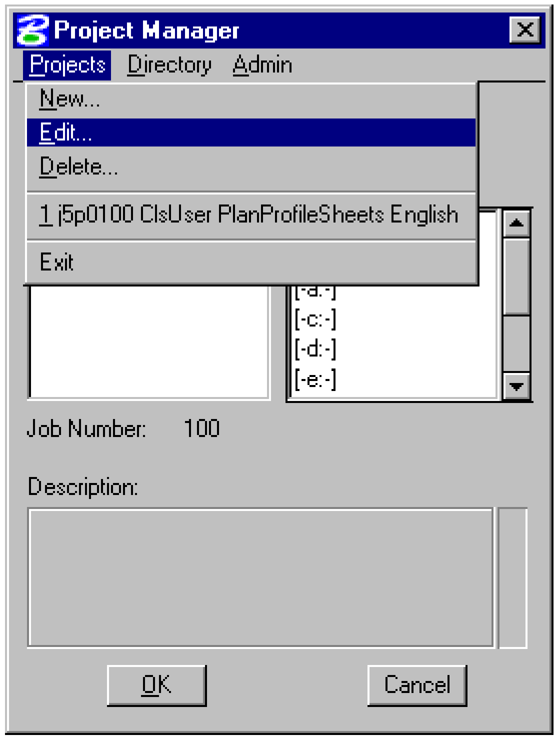

If the data was not mapped when survey file was processed, the user can map the data by using the **Mapping** button on the **Survey Manager**. The user can then select the **Set Search** button to select the run(s) they would like to map. Selecting the **Process** button will map the data into the Microstation drawing specified in the **Mapping Option** of the Survey Manager.



# Exercise 3-1

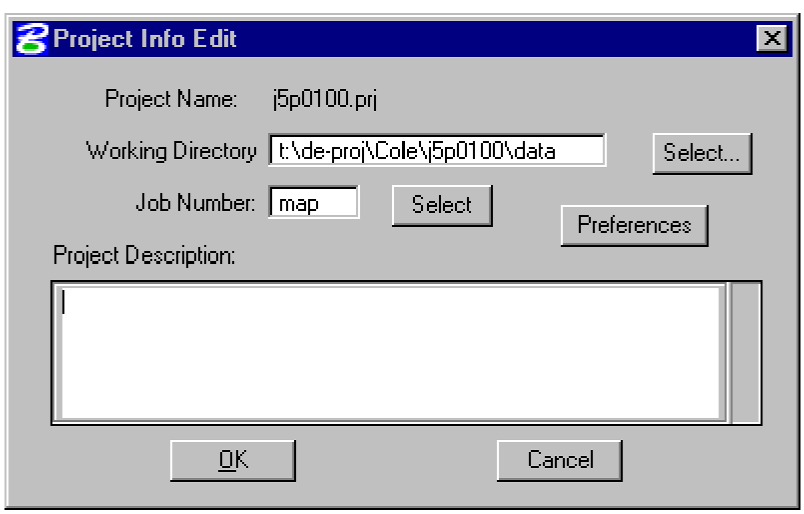
1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\topo_j5p0100.dgn**

2. Edit the project **j5p0100.prj** located in the **t:\de-proj\cole\j5p0100\project** directory.



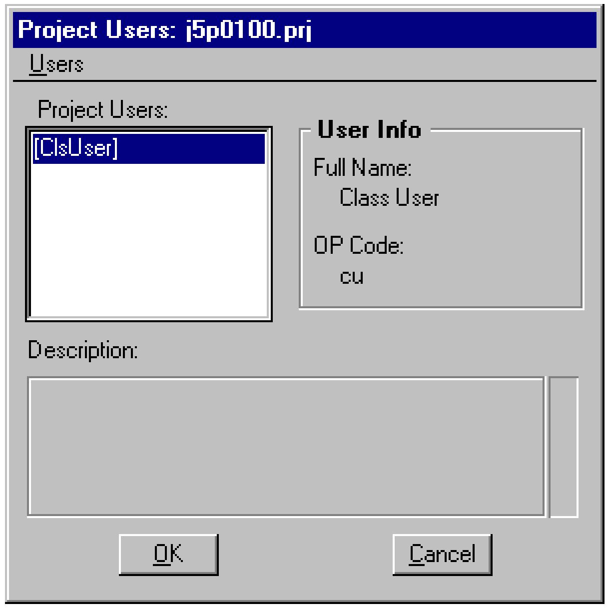

3. Change the Job Number to **map**.

   Press OK.

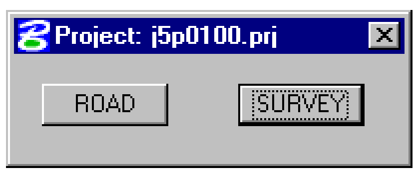


4. Open the project **j5p0100.prj**.

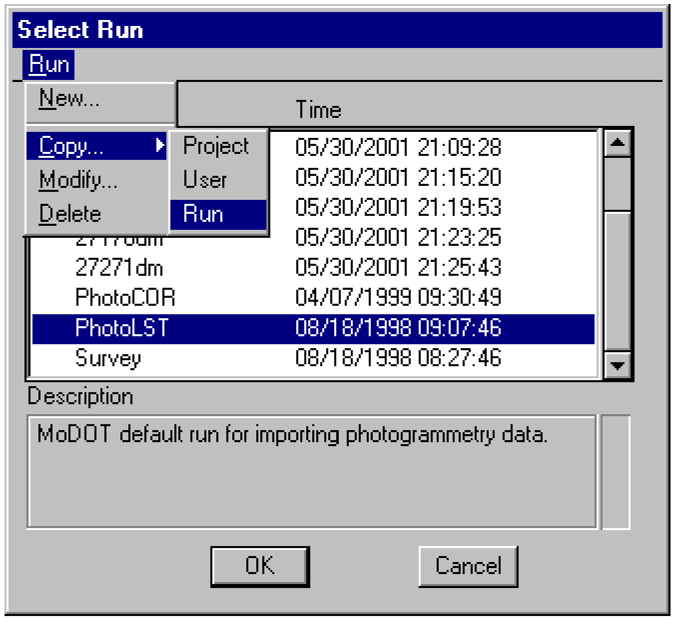
5. Choose the user **ClsUser**.

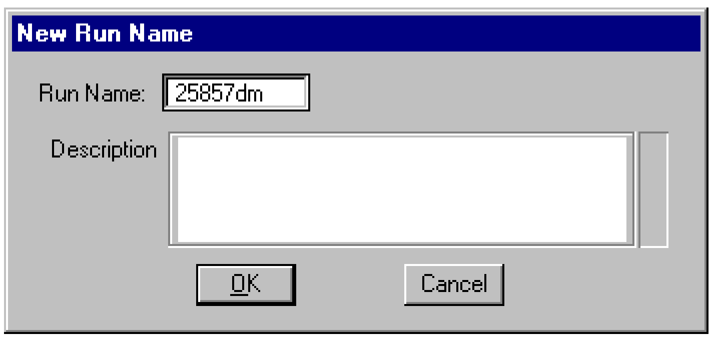



6. Enter the **Survey** Project Manager.

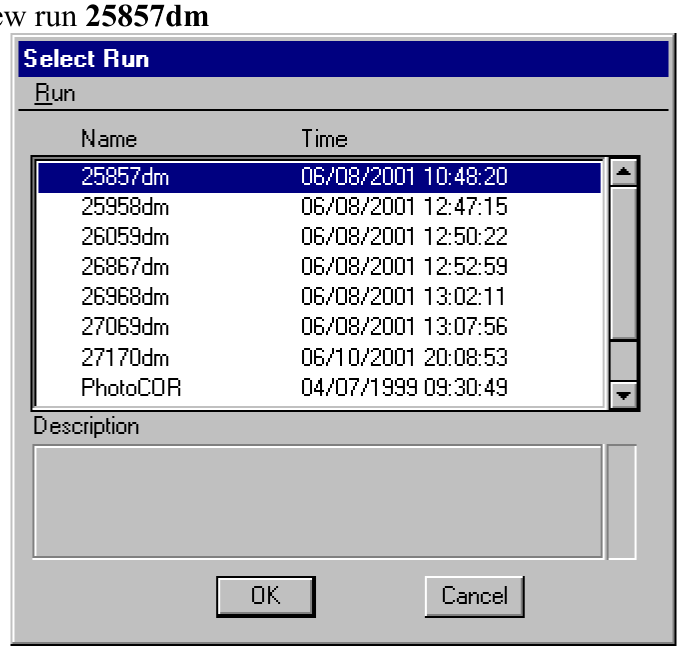


7. Copy the **PhotoLST** run, and rename the new run **25857dm**.

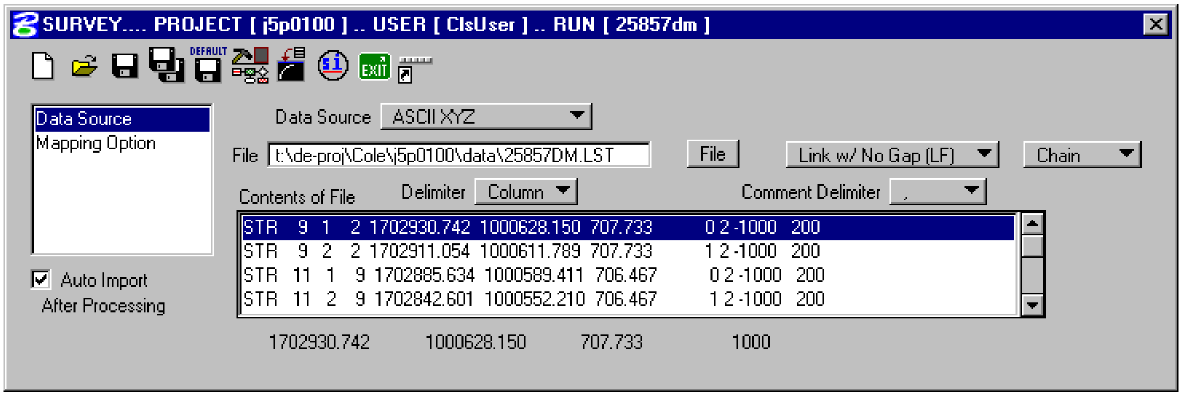



Select the new run **25857dm**

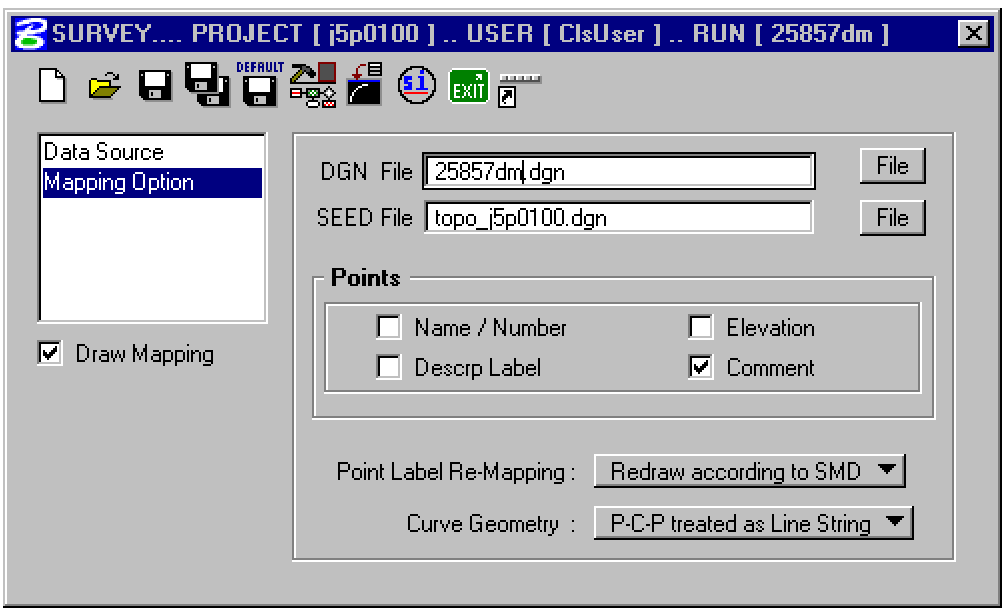


8. Enter or search for the file to be imported: **t:\de-proj\cole\j5p0100\data\25857dm.lst**



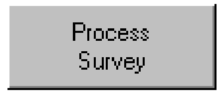

Select the first line of coordinate data.

9. Select **Mapping Option** and enter the name of the **DGN file** as **25857dm.dgn**.



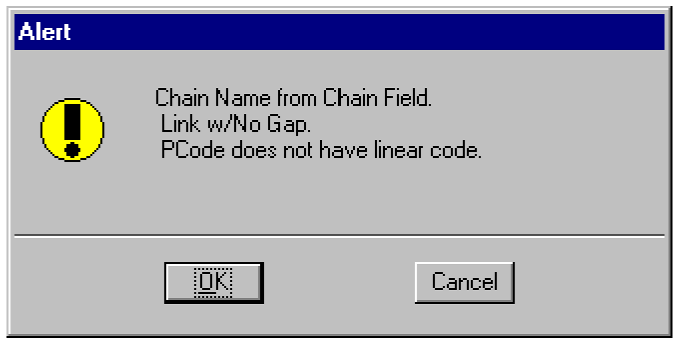

Be sure the **SEED File** is set to **topo_j5p0100.dgn**.

10. Select the **Process Survey** button in the **Survey Manager** flow chart.




Use the default **Initial Point Number**.

Select **OK** to the following Alert.

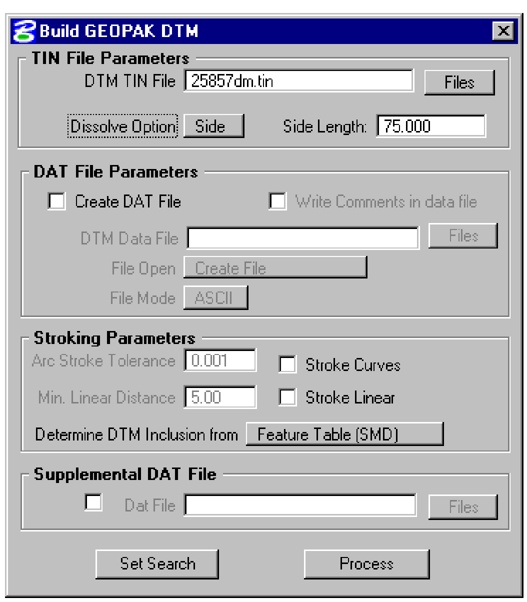



11. After the import is complete, select the **Create DTM** button.

Name the file **25857dm.tin**, set the **Dissolve** option to **Side**, and set the **Side Length** to 75, as shown below in the figure on the left.

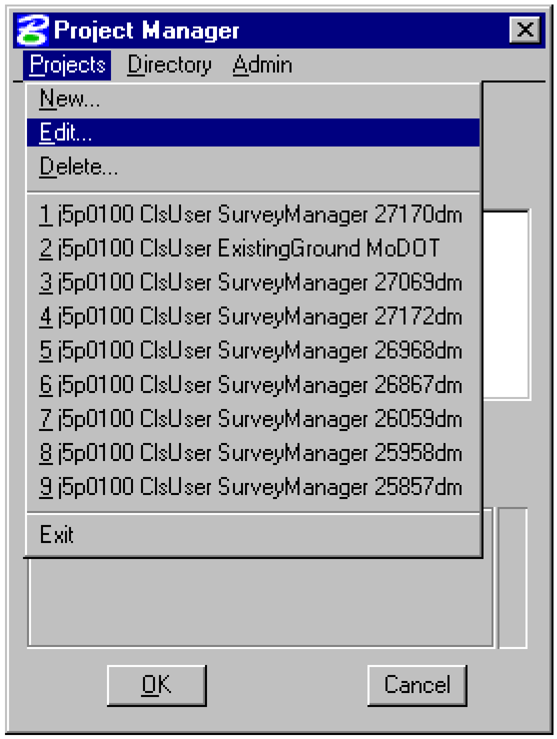
**Set the Search** for the run 25857dm, as shown below in the figure on the right and click OK.

Select **Process** in the Build GEOPAK DTM dialog.



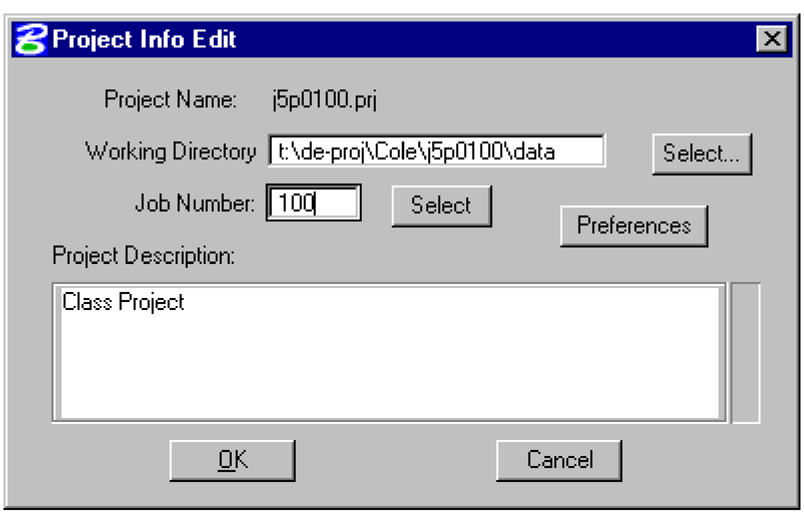

12. Close the **Survey Project Manager**.

13. Edit the project **j5p0100.prj** located in the **t:\de-proj\cole\j5p0100\project** directory.




14. Change the Job Number to **100**.

Press OK.



Chapter 4

# Digital Terrain Modeling

## 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.

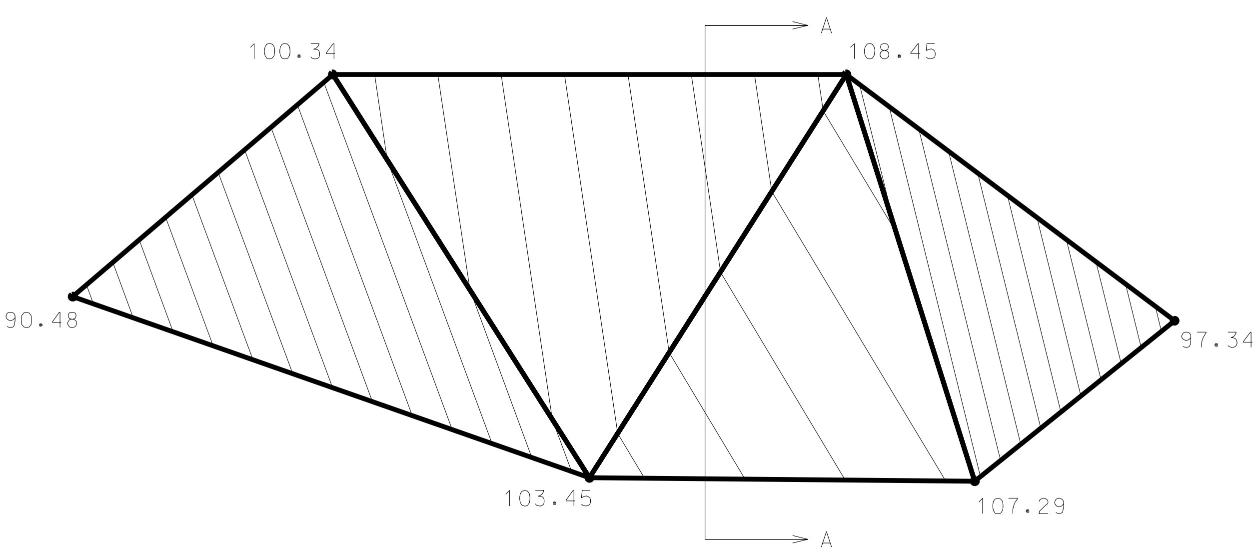
### 4.2.1 Digital Terrain Models

**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.

#### 4.2.1.1 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.

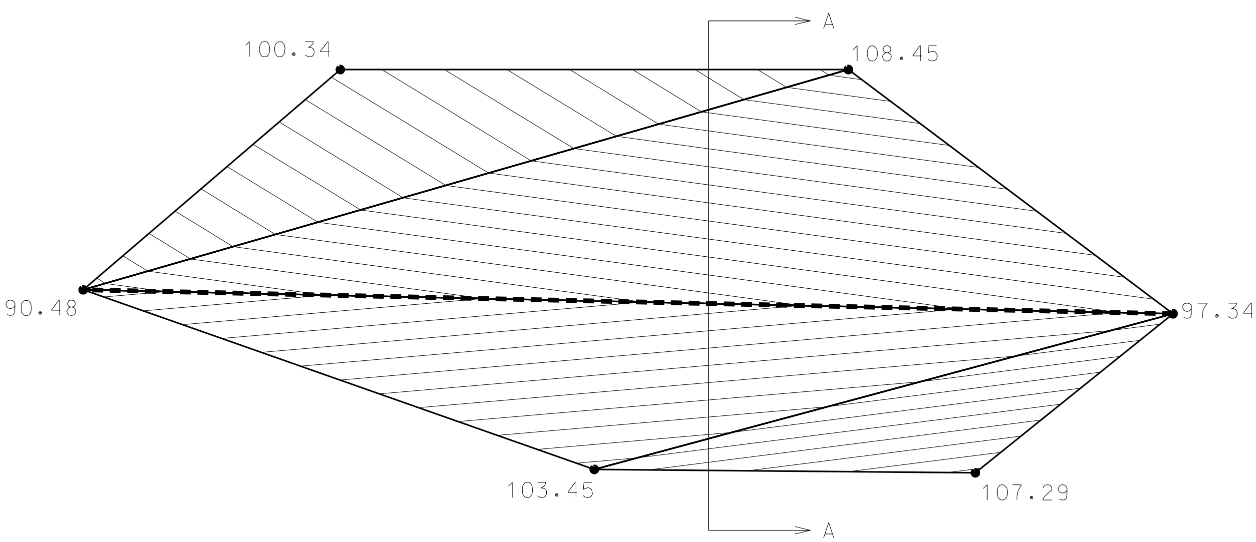


If a section is cut through this digital terrain model at the location A-A, where the elevation of the triangle leg as linearly interpolated between the triangle vertices is plotted along the distance of the section, the section would look as shown in the picture below.

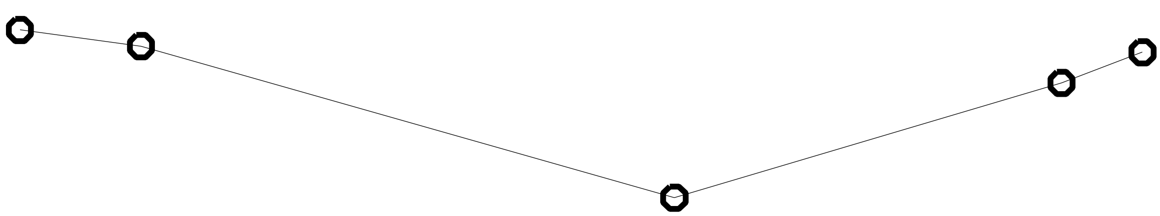
#### 4.2.1.2 BREAKLINES

Breaklines 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 breakline, 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.

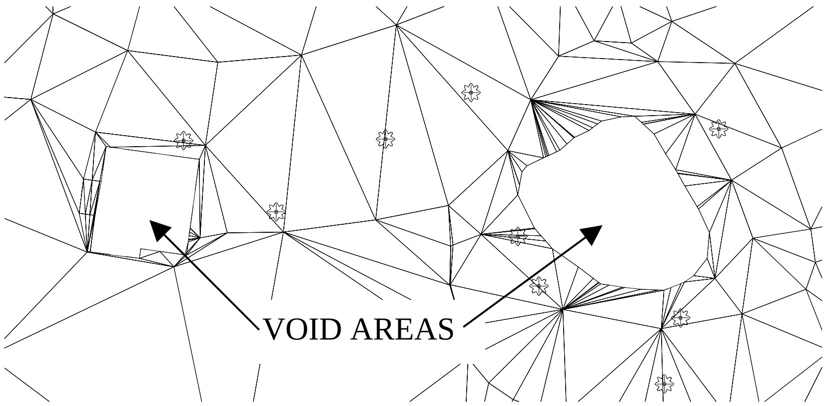


### 4.2.1.3 BOUNDARY

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

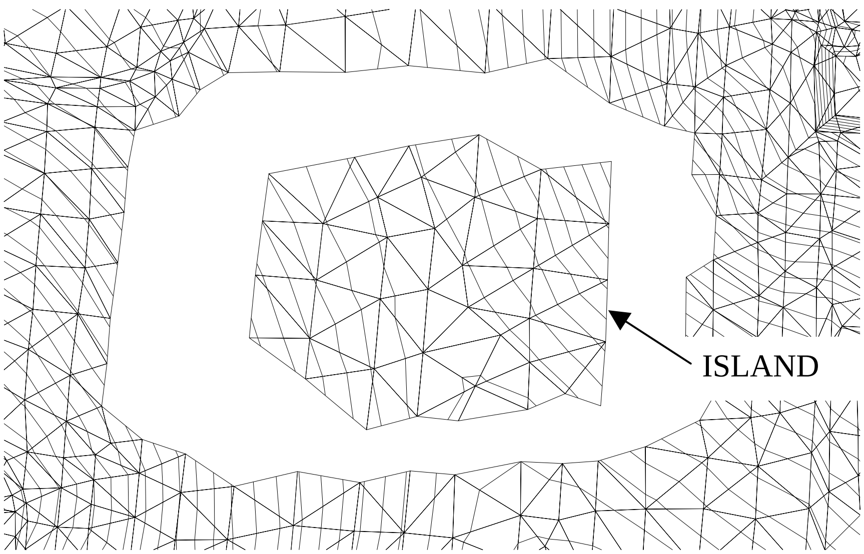
### 4.2.1.4 VOIDS

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



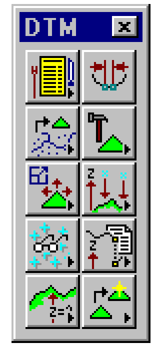

### 4.2.1.5 ISLANDS

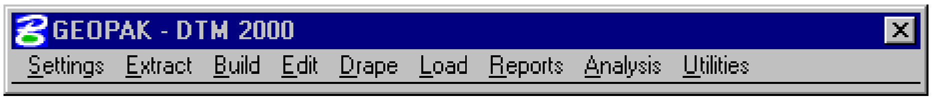
An island represents an area inside a void that contains contours.



## 4.3 Accessing

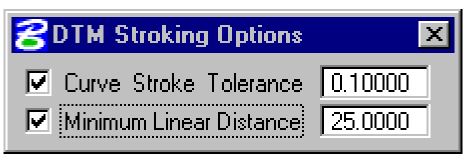
Selecting the Existing Ground push-button from Project Manger or the DTM Tools icon, and selecting a run will bring up the tool palette shown to the right. All of the DTM tools can be accessed from the tool palette or from the DTM menu that can be accessed from the first icon in the tool palette.


## 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.

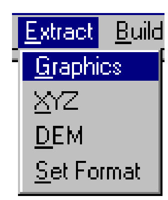


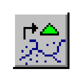

**Curve Stroke Tolerance** The maximum distance between the arc and the chord used to approximate the arc in the DTM.

**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.

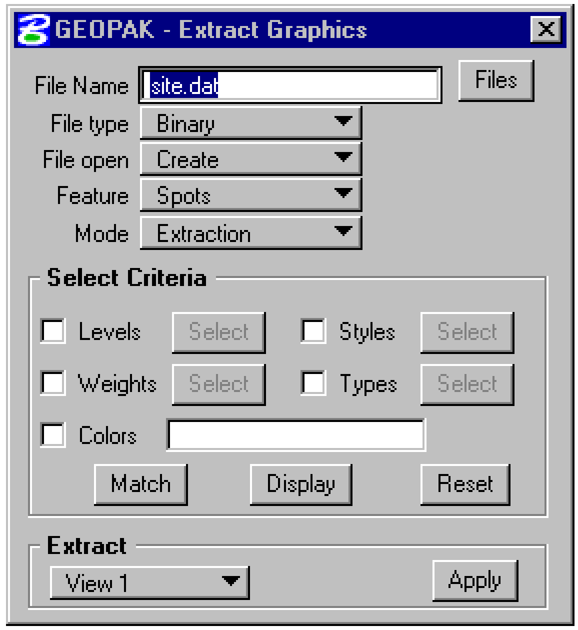


**File Name** specifies the name of the file to be created for storing the input data. If file already exists, it may be found using the **Files** button.

**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.

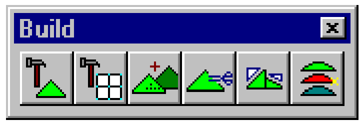
**Select Criteria** provides ways to specify the features to be extracted. When an “X” is placed in the box next to Levels, the Select box is activated. You may then click the Select button to indicate only those levels you want GEOPAK to search for when extracting data. If the Levels box is not turned 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.

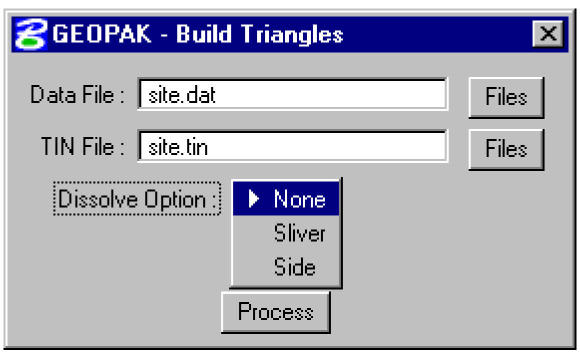
## 4.6 Build


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 **Files** 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.

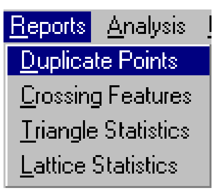
**Build** >> **Merge** allows two triangulated models to be merged together as long as the boundary of one model overlaps the other. This process will create a third model (**.tin**) from the combination of the two existing models.

**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.

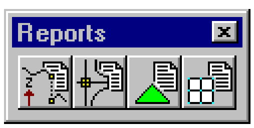
**Build>>Pad** defines a pad (such as a building slab) and integrates the pad into the existing terrain with a variety of slope options.

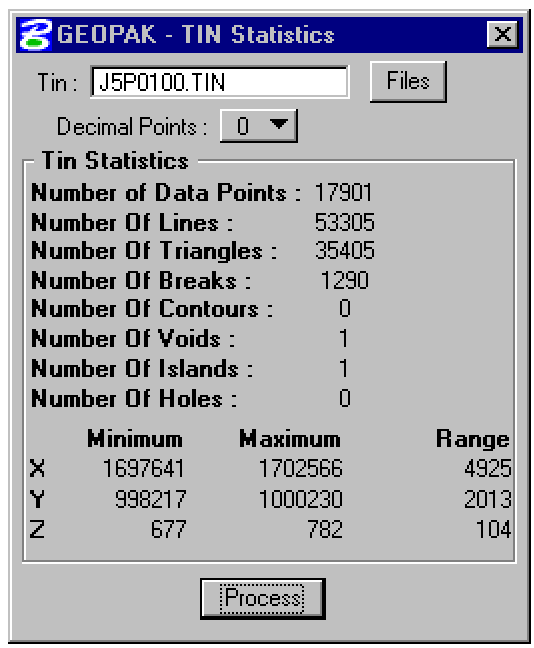
**Build>>Delta Surface** creates a new model based on the difference between two other models, or a model and elevation surface. The Z value in the model that is created is equivalent to the difference between the two specified models, or model and surface.

## 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.



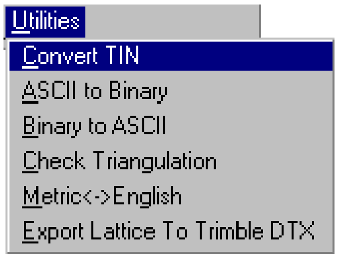




**Duplicate Points –** reports points with the same x and y coordinates.

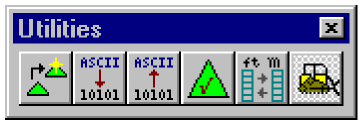
**Crossing Features –** reports intersecting breaklines or contours.

**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 DTM to Trimble DTX model.



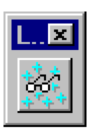

**Convert TIN –** permits the conversion of a triangulated file from a previous version of Geopak to a Geopak 98 format.

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

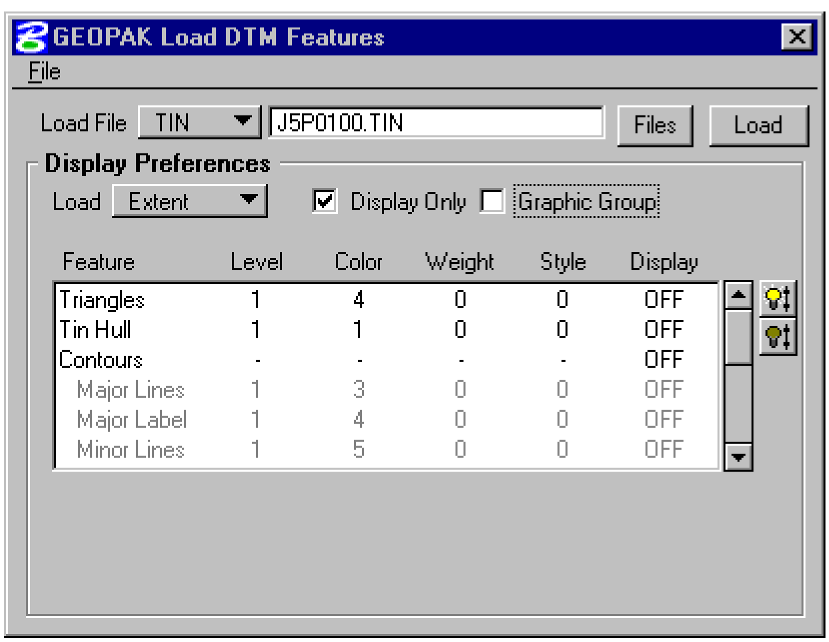
**Check Triangulation -** starts an internal process that verifies the integrity of the triangulated file. A message will appear indicating "Triangulation Valid".

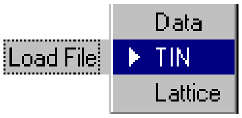
**Metric <-> English** – converts a file from English to Metric units, or from Metric to English or Imperial units. A custom scale factor can also be used. The DTM can also be translated or rotated. If translation or rotation is desired without scaling, a Custom scale of 1.0 can be used. This process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

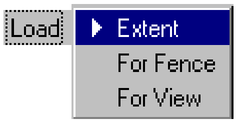
## 4.9 Load


**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.

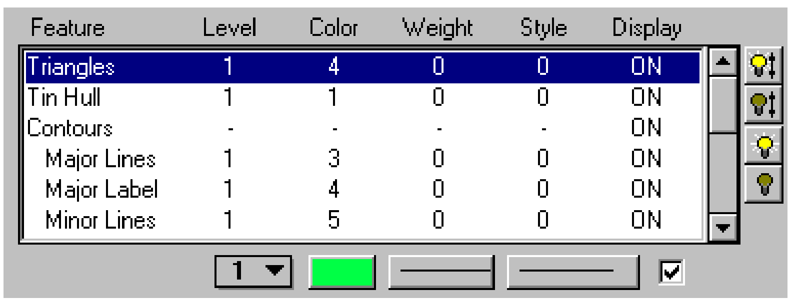




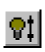

The user can choose to load the DTM data (.dat), the TIN file (.tin), or the lattice file (.lat). Each of these files can be loaded for the model extents, within a fence, or within a window.


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).

 Will turn on all items.

 Will turn off all items.

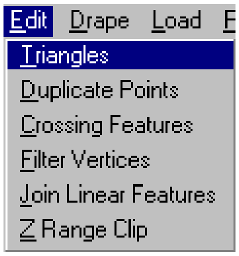
 Will turn on only the selected item.

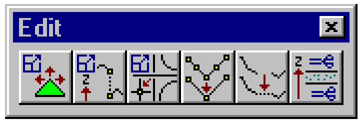
 Will turn off only the selected item.

# 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.

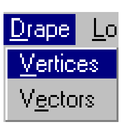
**Duplicate Points –** Reports and allows interactive editing of points in a survey data file with the same X and Y coordinates.

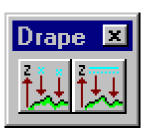
**Crossing Features** – Reports and allows the correction of crossing breaklines.

**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.

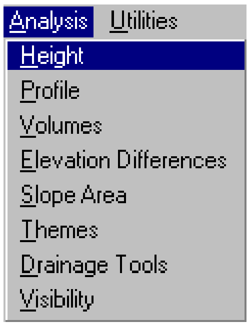


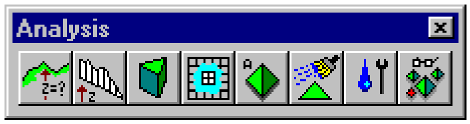




## 4.10.2 DRAPE

GEOPAK provides two tools for draping Microstation elements onto a triangulated model, vertices and vectors.

## 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.

**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 –** 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.

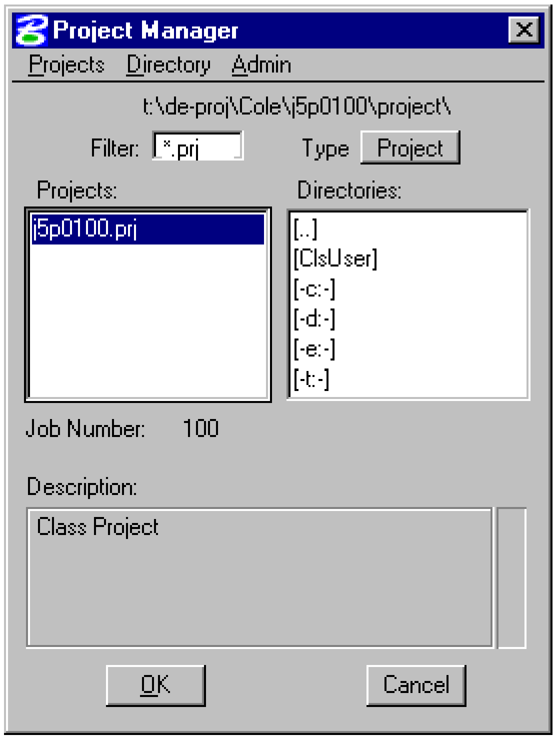
**Visibility** – Displays lines of sight (which triangles can and cannot be seen), or what is visible between two specified points.

For more information on these items, see the *Geopak Manual* or online help.

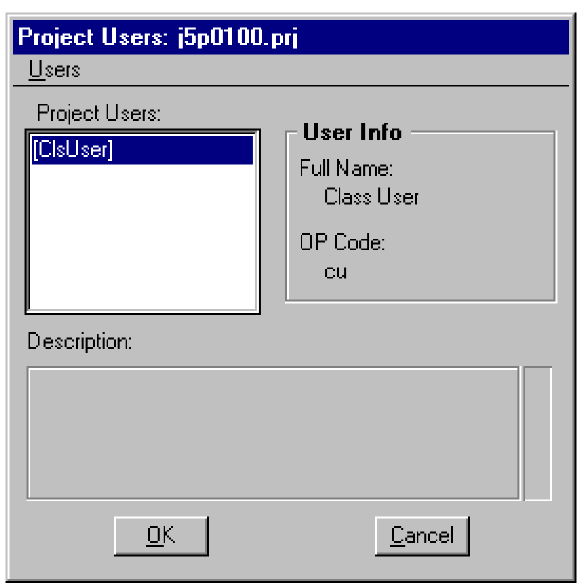
## 4.11 Exercise 4-1

1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\topo_j5p0100.dgn**.

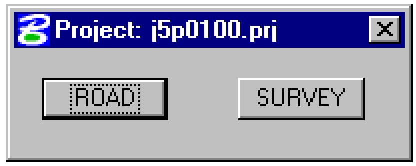
2. Open the project **j5p0100.prj**.




3. Select the user **ClsUser**.

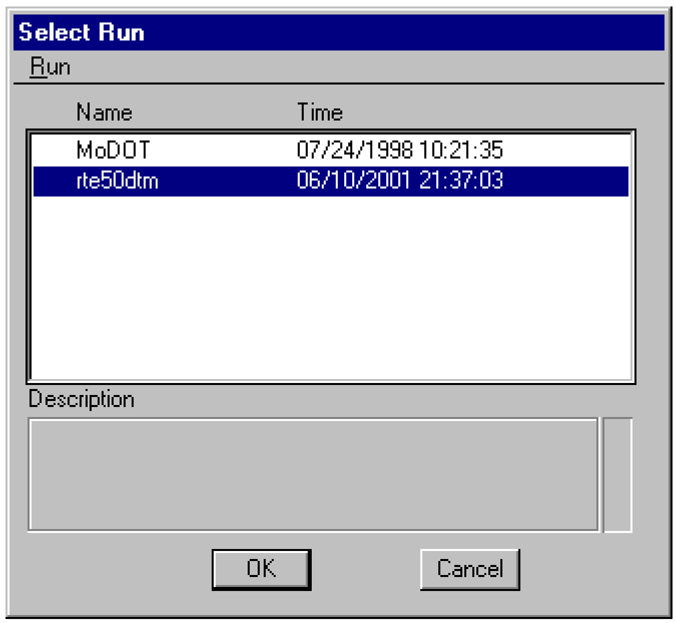


4. Select the **Road Project Manager**.




5. Select the **Existing Ground**.

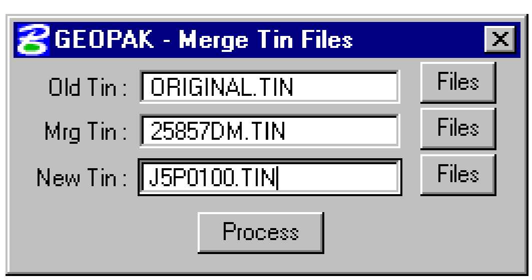

Copy the MoDOT run to **rte50dtm**, and open the **rte50dtm** run.



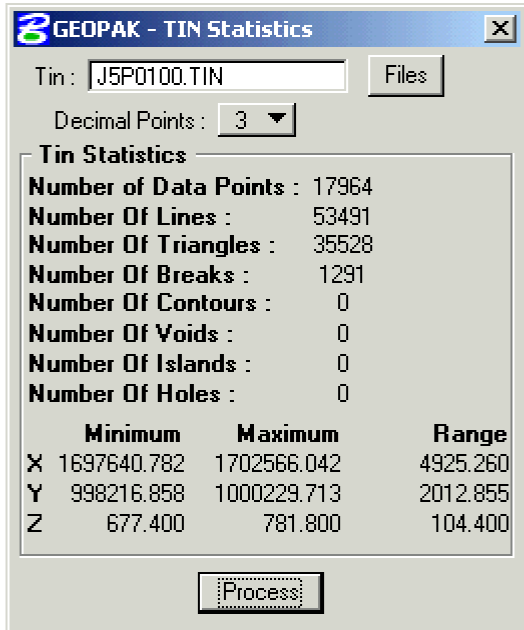

6. Use the **Build > Merge TINs** tool to merge the **25857dm.tin** with the **orignal.tin**.

Select the **original.tin** as the **Old Tin** and the **25857dm.tin** as the **Mrg Tin**.

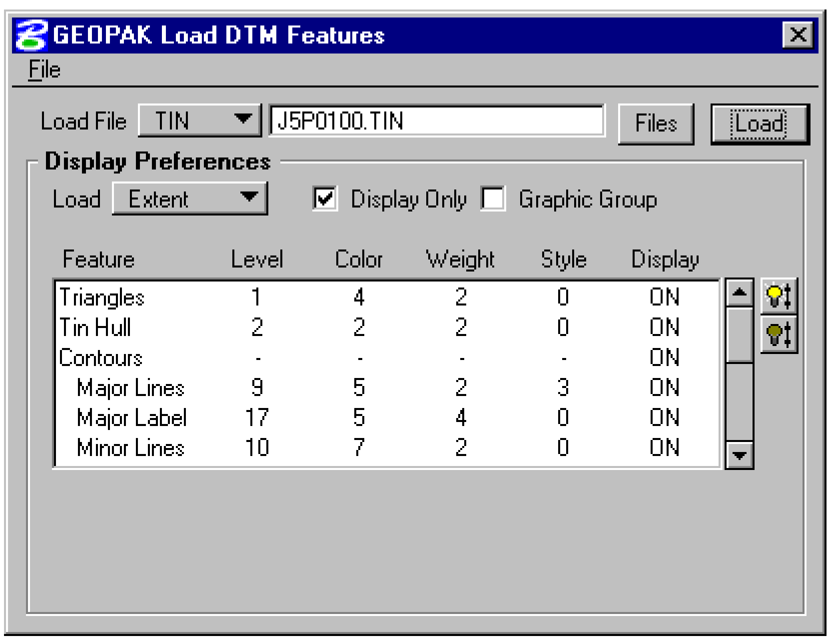
Set the **New Tin** to **J5P0100.TIN**



7. Check the **Triangle Statistics** (**Reports > Triangle Statistics**) of the tin file **j5p0100.tin**.

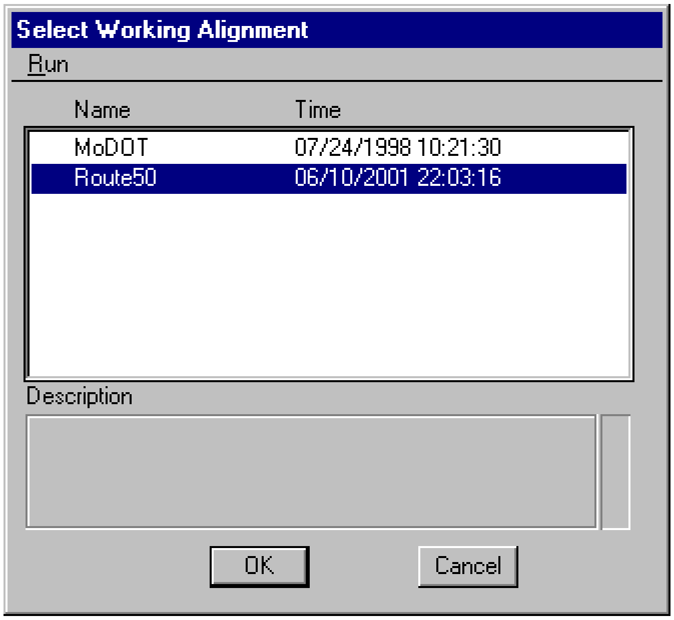



8. Load (**Load > DTM Features**) the triangles and contours into the view. Load them as **Display Only**.



9. In the **Road Project** dialog choose the **Select** button to create a new **Working Alignment**.

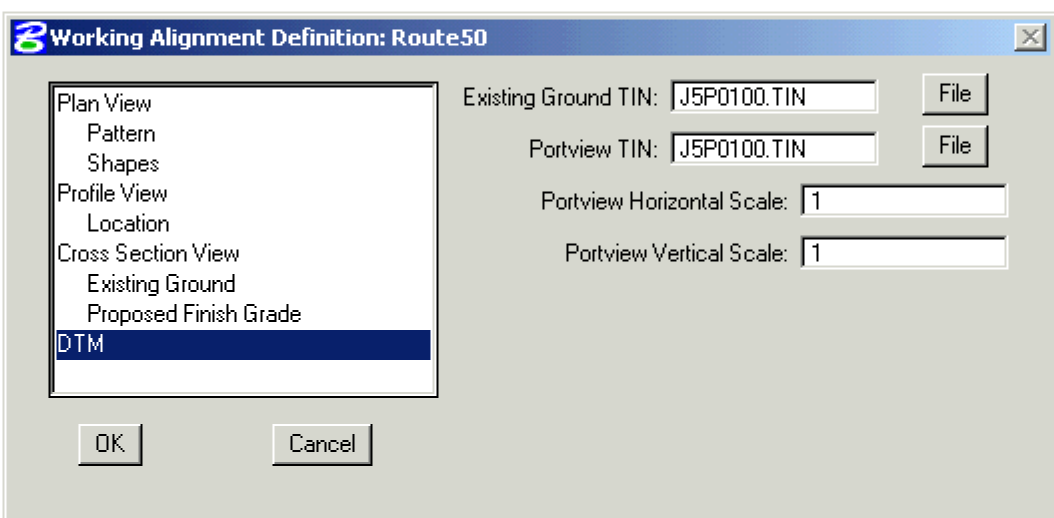
   Copy the MoDOT Working Alignment to **Route50**, and select the **Route50** working alignment.




10. Set the **DTM** section of the **Working Alignment Definition** (Define button)

   Set the **Existing Ground TIN** and **Portview TIN** to **t:\de-proj\cole\j5p0100\data\j5p0100.tin**

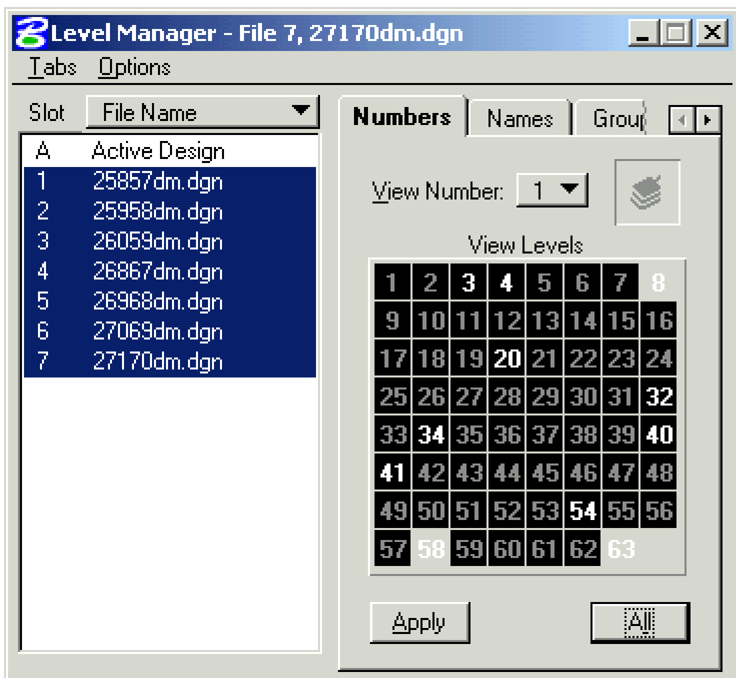
   Set the **Portview Horizontal** and **Vertical Scales** to **1**.



11. Reference (MicroStation menu **File > Reference** or **REF** icon) the photogrammetric files to **topo_j5p0100.dgn**:

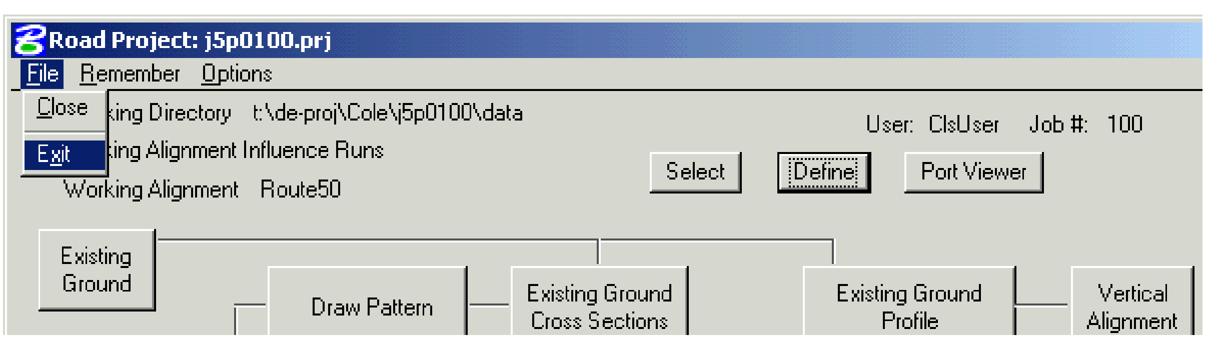
**25857dm.dgn**
**25958dm.dgn**
**26059dm.dgn**
**26867dm.dgn**
**26968dm.dgn**
**27069dm.dgn**
**27170dm.dgn**

Open the **MicroStation Level Manager**; highlight the attached reference files; and **turn off levels 8**, **58**, and **63** as shown below.




Save the changes to the MicroStation file.

12. Exit Project Manager by going to the Road Project pull down menu **File** > **Exit**.



# Quiz 1

1. GEOPAK needs to be activated every time you start MicroStation.
   a. True
   b. False

2. .TIN files store triangular surface information.
   a. True
   b. False

3. Project data is stored
   a. in the job directory in My Documents.
   b. In the t:\de-proj\county\jobnumber\data directory.
   c. anywhere you wish.
   d. In the t:\de-proj\county\jobnumber\project directory.

4. The **Job Number** folder name and the **Project Name** in Project Manager should be the same.
   a. True
   b. False

5. After opening the Project Manager dialog, the first step in selecting a Project Manager (.prj) file is to
   a. select Project>>Edit.
   b. navigate to the t:\de-proj\county\jobnumber\data directory.
   c. set the working directory.
   d. navigate to the t:\de-proj\county\jobnumber\project directory.

6. Breaklines are used to define a change in slope.
   a. True
   b. False

## Chapter 5

# Coordinate Geometry

## 5.1 Objectives

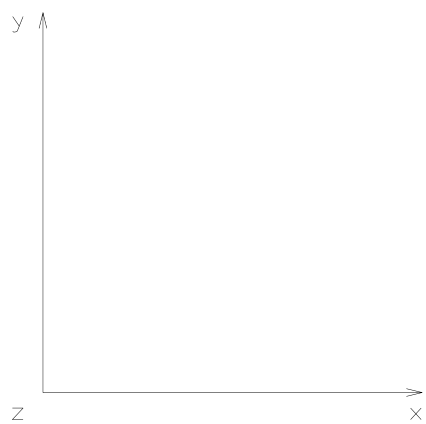
- Learn to set up and access the coordinate geometry database.
- Become proficient in using Geopak Coordinate Geometry.

## 5.2 Definitions

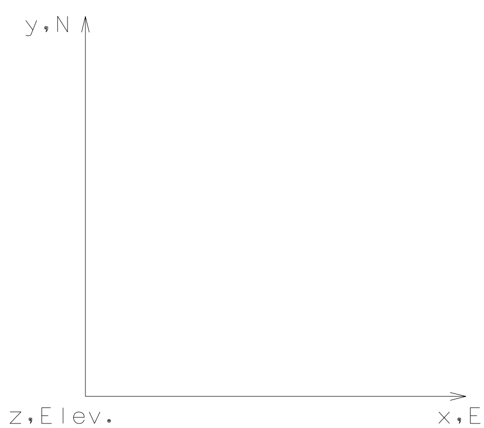
**Coordinate Geometry (COGO)** is a method of using XYZ coordinates to store geometric elements such as points, lines, curves, spirals, chains, parcels, and profiles. The **Coordinate Geometry** dialog box is an interactive graphical user interface for storing coordinate geometry elements.

### 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.



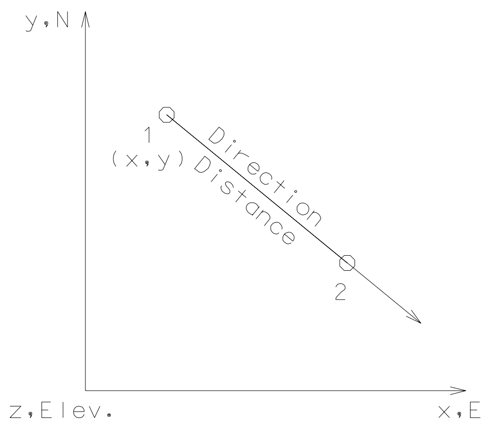
The user must be aware of the coordinate system the data is in, and the coordinate system that GEOPAK is using. When referring to the **XYZ** coordinate system, the coordinates are listed as **(X, Y, Z)**. When referring to the **Northing, Easting, Elevation** coordinate system, the coordinates are listed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

### 5.2.2 Points

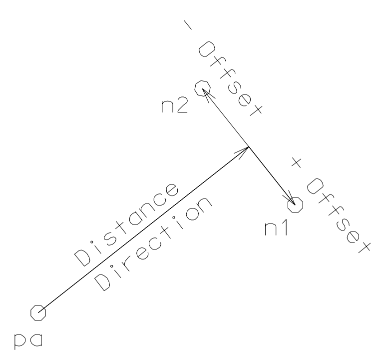
**Points** are defined by a single set of coordinates. Each **point** will have an X and a Y coordinate. The point may also have a Z coordinate if an elevation is defined.

**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.

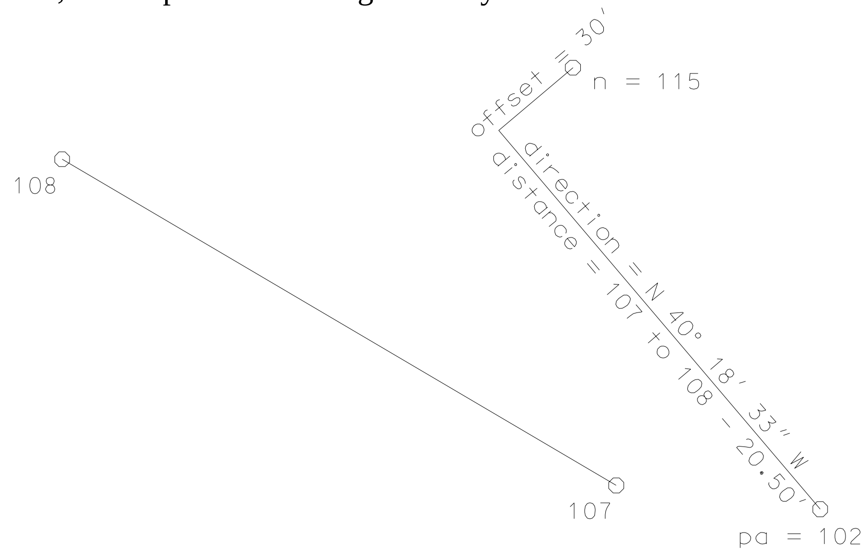
**Points** can be stored from a set of coordinates, or located from other elements. To define a point from another point, a distance and direction need to be defined.




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



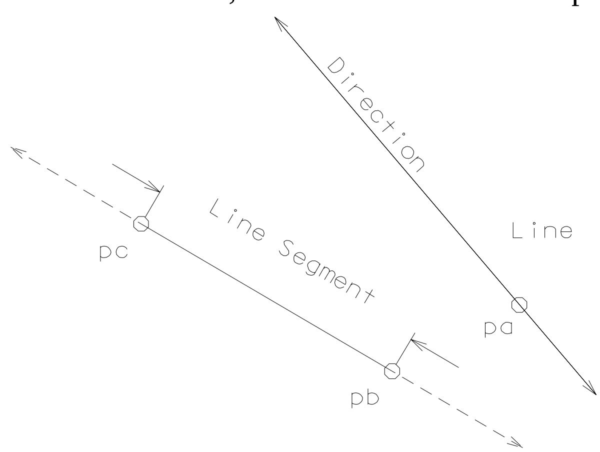
Distances and directions can also be found mathematically. Values can be added, subtracted, multiplied, divided, or computed with a trigonometry function




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.

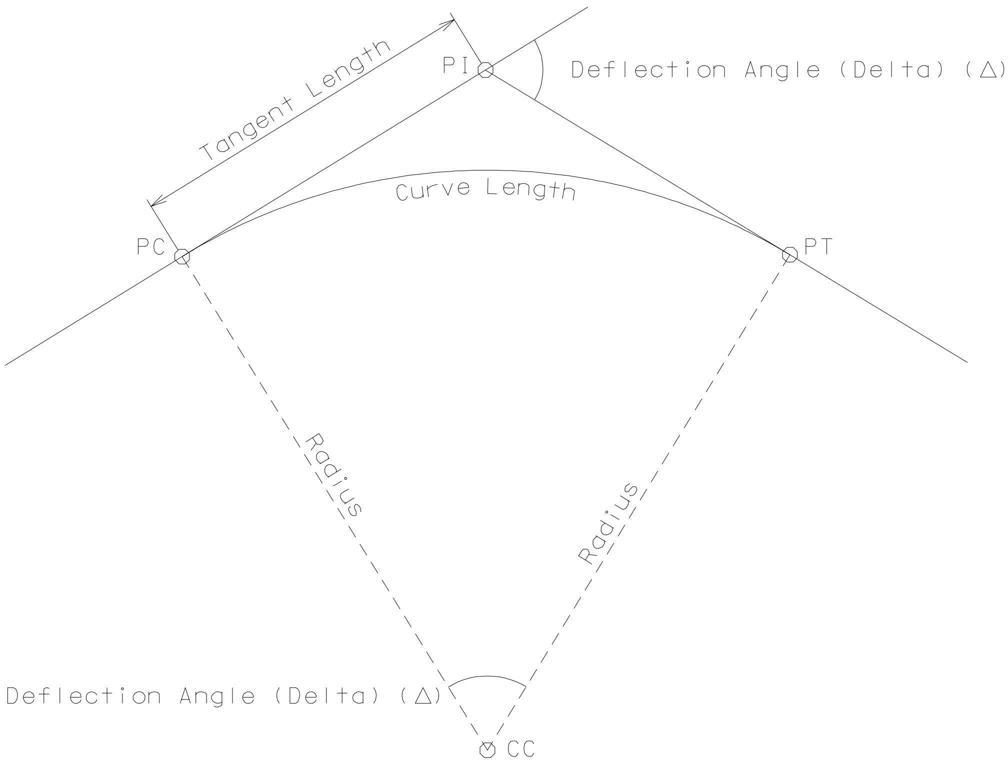


### 5.2.4 Curves

**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.



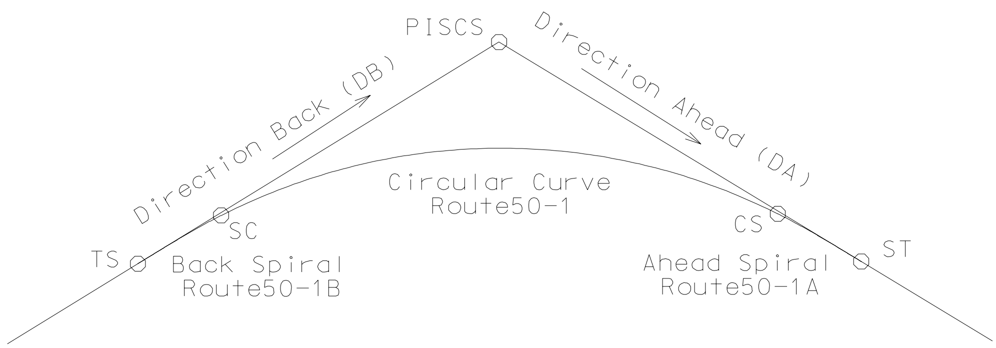

**Curve** names can be any alpha-numeric characters up to nine characters in length.

### 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.

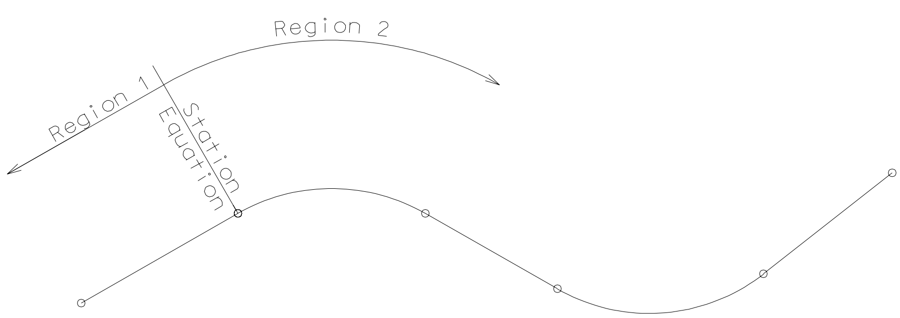
Several points are also stored with a **spiral**. They are as follows:

**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

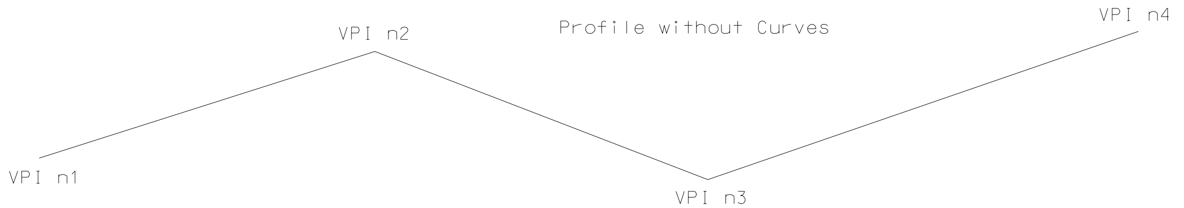
**Chains** are a combination of other elements. They can consist of points, curves, spirals, or other chains. **Chains** can represent horizontal alignments, or the horizontal location of some element. **Chains** have **stationing** associated with them. Locations along the chain can be determined by 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.

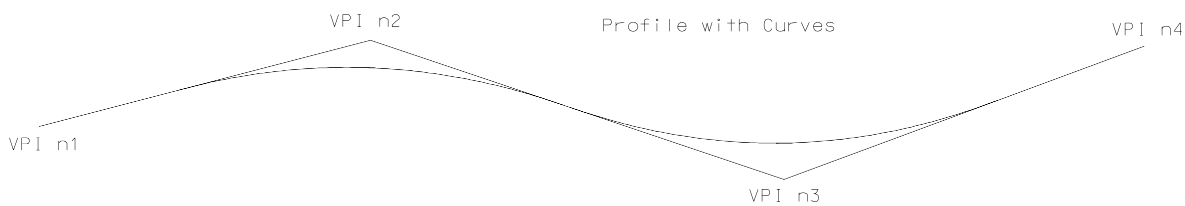



**Chain** names can be any alpha-numeric characters up to a length of nine characters.

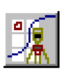
### 5.2.7 Profiles

**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.

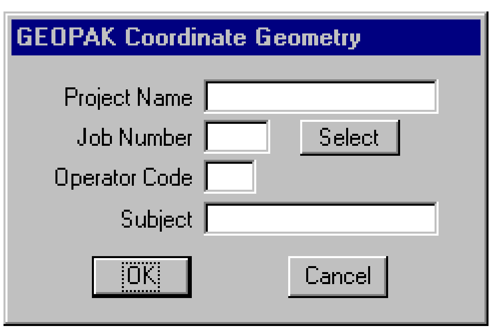



## 5.3 Accessing



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.

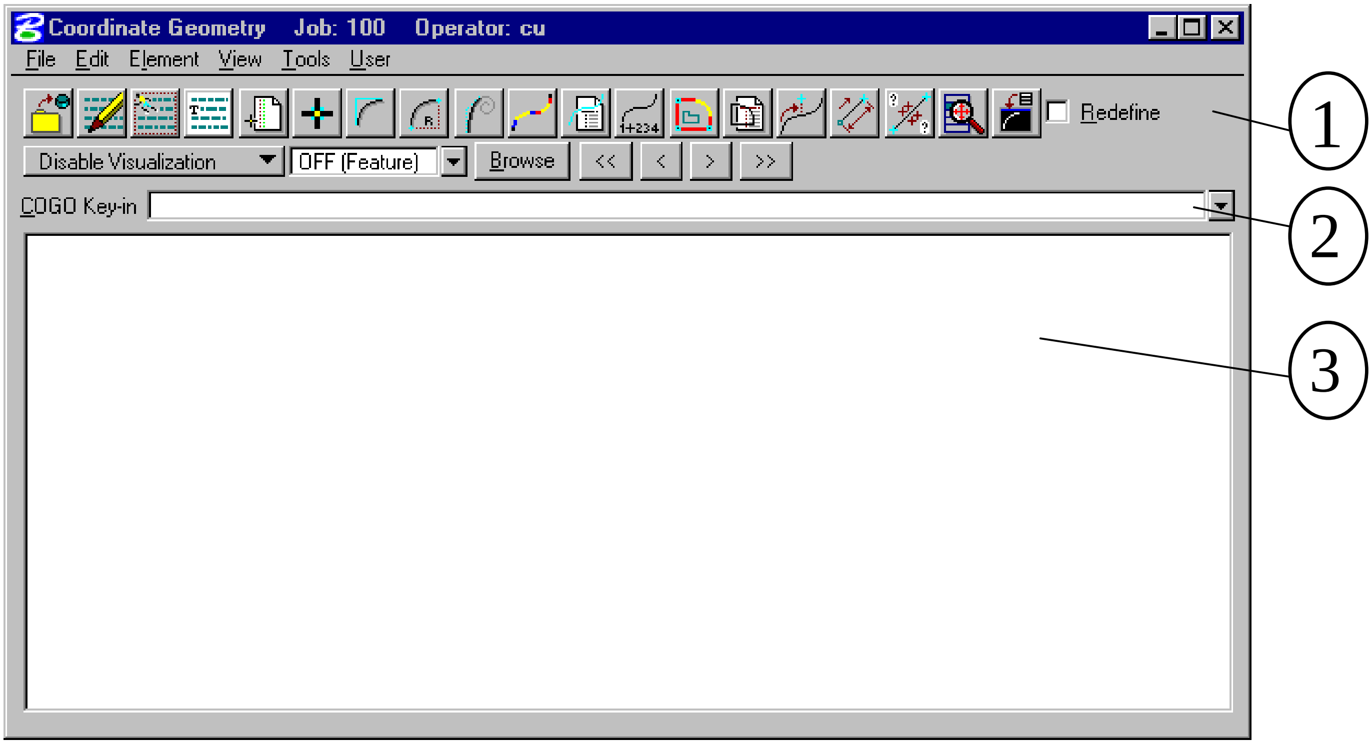
**Job Number** - identifies coordinate geometry database (3 alphanumeric characters, max) (required). If **Project Manager** is used, this field will be filled in automatically.

**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



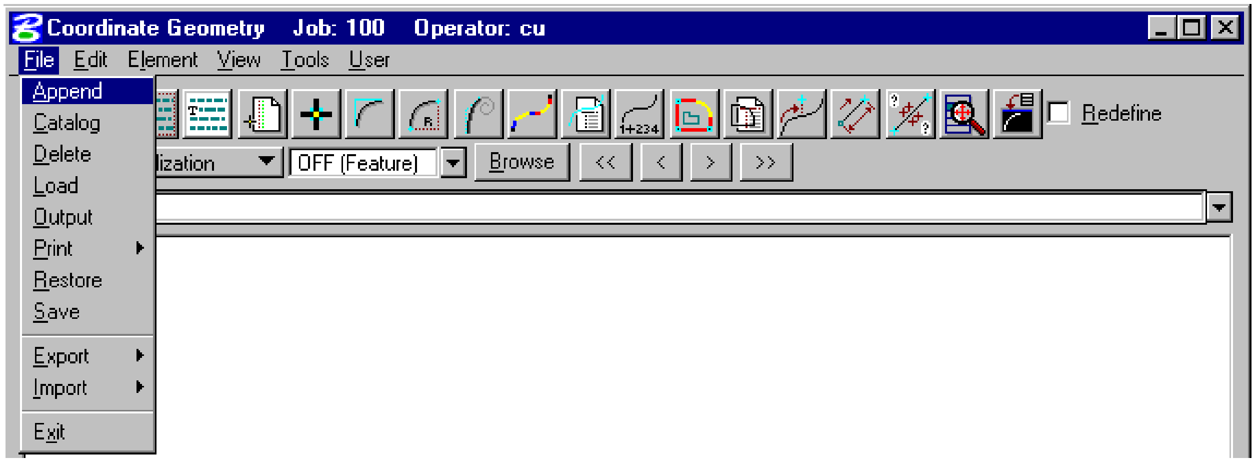

The coordinate geometry dialog box is made up of three separate display areas:

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




**Append -** this command is for *input files* only. 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.

**Load -** when selected, a menu appears listing all saved input files. *Highlight* a file then click the **OK** button. The input lines from the highlighted file are now displayed in the output buffer and are ready for modify, delete, edit or read.

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

**Print -** sends your output/input file to the printer.

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

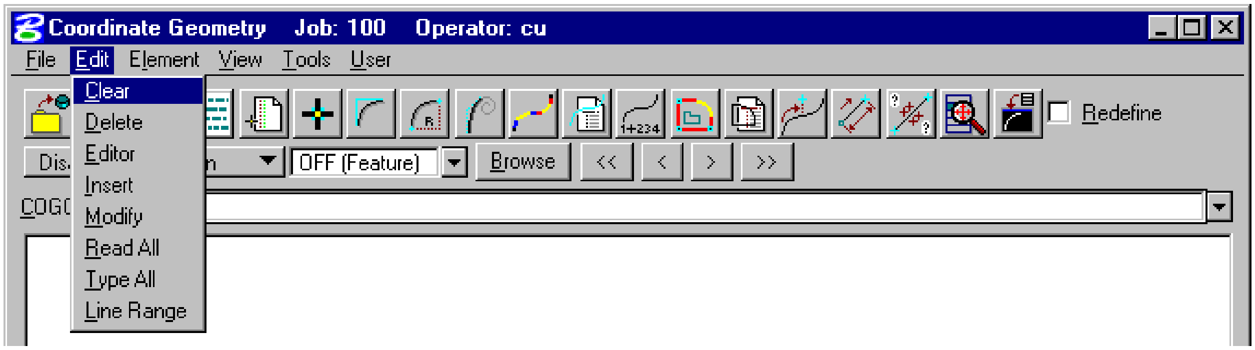
**Save -** will save the current input buffer to a file. (**Fname999.ioc**)

**Export -** will export Geopak chains and profiles into RDS format and Geopak chains and points into SDMS format.

**Import -** will import horizontal and vertical alignments and points from RDS and SDMS format into the Geopak .gpk file.

**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.

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

**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

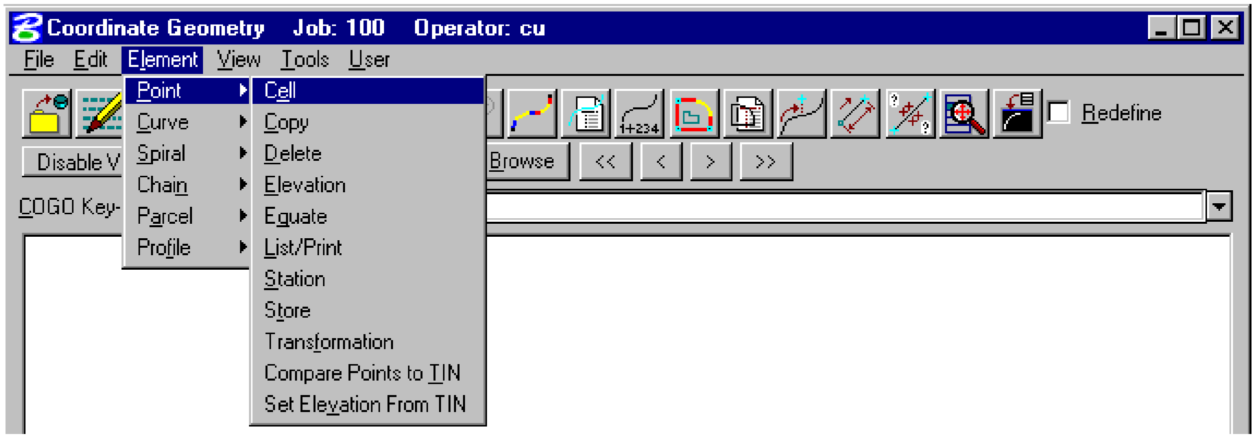
**Modify -** allows the user to change a word in a command line. The modified command line will not be computed until the operator uses the **Read** command.

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

## 5.4.3 Element Commands

### 5.4.3.1 ELEMENT>>POINT




**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

**Delete -** allows you to input a point number (or range of numbers) to be deleted from the database.

**Elevation** - assigns an elevation to a previously stored point

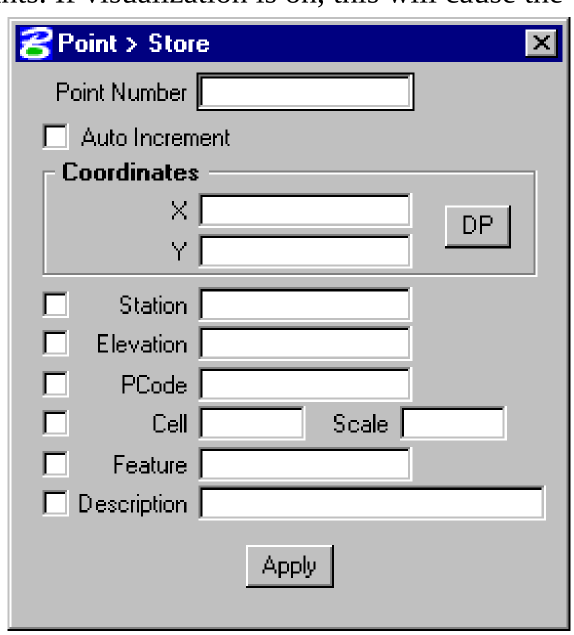
**Equate** - stores a new point with the same values as a previously defined point

**List/Print -** input a range of point numbers; **List** displays only the point numbers currently stored in the .gpk file. **Print** displays point number, x, y, z coordinates, station value and other information in the output buffer for the requested points. If visualization is on, this will cause the points to be displayed.

**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.

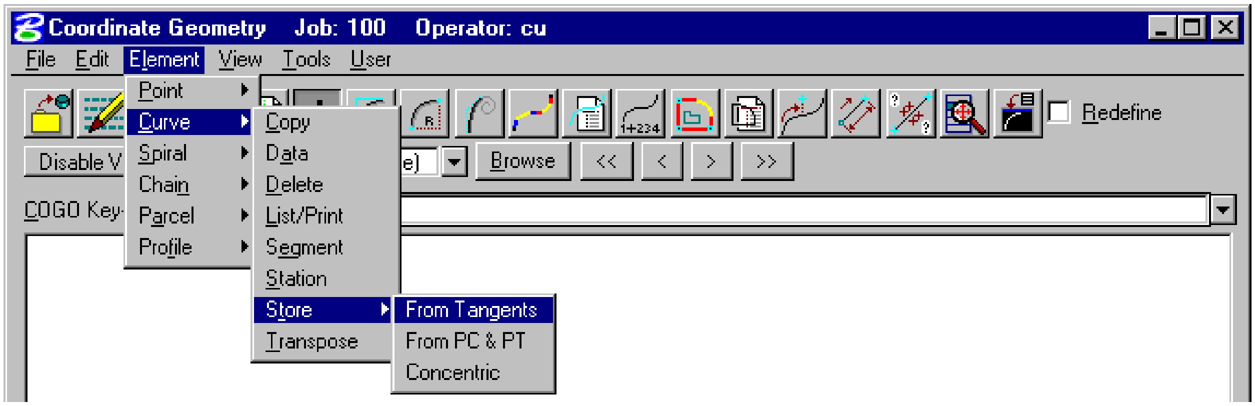
**Transformation** - transform one set of points into a new coordinate system.



**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>>CURVE




**Copy -** copy a specified curve to another curve name

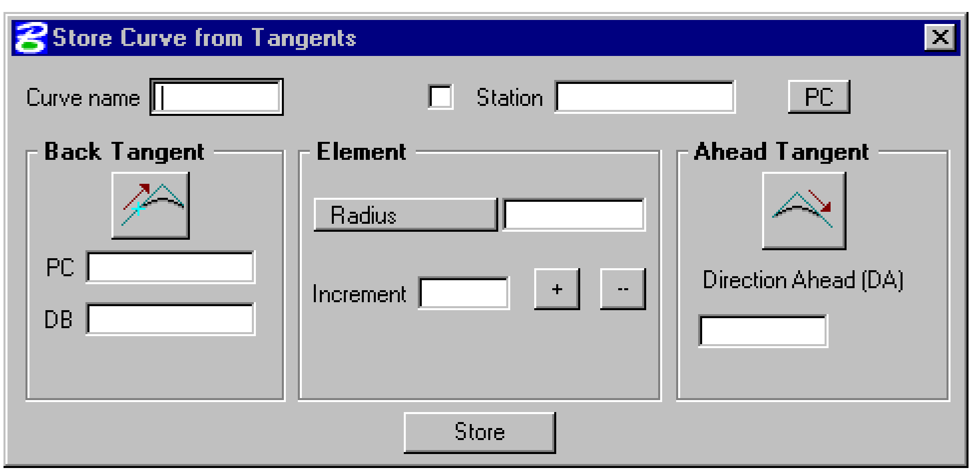
**Data -** calculates the geometric parameters of a curve, displaying values for Delta, Degree, Tangent, Length and Radius

**Delete -** will delete selected curve from the .gpk database

**List/Print -** will display all curve data for the selected curve. **List** displays only the curve names currently stored in the .gpk file. **Print** displays the curve data of the selected curve. Also if visualization is on this will cause the curves to be displayed.

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

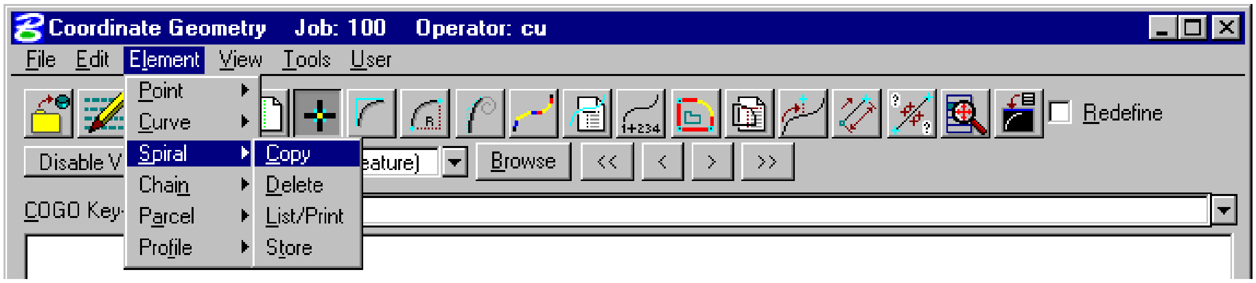
**Station -** allows the user to identify a curve and the position on the curve (PC, PI, or PT) that a station value may be assigned.




**Store -** provides various options for defining and storing lines and curves such as **Store Curve from Tangents** as shown to the right.

**Transpose –** reverses the curve direction.

### 5.4.3.3 ELEMENT>>SPIRAL

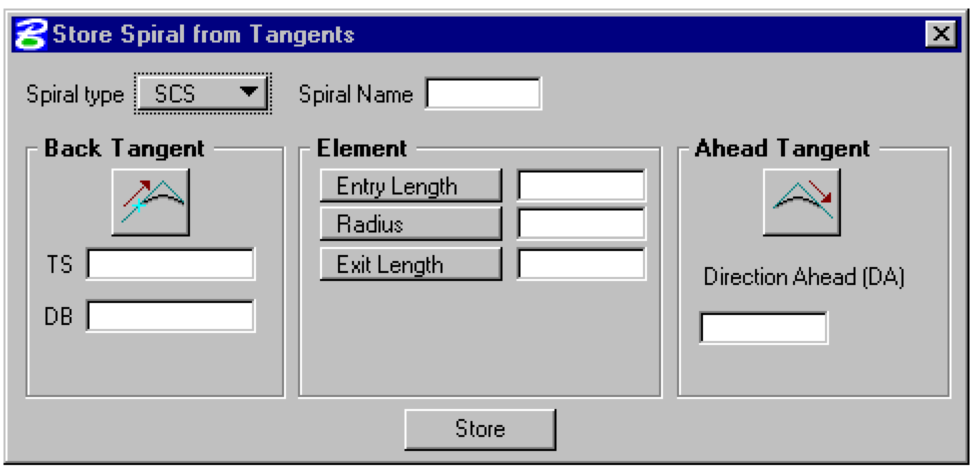



**Copy -** copy a specified spiral to another spiral name

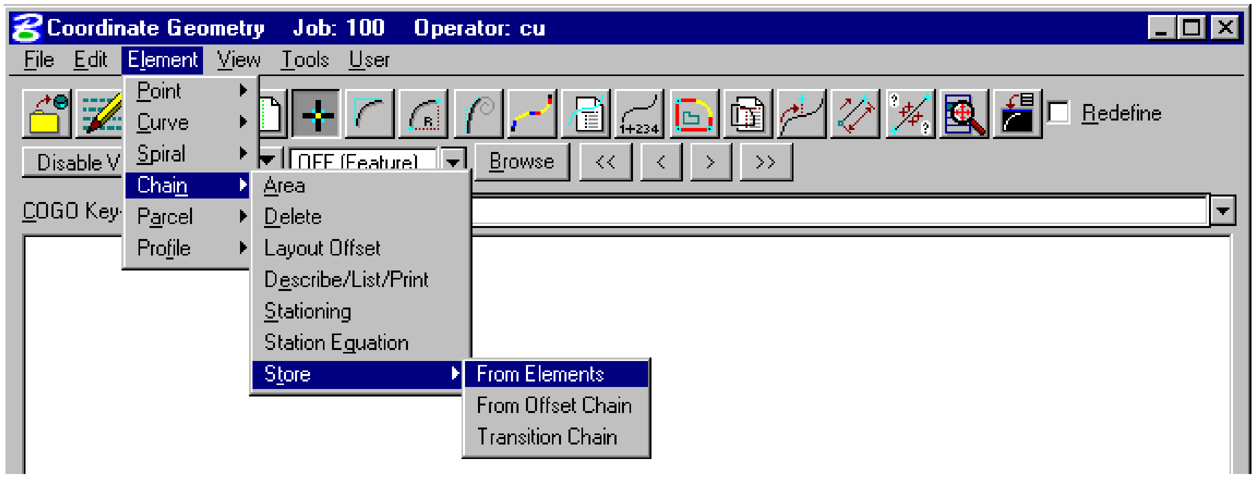
**Delete -** will delete selected spiral from the .gpk database

**List/Print -** will display all spiral data for the selected curve. **List** displays only the spiral names currently stored in the .gpk file. **Print** displays the spiral data of the selected spiral. Also if visualization is on this will cause the spirals to be displayed.

**Store -** provides various options for defining and storing spirals.



### 5.4.3.4 ELEMENT>>CHAIN




**Area –** calculates the area of a closed chain

**Delete -** deletes selected chains from **.gpk** database

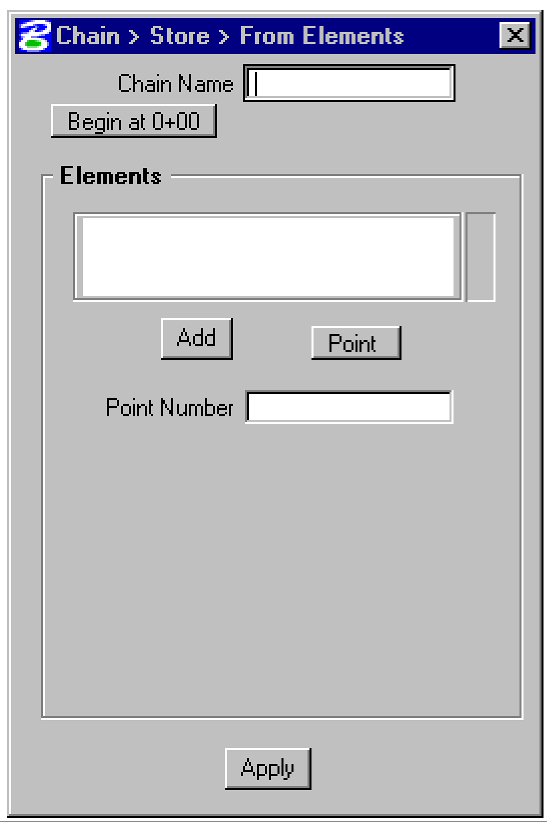
**Layout Offset** – computes the station and offset of a point or a chain based on a given chain.

**Describe/List/Print –** displays chain information. **Print** displays the name of each chain element. **Describe** displays the alignment data of each element in the selected chain.

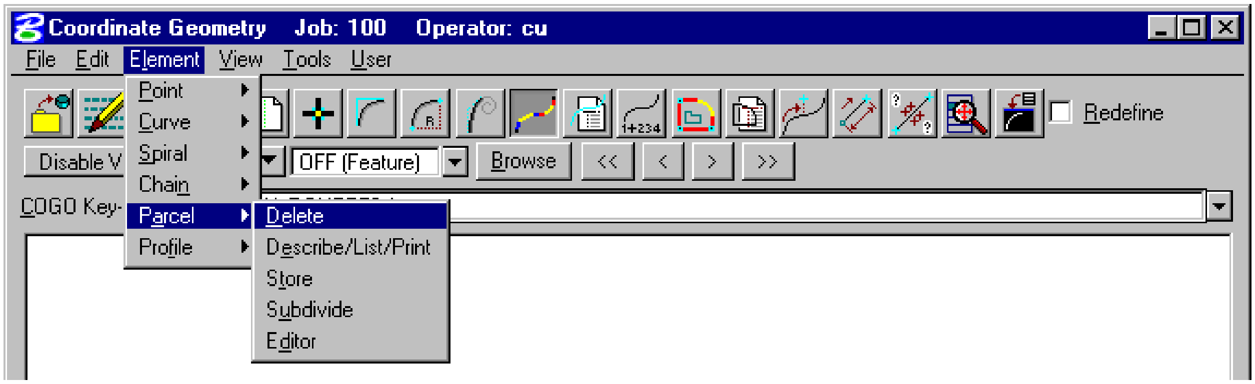
**Stationing -** provides a method for stationing or re-stationing a chain.

**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**.



### 5.4.3.5 ELEMENT>>PARCEL




**Delete -** deletes selected parcels from **.gpk** database

**Describe/List/Print -** displays parcel information. **Describe** displays the elements of composition, the area of tract stored, taken and remaining and a point, bearing, distance description of the specified tract. **Print** displays the elements of composition, the area of tract stored, taken and remaining.

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

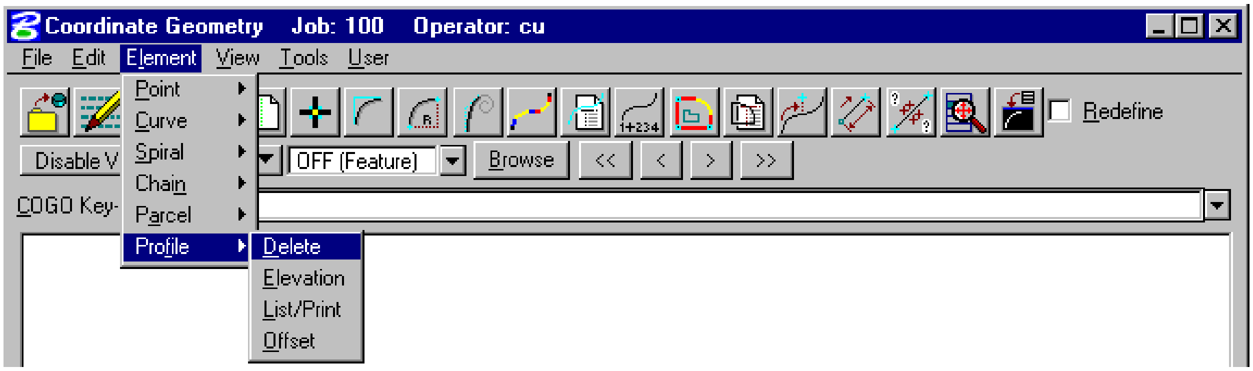
**Store Easement -** allows you to store an easement by entering point and curve names in either a clockwise or counterclockwise direction.

**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, the *Geopak Manual* or the online help.

### 5.4.3.6 ELEMENTS>>PROFILES



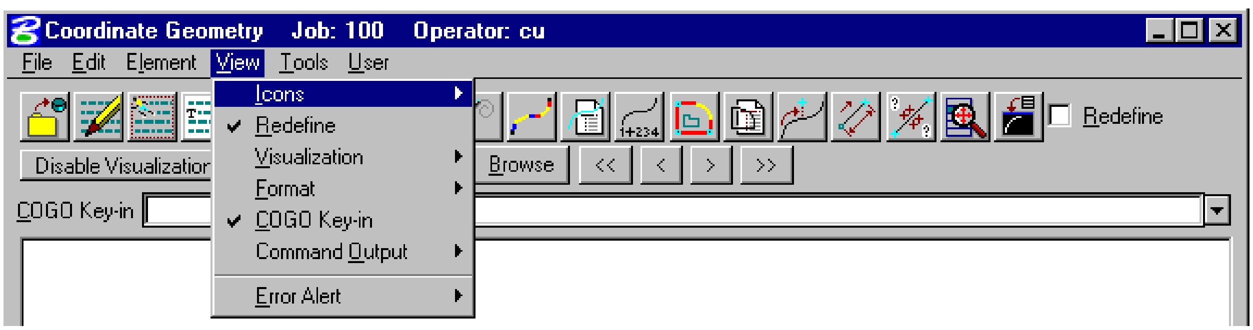

**Delete -** deletes selected profiles from **.gpk** database

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

**List/Print –** displays profile information. **Print** displays the data of the selected profile from the **.gpk** database

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

## 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.

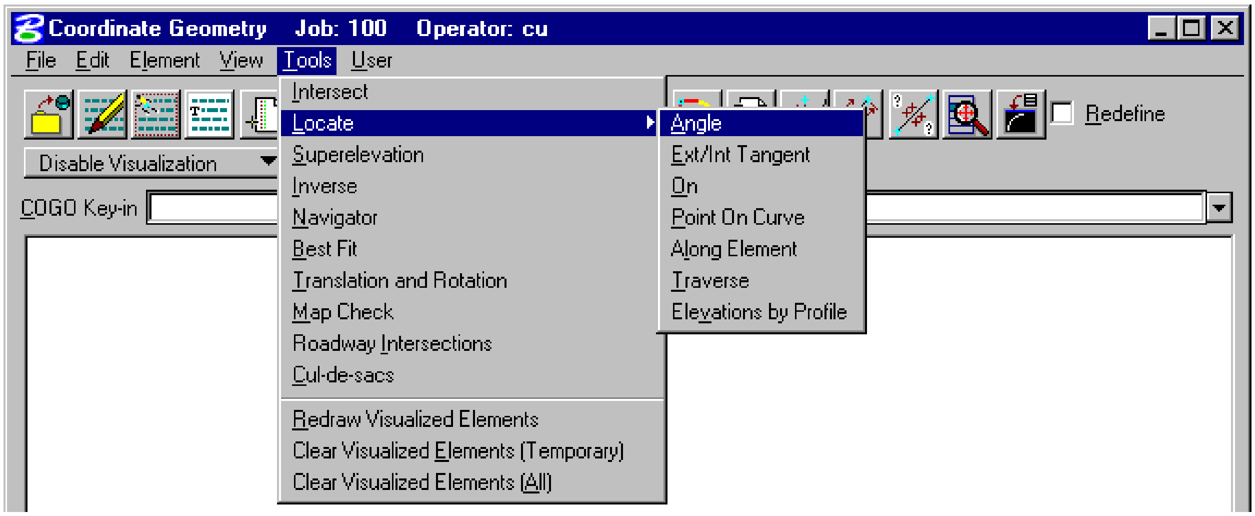
**Format** – shows the format items (i.e. number of decimals, station format, etc.) on the tool bar.

**COGO Key-in –** shows the COGO Key-in box for entering commands in the dialog.

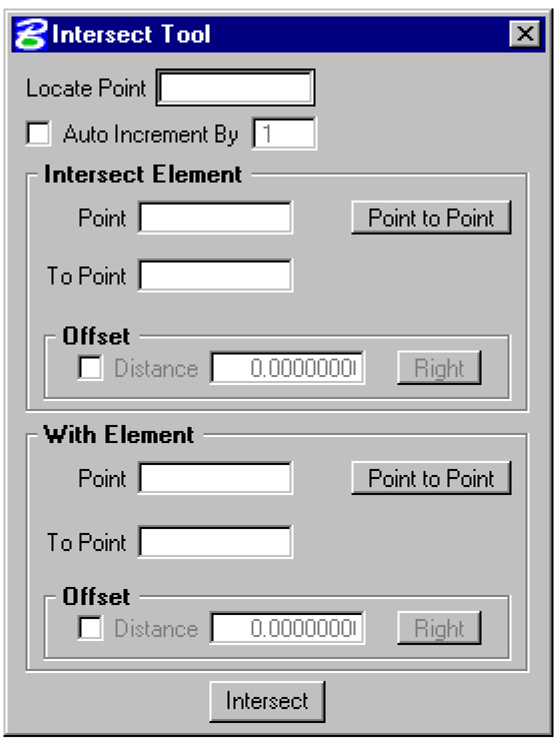
**Command Output** - show the Command Output Window in the dialog box, and controls options for the Command Output Window.

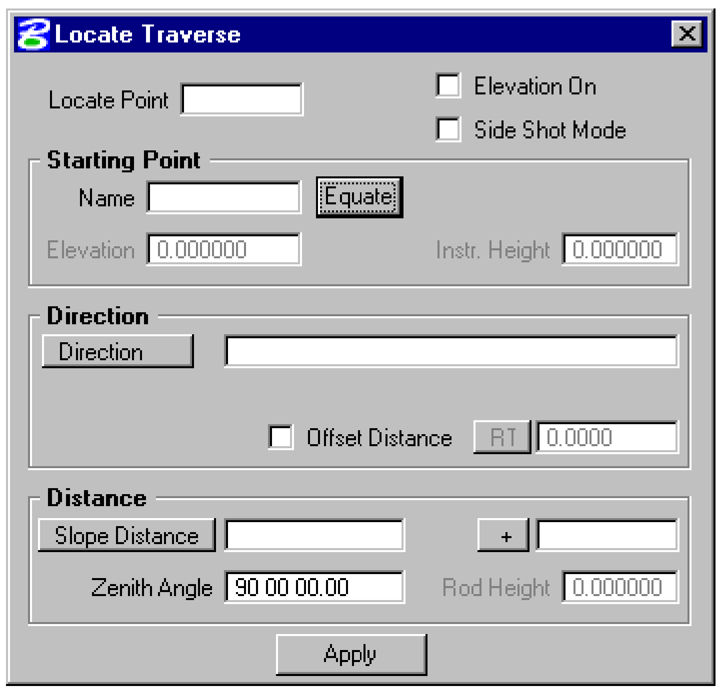
**Error Alert** – allows the user to turn on a *beep* and/or bring up the COGO dialog when an error occurs.

## 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.

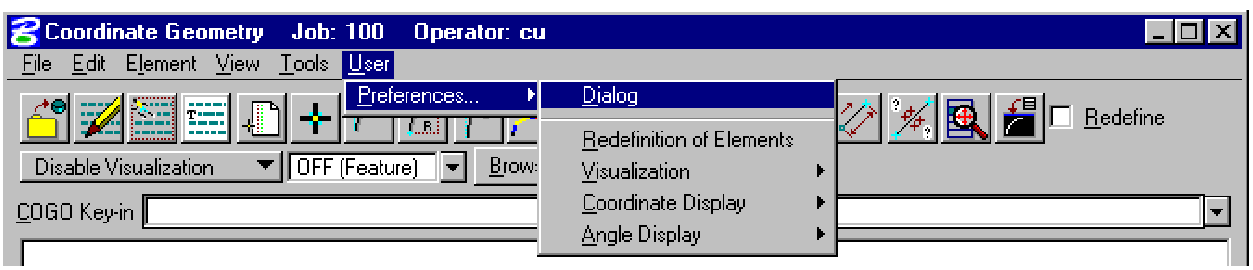
**Cul-de-sacs –** calculates the data for a cul-de-sac.

**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.)

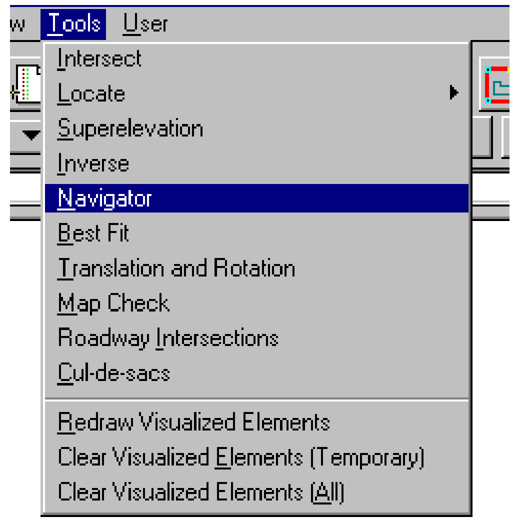
**Visualization –** allows the elements to be displayed in the Microstation file permanently or temporarily.

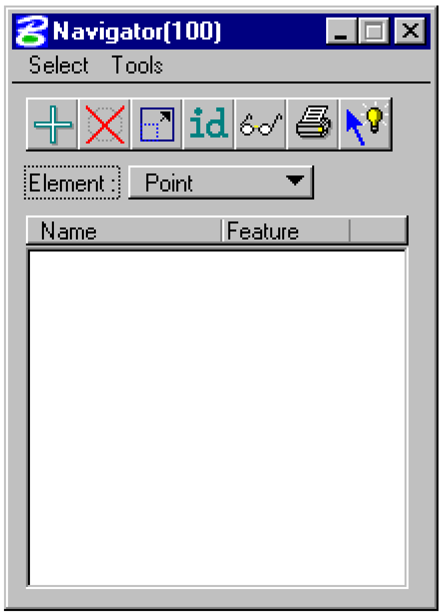
**Coordinate Display –** toggles between displaying NE or XY coordinates.

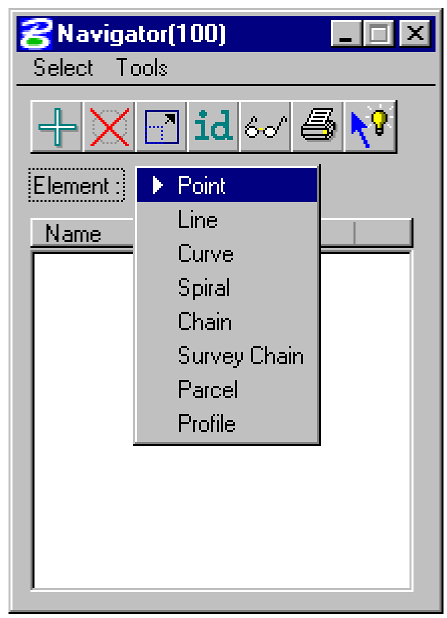
**Angle Display –** toggles between displaying Bearing or Azimuth.

## 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.

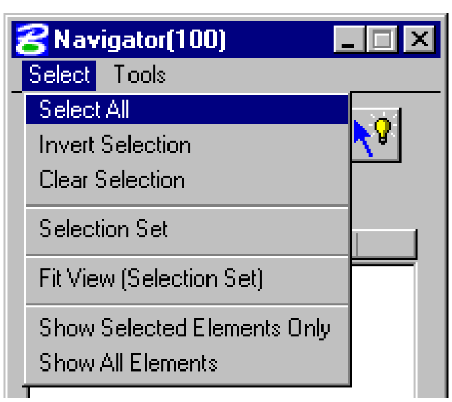



From the **Navigator**, points, curves, spirals, chains, survey chains, parcels, and profiles can be added, deleted, modified, identified, visualized, printed, or selected.

### 5.5.1.1 NAVIGATOR>>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.

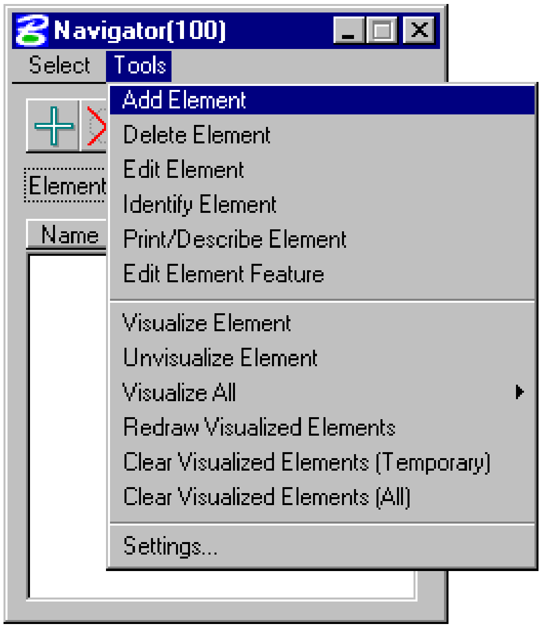
**Selection Set -** allows the user to create a selection set that meets particular criteria. This is the same as using the **Selection Set** icon.

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

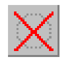
**Show Selected Elements Only** – only the items in the selection set will be displayed in the Microstation window.

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

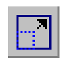
### 5.5.1.2 NAVIGATOR>>TOOLS




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



**Delete Element –** deletes the selected type of element.

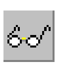


**Edit Element** – allows the selected element to be edited.

**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.

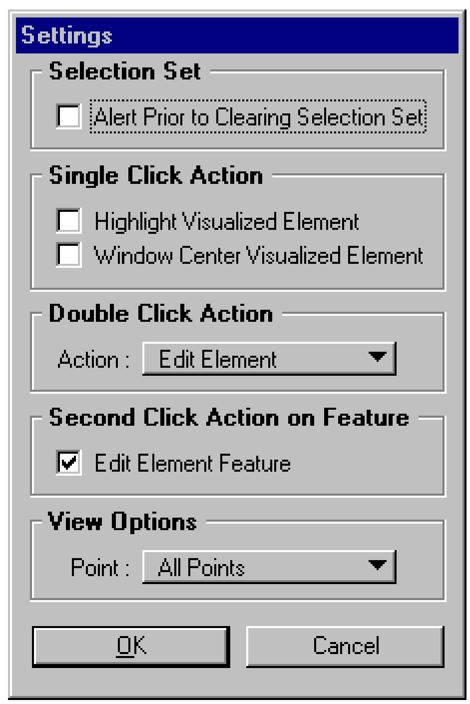
**Visualize All –** displays all of the elements of a certain type, or all elements.

**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 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**.

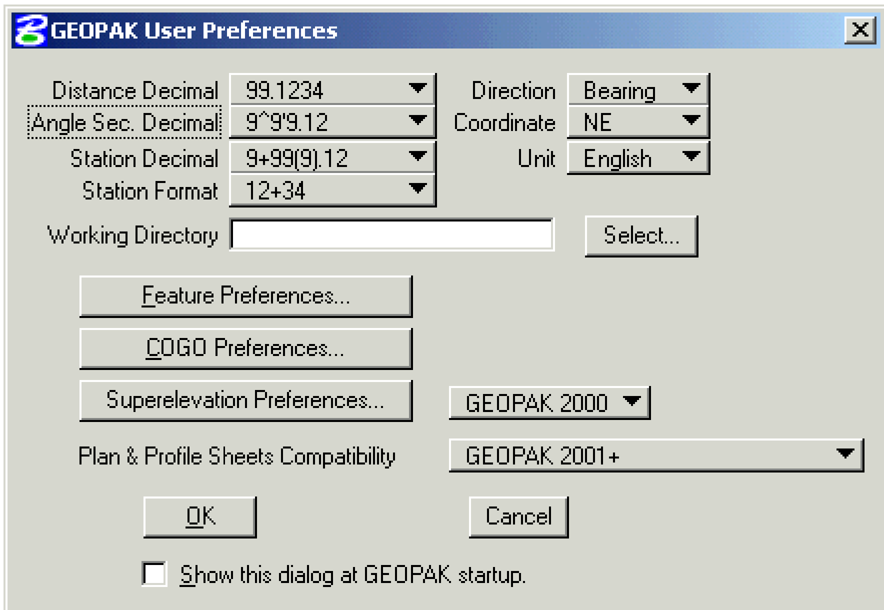
## 5.7 Additional Information

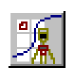
Additional COGO commands and information can be found in the *Geopak Manual*.

# Exercise 5-1

1. Open the Microstation file t:\de-proj\Exercise_Rte_24\Route_24.dgn.

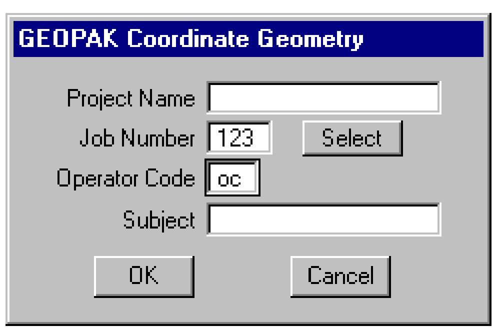
2. Go to **Applications>>GEOPAK Road>>User Preferences** and delete the working directory



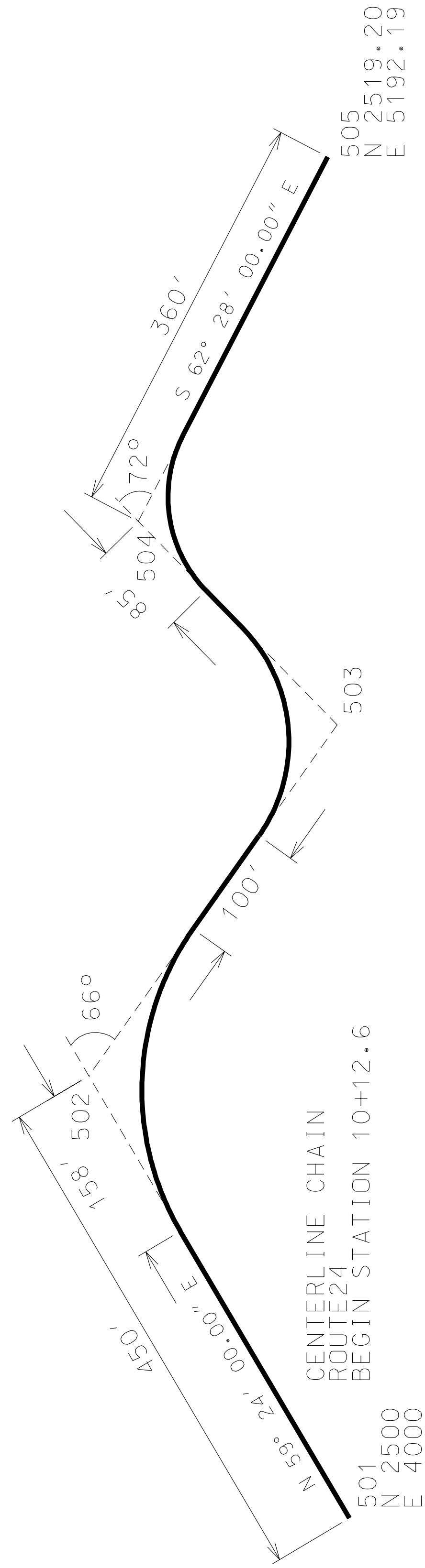

3. Open the **Coordinate Geometry** dialog. 

Create **Job Number: 123**

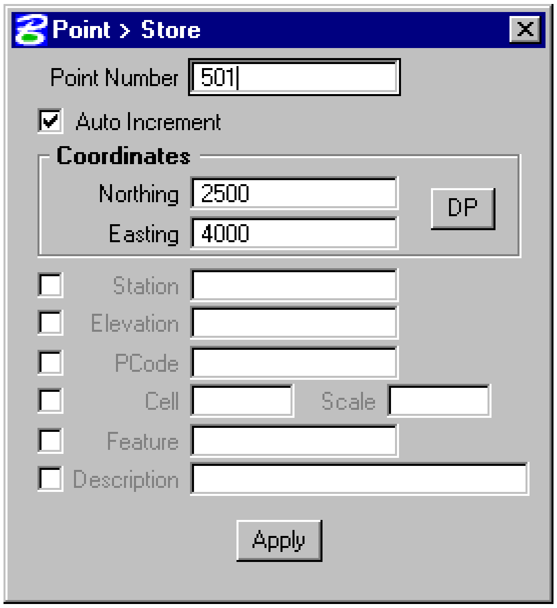
Set the **Operator Code** to your initials.

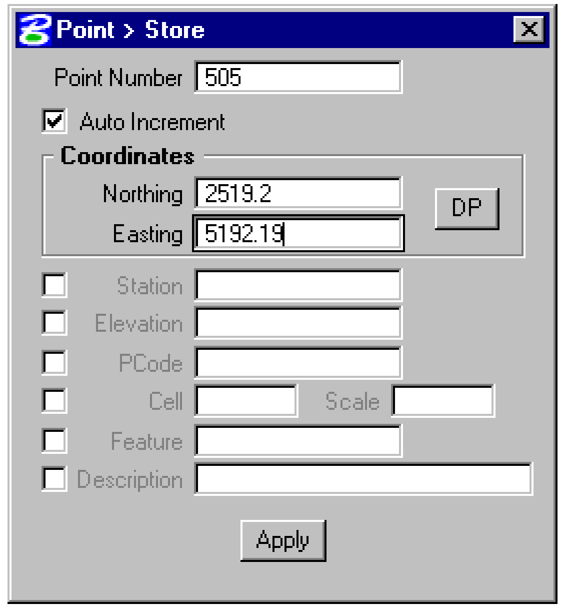


Create the following alignment as shown on the following pages.

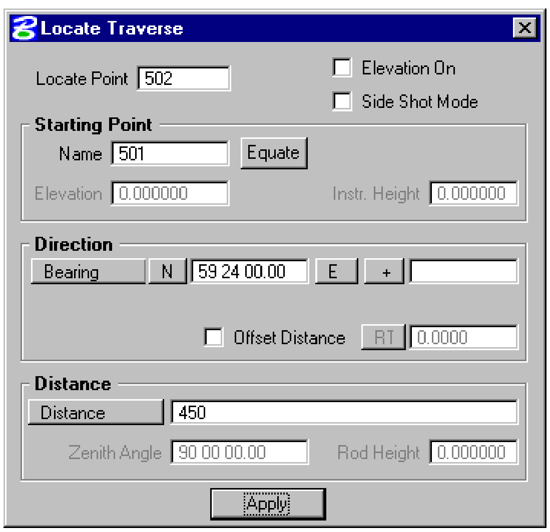


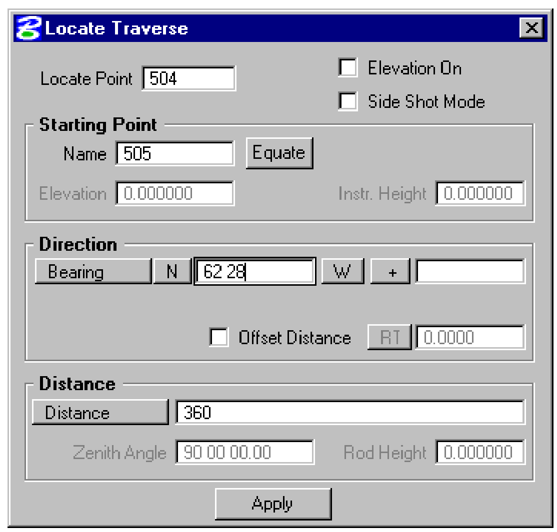
4. Store points 501 and 505 with the coordinates shown.



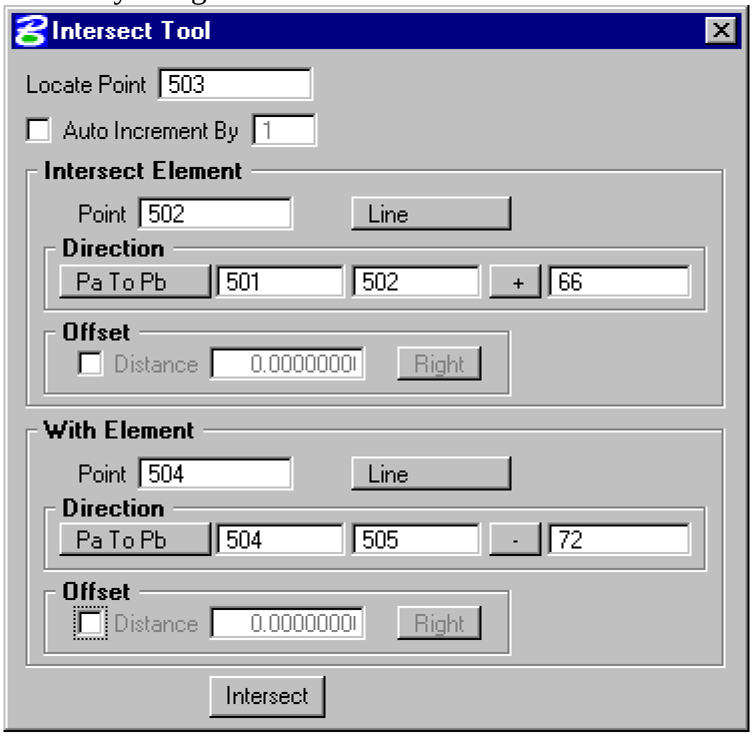




5. Locate points 502 and 504.

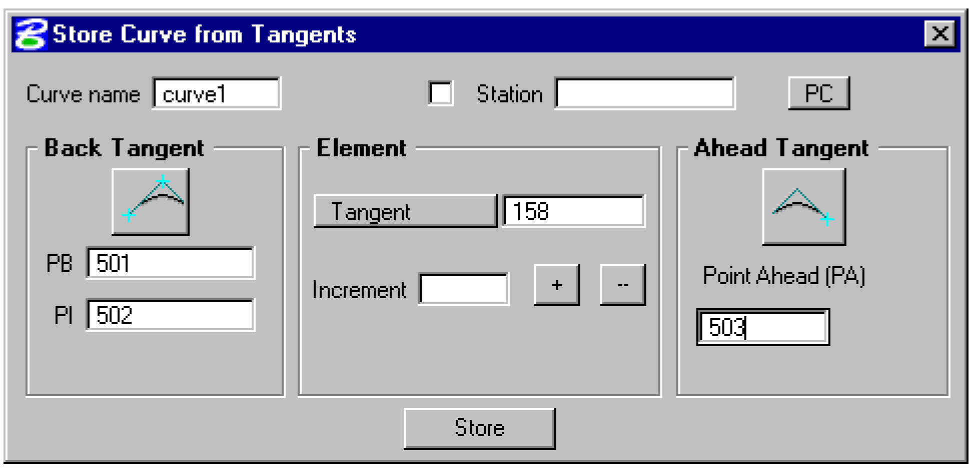


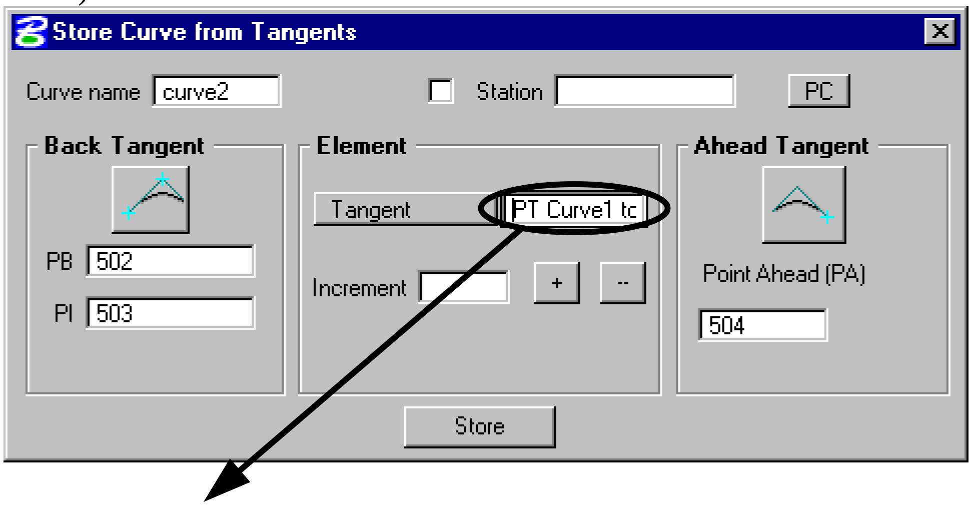
6. Locate point 503 by using the **Intersect** tool.



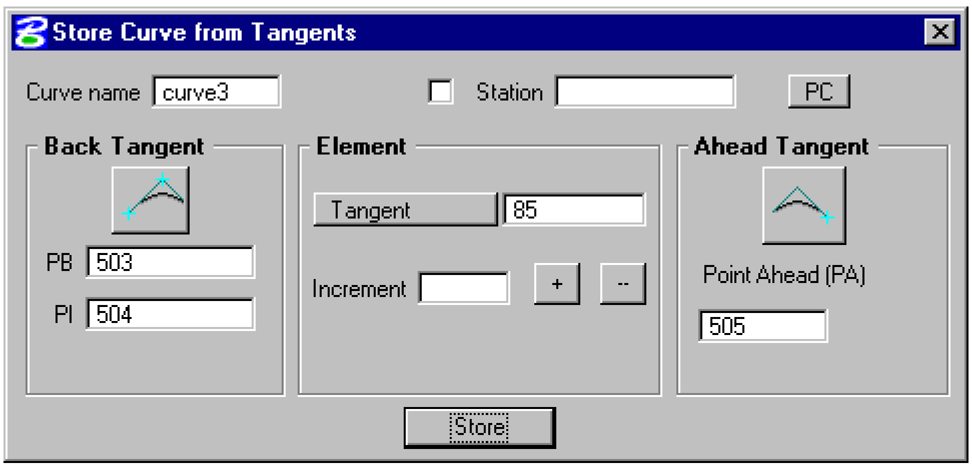

7. Store CURVE1, CURVE2, and CURVE3.



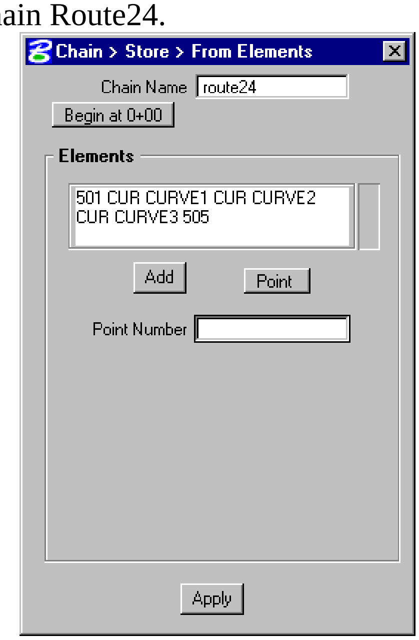
7. (Continued)



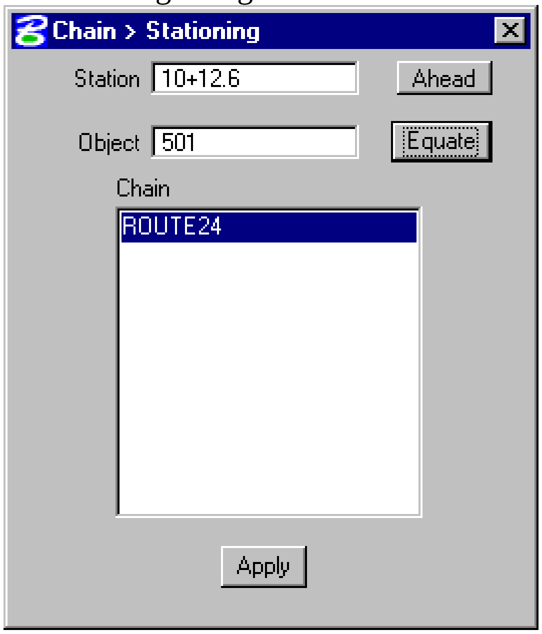

PT Curve1 to 503 m 100




8. Store the alignment chain Route24.



9. Station the centerline at the beginning with station 10+12.6



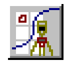

10. Describe the chain and save the output file. Review the output file in **UltraEdit**.

11. Use **COGO Navigator** to view the data.

12. Exit Coordinate Geometry.

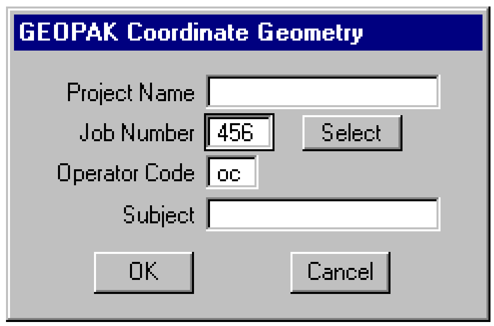
# Exercise 5-2

| | |
|---|---|
| 1. | Open the Microstation file t:\de-proj\exercise_B1\b1.dgn |

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

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

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

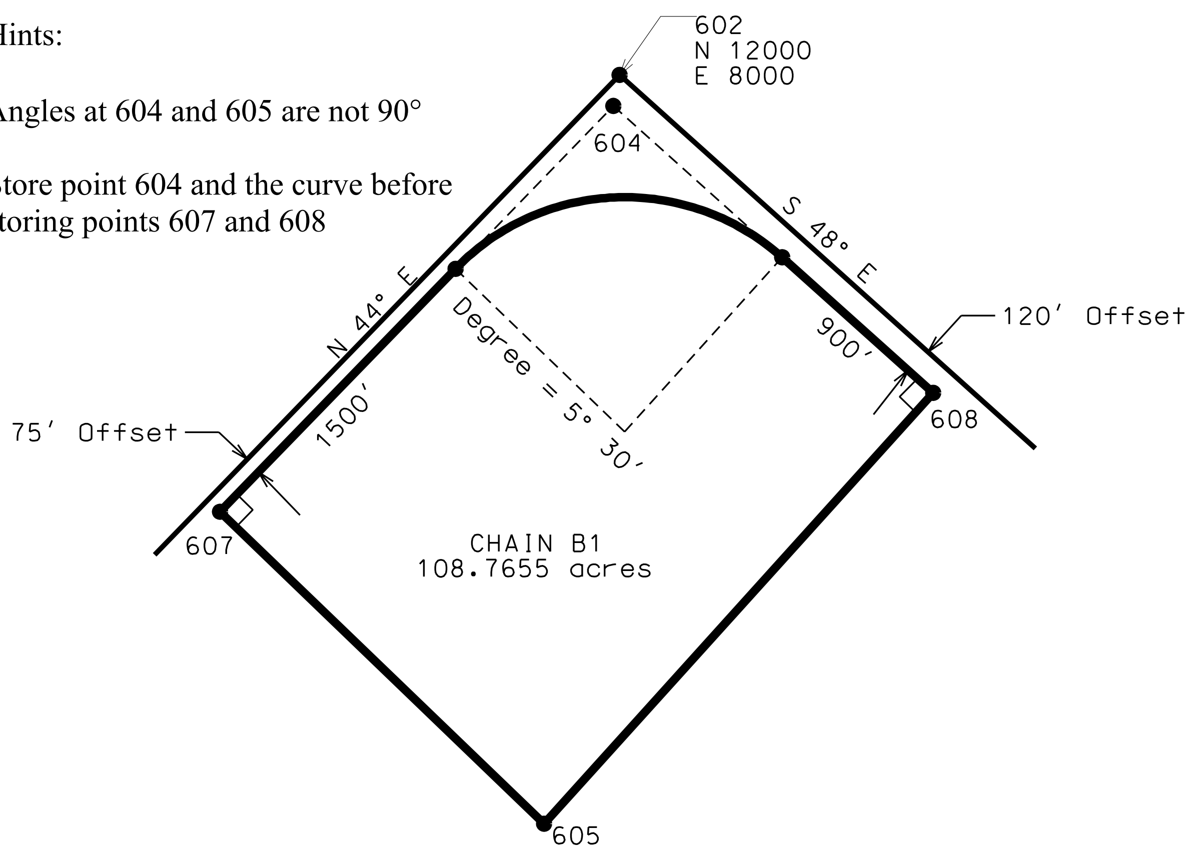



| | |
|---|---|
| 3. | Use the **Coordinate Geometry** tools to create chain B1 as shown below. Verify the area of the chain. |

Hints:

Angles at 604 and 605 are not 90°

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

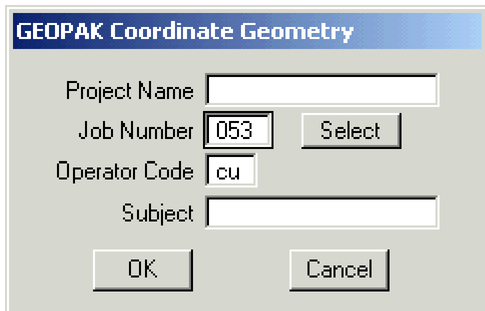


# Exercise 5-3

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

1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\plan_j5p0100.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.

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

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

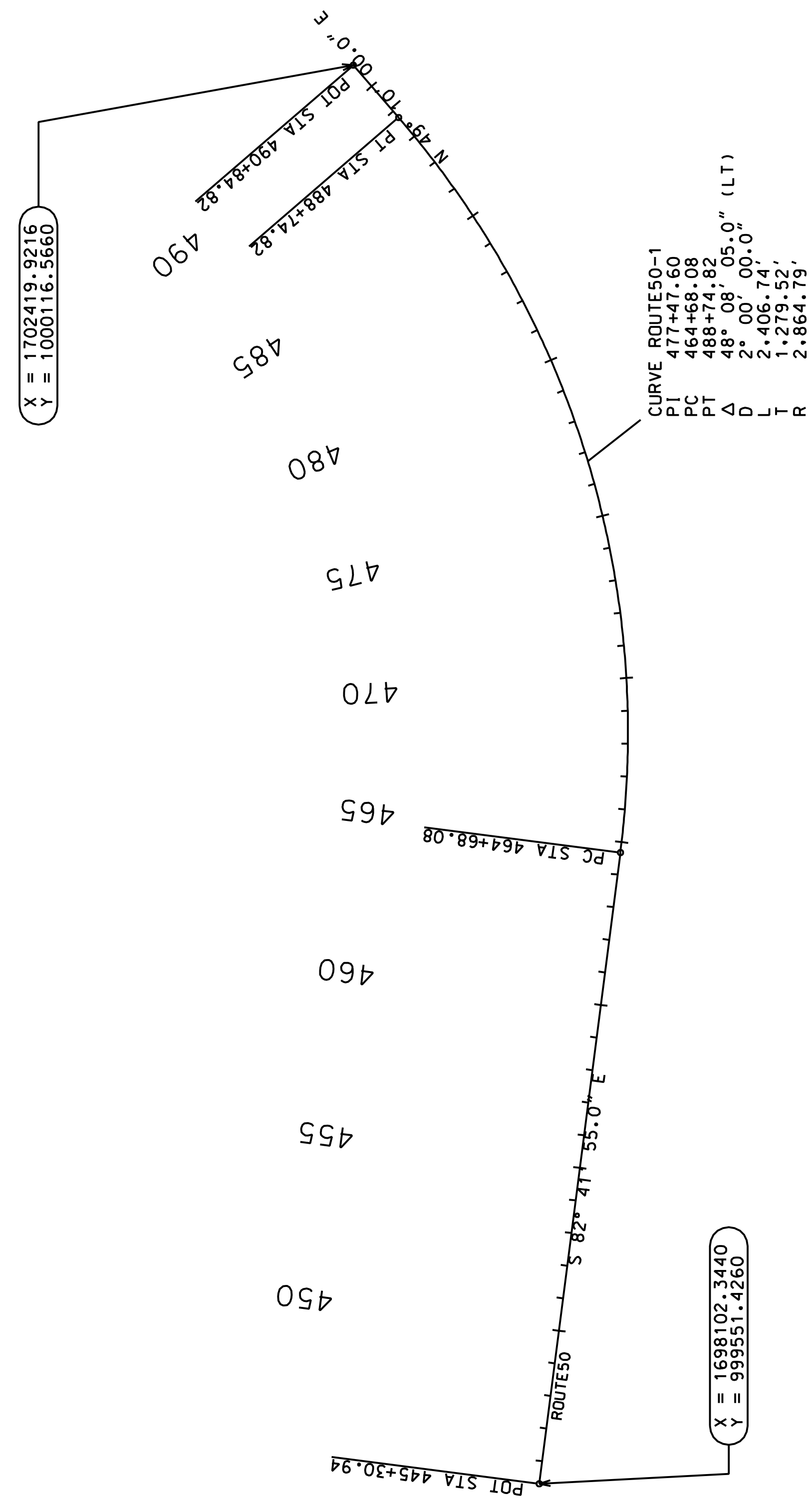
Degree of Curve = 2° 00’ 00”

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”

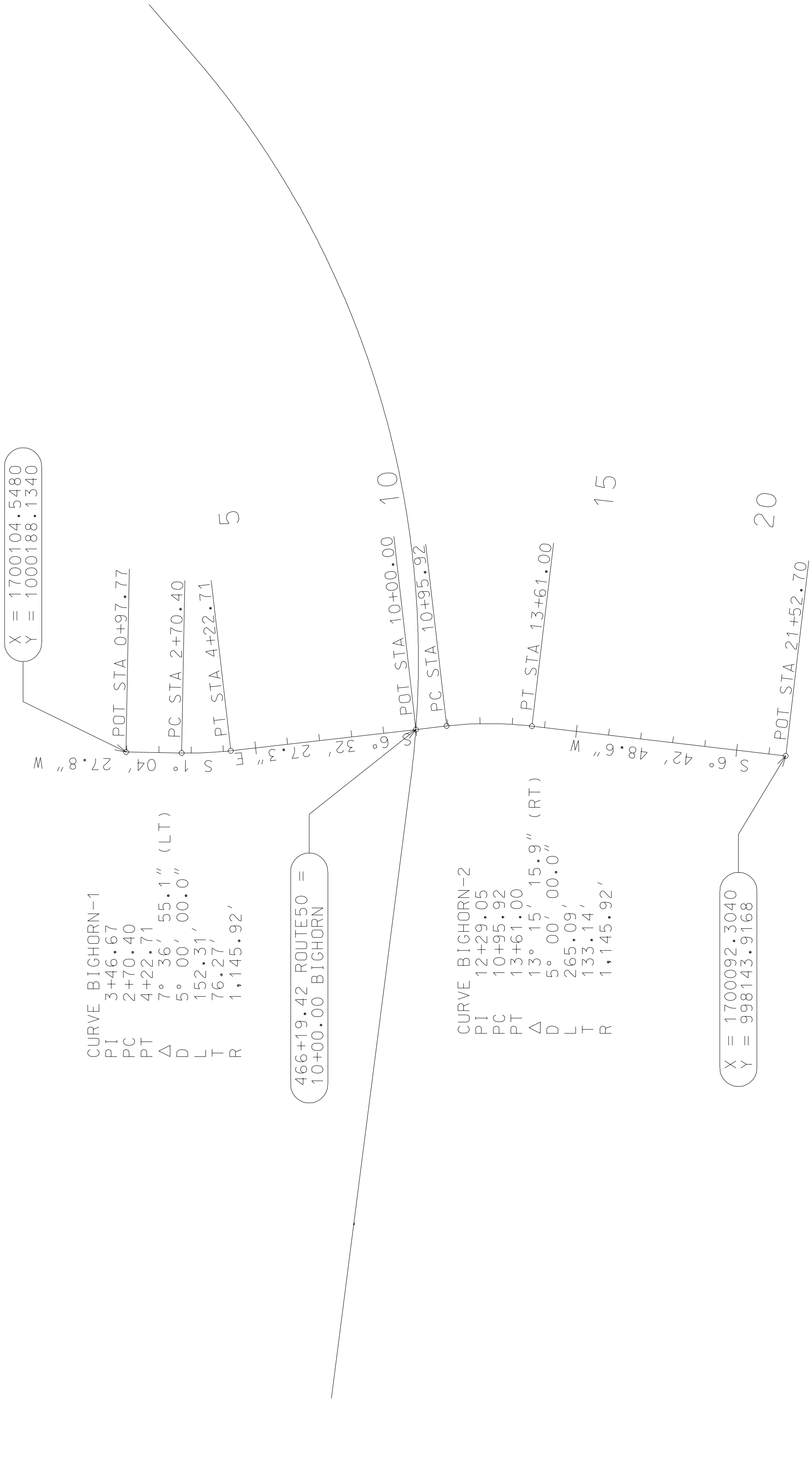
Direction Ahead of second curve = S 6° 42’ 48.6” W

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
S 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.

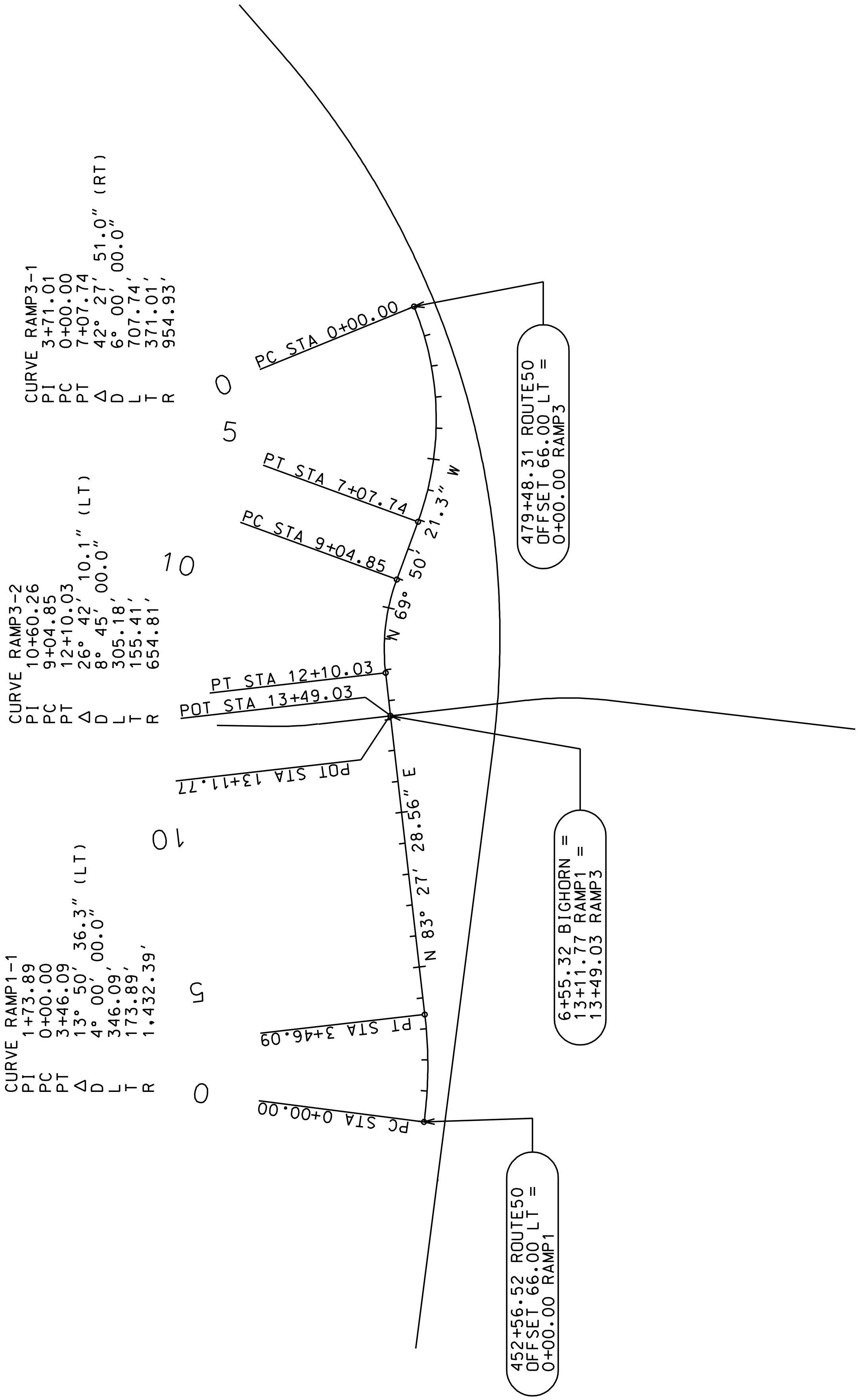
Degree of Curvature for the second curve = 8° 45' 00"

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
N 69° 50′ 21.3″ W
PT STA 12+10.03
POT STA 13+49.03
POT STA 13+11.77
N 83° 27′ 28.56″ E
PT STA 3+46.09
PC STA 0+00.00
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
0
5
10
10
5
0

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

5. Delete all of the graphics in the Microstation drawing by going to **Edit>>Select All**, and then selecting the **Delete** button.

1. In the following alignment description, find 3 reasons why this is a poor alignment.

```
Beginning chain CLASS description
================================================================================
Point 1006    N     999,316.7962  E     1,698,550.3961  Sta     10+00.00

Course from 1006 to PC CLASS-1  N 70^ 06' 55.04" E       Dist 380.0001

                          Curve Data
                          *----------*
Curve CLASS-1
P.I.  Station         22+36.99  N      999,729.7630  E     1,699,716.4028
Delta      =     48^ 20' 00.00" (RT)
Degree     =      3^ 00' 00.00"
Tangent    =          856.9896
Length     =        1,611.1111
Radius     =        1,909.8593
External   =          183.4619
Long Chord =        1,563.7635
Mid. Ord.  =          167.3830
P.C.  Station         13+80.00  N      999,446.0451  E     1,698,907.7401
P.T.  Station         29+91.11  N      999,314.2862  E     1,700,465.9429
C.C.                            N      997,643.8856  E     1,699,540.0247
Back       = N  70^ 40' 00.00" E
Ahead      = S  61^ 00' 00.00" E
Chord Bear = S  85^ 10' 00.00" E

Course from PT CLASS-1 to PC CLASS-2  N 61^ 00' 00.00" W       Dist 27.8502

                          Curve Data
                          *----------*
Curve CLASS-2
P.I.  Station         36+19.82  N      999,036.4852  E     1,700,967.1091
Delta      =     66^ 10' 00.00" (LT)
Degree     =      6^ 12' 44.06"
Tangent    =          600.8607
Length     =        1,065.1017
Radius     =          922.3047
External   =          178.4584
Long Chord =        1,006.8953
Mid. Ord.  =          149.5263
P.C.  Station         30+18.96  N      999,327.7882  E     1,700,441.5845
P.T.  Station         40+84.06  N      999,399.4866  E     1,701,445.9238
C.C.                            N    1,000,134.4541  E     1,700,888.7267
Back       = S  61^ 00' 00.00" E
Ahead      = N  52^ 50' 00.00" E
Chord Bear = N  85^ 55' 00.00" E

Course from PT CLASS-2 to 1007  N 52^ 50' 00.00" E       Dist 629.1392

Point 1007    N     999,779.5720  E     1,701,947.2733  Sta     47+13.20

================================================================================
Ending chain CLASS description
```

2. Coordinate Elements can have up to ____ characters in the name.
   a. 6
   b. 7
   c. 9
   d. 10

3. DB stands for Distance Back
   a. True
   b. False

## Chapter 6

# Graphical COGO

## 6.1 Objectives

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

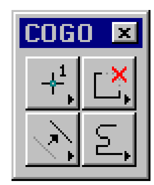
## 6.2 Definitions

Graphical Coordinate Geometry 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.  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 Horizontal and Vertical Geometry toolbox or by selecting **Applications>>Geopak Road>>Geometry>>Graphical Coordinate Geometry**.  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.

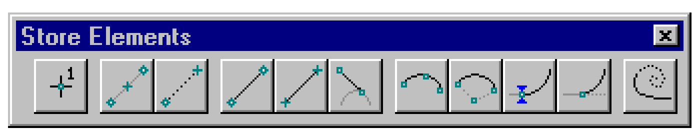
When Graphical COGO is started, the following dialog appears.



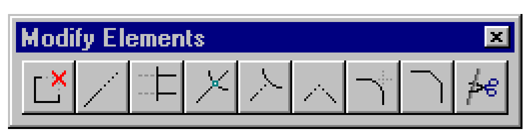

## 6.4 Dialog

The Graphical COGO dialog contains four toolboxes.

### 6.4.1 Store Elements

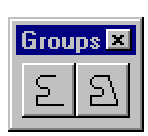



### 6.4.2 Modify Elements

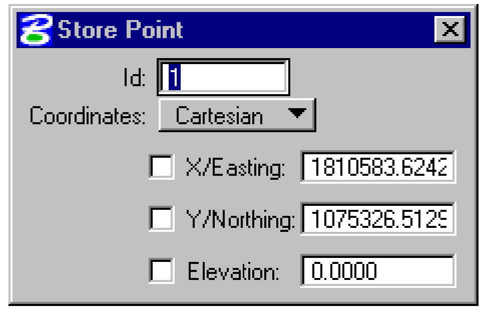



### 6.4.3 Manipulate Elements


### 6.4.4 Groups

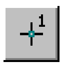


When a tool in one of the toolboxes is selected, a dialog box will appear for the user to key-in any required information.

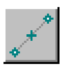



## 6.5 Store Elements Tools

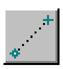
The Store Elements toolbox is used to store points, lines, curves, and spirals. The following tools are contained in the Store Elements toolbox.



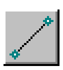
**Store Point** – stores a point. The user can store a point by either Cartesian coordinates (XYZ), or curvilinear coordinates (station and offset). The XY and/or Z coordinates or the station, offset, and/or elevation can be locked or a data point can be used to place the point.



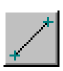
**Store Equally Spaced Points** – stores a given number of points spaced equally between two specified points.



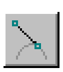
**Locate Point** – stores a point by distance and direction. The distance, direction, offset, and slope can be locked. A line segment can also be stored.



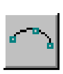
**Store Line** – stores a line segment between two previously stored points.



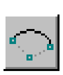
**Store Line by 2 Points** – stores a line segment and its endpoints. The distance and direction of the line segment can be specified.



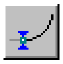
**Store Tangent Line** – stores a line segment that is tangent to a curve. The two endpoints of the line segment are also stored.



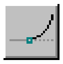
**Store Curve by 3 Points** – stores a circular curve by specifying the beginning and ending points, and a point on the curve.



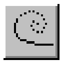
**Store Curve by Center** – stores a curve by specifying the beginning point of the curve, the center of the curve, and the ending point of the curve.



**Store Tangent Curve Constrained –** stores a curve tangent to the specified curve or line.



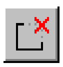
**Store Tangent Curve Unconstrained –** stores a curve through a specified point, and tangent to the specified line or curve.



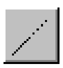
**Stores Tangent Spiral –** stores a spiral tangent to specified line or curve.

## 6.6 Modify Element Tools

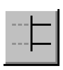
The Modify Elements toolbox is used to modify previously stored cogo elements. The redefine toggle must be turned on to modify existing elements. The following tools are contained in the Modify Elements toolbox.



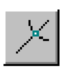
**Partial Delete –** deletes part of an element creating two separate elements. Additional points will be stored if needed.



**Extend Plan View Element –** extends or shortens any cogo element.

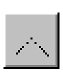


**Trim Elements –** trims or extends elements to intersect with another element.

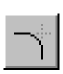


**Intersect Elements –** stores a new point at the intersection of two elements. The original elements are not modified.

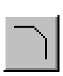
**Extend Element to Intersection –** lengthen or shorten an element to another element. Works functionally the same as its Microstation counterpart.



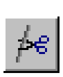
**Extend Elements to Intersection –** lengthens or shortens two elements to intersect each other. Works functionally the same as its Microstation counterpart.



**Construct Circular Fillet –** stores a circular curve between two elements. Works functionally the same as its Microstation counterpart.



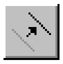
**Construct Chamfer –** stores a line and its endpoints between two elements. Works functionally the same as its Microstation counterpart.



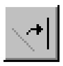
**Cut Element –** cuts an element into segments.

## 6.7 Manipulate Elements

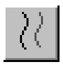
The Manipulate Elements tools allow the user to adjust previously created elements. If an element is moved, the redefine toggle must be turned on. The following tools are in the Manipulate Elements toolbox.



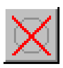
**Move Plan View Element** – moves or copies an element.



**Rotate Plan View Element –** rotates the element about a specified point.



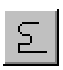
**Copy Parallel –** moves or copies an element parallel to the original element.



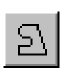
**Delete Element** – deletes an element from a .gpk file. **Warning**: There is no undo for this command.

## 6.8 Groups

The Groups tools allow the user to create a chain or parcel. The following tools are contained in the Groups toolbox.



**Store Chain** – stores a chain from previously stored elements. The user selects the first element, then data points to accept the each element. When all elements are selected, the user is prompted to data point for the direction of the stationing.



**Store Parcel –** stores a parcel, takings, or easements from previously stored elements. The user can either automatically select the elements as with Store Chain, or manually select the elements. 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 Alignments

## 7.1 Objectives

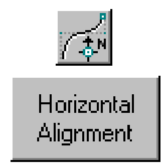
- Create and store horizontal chains using graphical tools.

## 7.2 Definitions

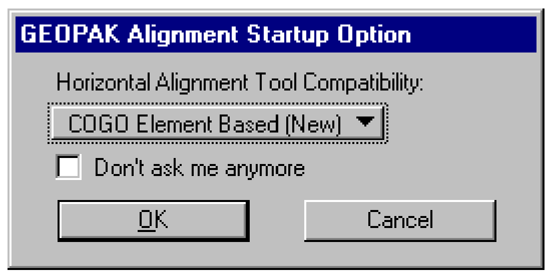
The **Horizontal Alignment** tools enable the user to create or modify horizontal geometry elements. Spirals, curves, tapers, and ramps can all be placed according to user-defined parameters.

## 7.3 Accessing

The **Horizontal Alignment** tools can be accessed from the menu **Applications>>Geopak Road>>Geometry>>Layout Alignments Horizontal**, from the **Horizontal Alignment** icon, or from the **Horizontal Alignment** button on **Project Manager**.




When the **Horizontal Alignment** tools are started for the first time, the dialog shown to the right will appear. The user has the option to select the **COGO Element Based (New)**, or the **Graphic Element Based Horizontal Alignment** tools.



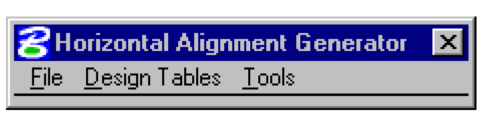

The **COGO Element Based** tools write the created elements directly into the coordinate geometry database (.gpk) as cogo elements. For this option, a Geopak COGO session must be active.

The **Graphical Element Based** option first creates Microstation graphical elements in the .dgn file. The user then has to store these elements as a COGO element in the coordinate geometry database (.gpk).

If the Don't ask me anymore toggle is set, the user will not see this dialog when going into the **Horizontal Alignment** tools.

** Note: It is recommended to use the **COGO Element Based Horizontal Alignment** tools. The **COGO Element Based Horizontal Alignment** tools will allow the user to better achieve an efficient, accurate design. Only the **COGO Element Based Horizontal Alignment** tools will be discussed in this class.

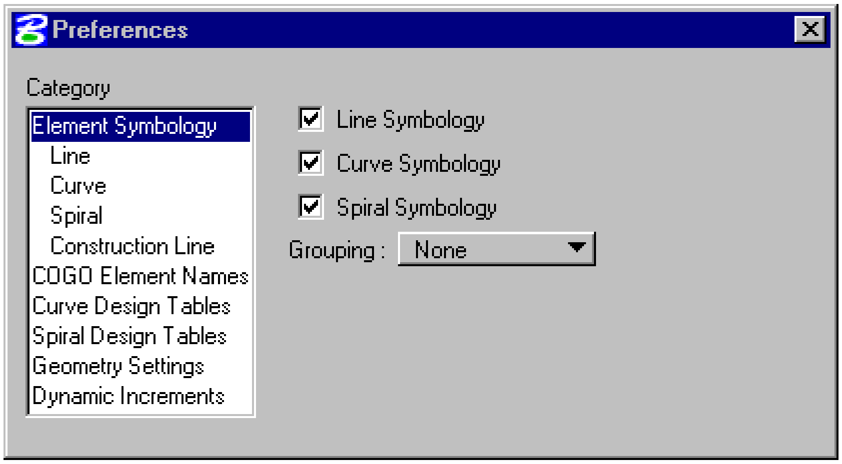
When the **COGO Element Based Horizontal Alignment** tools are chosen, the following dialog will open.



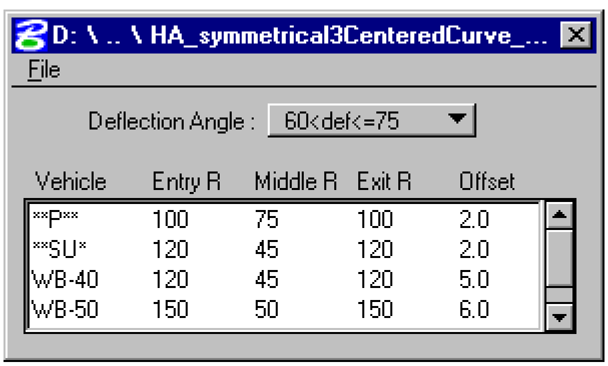
## 7.4 Dialog

The **Horizontal Alignment Generator** dialog has three menus, **File**, **Design Tables**, and **Tools**.

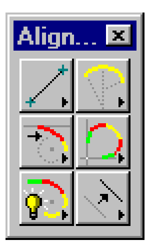
The **File** menu opens the following dialog which allows the user to change various preferences such as element symbology, beginning element names, curve vehicle tables, curve definition and dynamic increments.



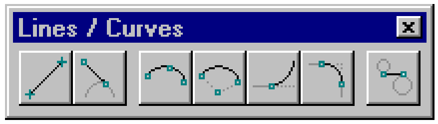

**Design Tables** allows the user to set up Design Tables for Symmetrical 3 Centered Curves, Asymmetrical 3 Centered Curves, Taper Curves, and Spiral Curves. Entry, middle, and exit radiuses can be set up for various vehicle types and deflection angles.



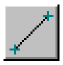

The **Tools** menu allows access to the Main tool dialog, or to any of the tool boxes to store a Horizontal Alignment.

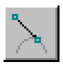


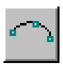
## 7.5 Lines/Curves Tools

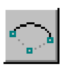


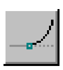

The **Line/Curves** tools allow the user to place line and curve elements by various methods. The **Line/Curves** toolbox contains the following tools.

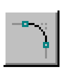
 **Store Line By 2 Points –** stores a line and its endpoints.

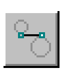
 **Store Tangent Line** – stores a line tangent to a curve and the endpoints of a line.

 **Store Curve By 3 Points –** stores a circular curve by selecting the beginning and ending points of the curve, and a point on the curve.

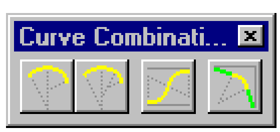
 **Store Curve By Center** – stores a circular curve by defining the center point, radius, and sweep angle.

 **Store Tangent Curve Unconstrained –** places a curve tangent to a line or curve, and through a specified point.

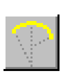
 **Place Curve Between Two Elements –** places a circular curve between two elements.

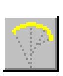
 **Place Simple Transition** – draws a tangent, curve, or spiral between two arcs.

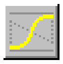
## 7.6 Curve Combination Tools

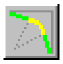



The **Curve Combination Tools** allows the user to place compound curves, three centered curves, reverse curves, and tapered curves.

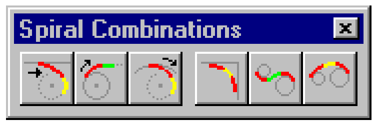
 **Place Compound Curves** – places a compound curve between two elements.

 **Place Three Centered Curves** – stores a three-centered curve between two elements. Design vehicle parameters from File>>Preferences can be utilized.

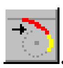
 **Place Reverse Curves** – stores reverse curves between two elements. A short tangent section between the curves can also be specified.

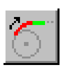
 **Place Taper Curves** – places a curve and tapers between two elements. The design vehicle parameters from File>>Preferences can be utilized.

## 7.7 Spiral Combinations

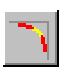


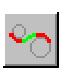

The **Spiral Combinations** tools allow the user to place spirals with curves, tangents, and other spirals.

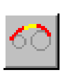
....**Place SC Tangent To Line** – stores a spiral curve combination tangent to a specified line.

 **Place ST Tangent To Curve** - stores a spiral tangent combination tangent to a curve.

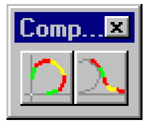
 **Place SC Tangent To Curve** – stores a compound spiral curve combination tangent to a curve. The spiral will be placed between the curves.

 **Place SCS (Intersecting Elements)** – stores a spiral curve combination tangent to a line.

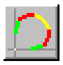
 **Place STS (Disjoint Curves)** – stores a spiral tangent spiral combination between two curves.

 **Place SCS (Disjoint Curves)** – stores a spiral curve spiral combination between two curves.

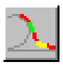
## 7.8 Complex Transitions




The **Complex Transitions** tools allow the user to place complex ramp designs.



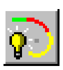
**Place Complex Ramp** – places simple to complex ramp geometry.



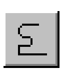
**Place Ramp Connector** – places simple to complex ramp connector.

## 7.9 Alignment Tools


The **Alignment Tools** allows the user to either store an alignment from existing COGO elements or to dynamically place an alignment.

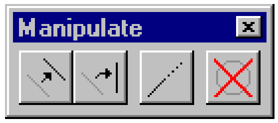


**Place Dynamic Element** – places an alignment dynamically. The user needs to select a starting element and then specify the length of curves and length of tangents to create the alignment. The degree of curvature can be changed, and spirals can be added as the user moves along the alignment.

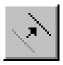


**Store Chain** – stores an alignment by selecting graphical elements. This tool works similar to the Microstation Automatic Create Complex Chain tool.

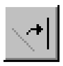
## 7.10 Manipulate Tools



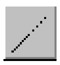

The **Manipulate** tools allow the user to move/copy, rotate, extend, and delete elements.



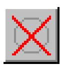
**Move Plan View Element** - moves or copies an element.



**Rotate Plan View Element** - rotates the element about a specified point.



**Extend Plan View Element** – extends or shortens any cogo element.



**Delete Element** – deletes an element from the coordinate geometry database (.gpk).

## Chapter 8

# Design and Computation Manager

## 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 three overall categories – **Pay Items**/, **Drafting Standards**/, and **Design Standards/**. These three categories each contain sub-categories. The sub-categories break down each classification into more specific sections. (See dialog box next page).

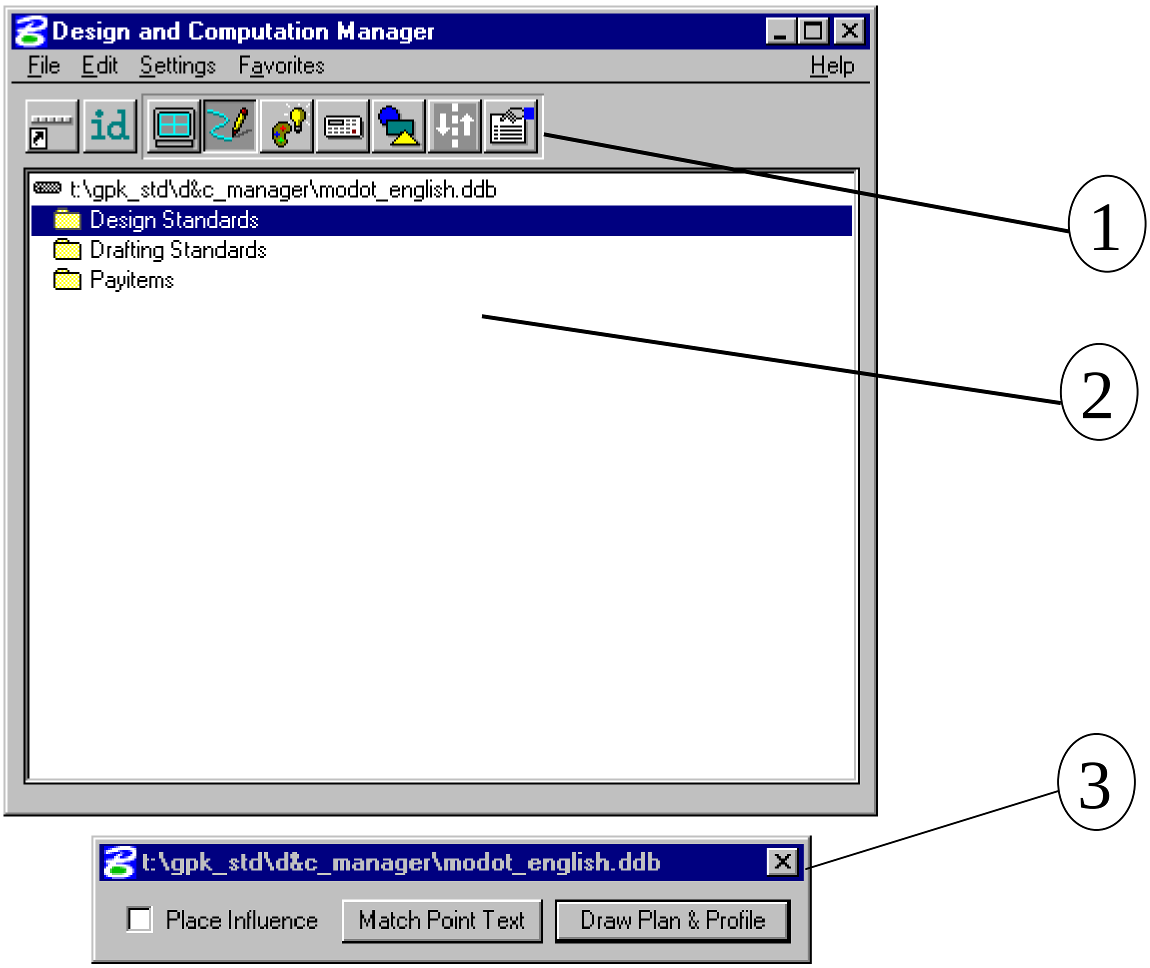
For example, **Pay Items**/ is broken into several additional categories like **Pipes/** and **Lighting and Signals/**. **Pipes/** is broken into many different categories representing various types of pipes and pipe features that may be used in the design of your project like **Flared End Sections/**.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

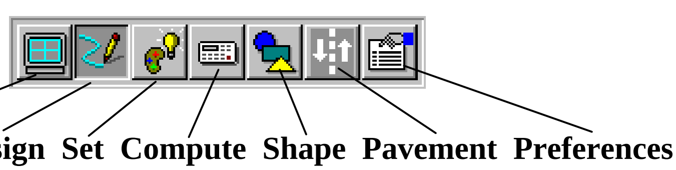
**Design and Computation Manager** can be accessed from **Project Manager >> Plan View Quantities** or from the **Design and Computation Manager** icon.

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**

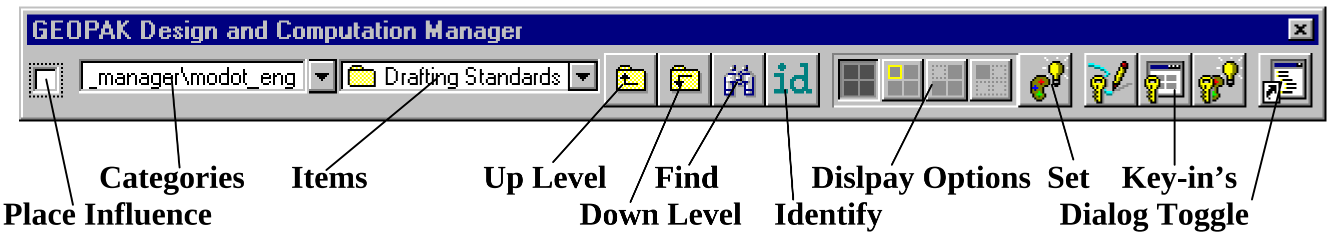


2) The **Content box** lists the sub-categories or items available at your current position within the database structure.

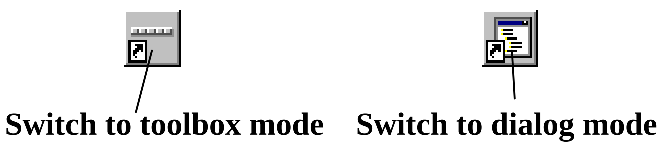
3) The **Operations box** will appear differently depending on the set mode of operation.

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.

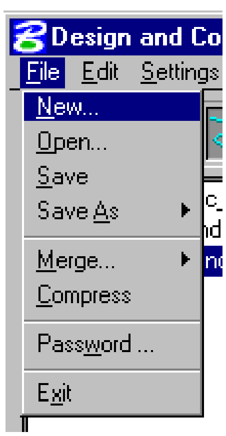
The toolbox mode as shown below, allows the D&C Manager dialog to be docked on the Microstation toolbars. With this format, the user accesses items from the pull-down menus, and can toggle the various tools from the tool bar.




The dialog box can be toggled using the appropriate icons.

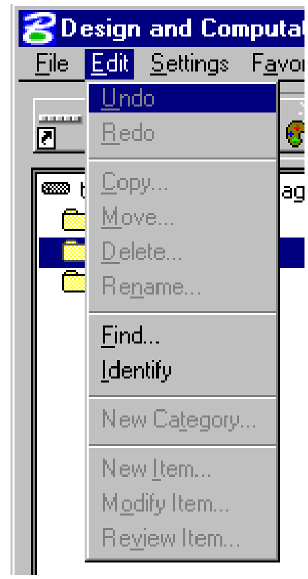



## 8.4.1 File Commands



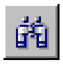

For a MoDOT Geopak user, the only file command options needed are **Open** and **Exit**.

**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.



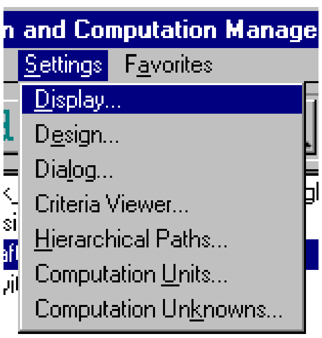

## 8.4.2 Edit Commands

**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.

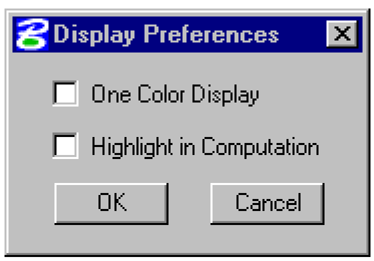


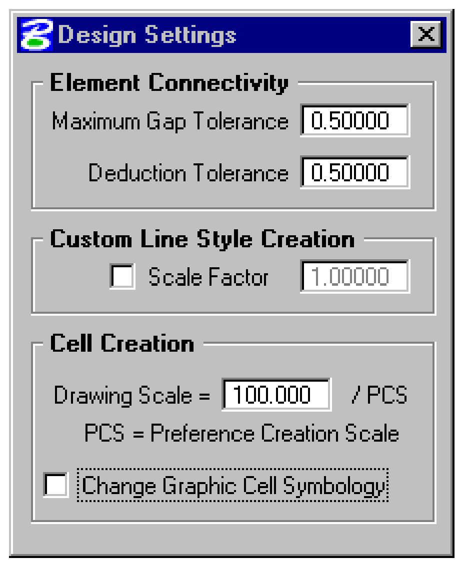
**Identify –** will show the item name and description attached to an element in the design file.


## 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

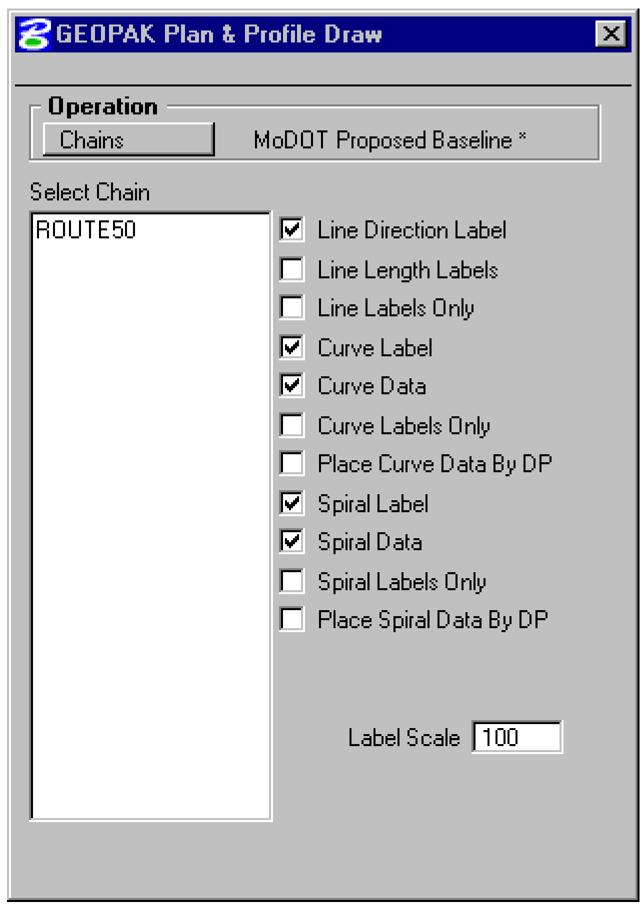
## 8.5.1 Design


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**.

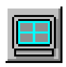
The points and lines dialog boxes have a key-in field that allows the user to specify the names of the COGO elements to be drawn. To use the line operation, the user must use point numbers to specify the ends of the line. The points/lines are drawn immediately after you enter their respective names and 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.

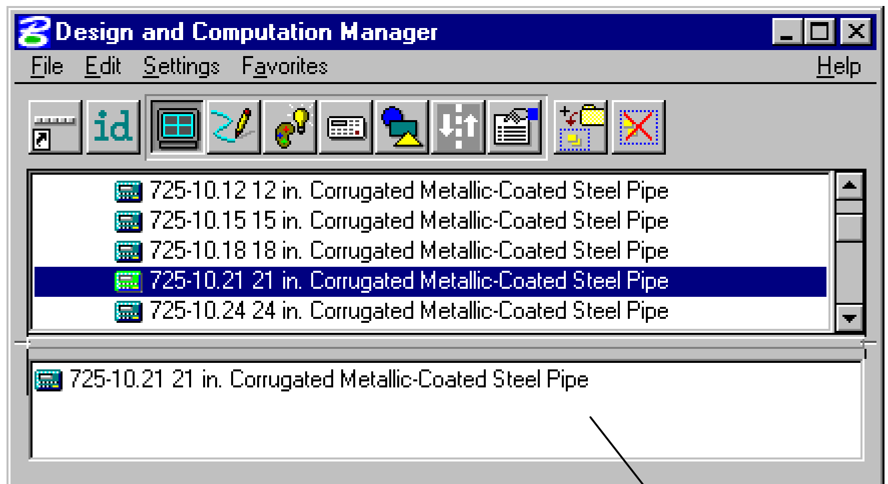
The dialog boxes for curves, spirals, chains, stationing, parcels, and profiles have a list box that display the names of all stored curves and chains. Highlighting one of the available elements causes it to be drawn into the file. Each type of item has a list of options that can be plotted.

**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

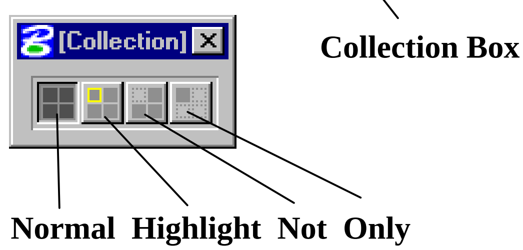





**Display** mode is used to enhance on screen visualization.

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.

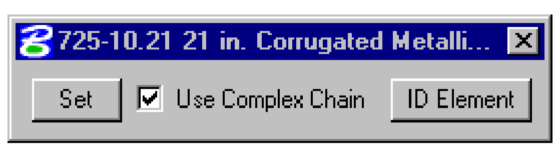
**Highlight -** will change those items stored in the collection area to the Microstation highlight color.




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

**Only -** will turn off everything but the collection items.

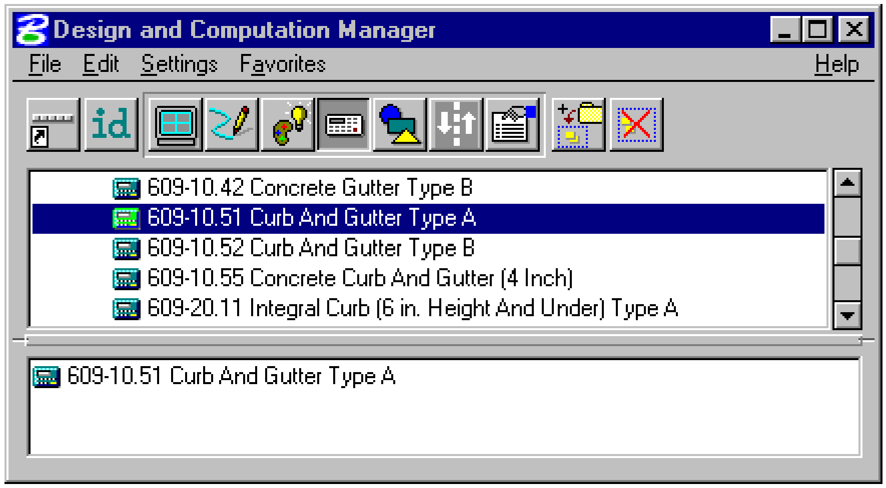
### 8.5.3 Set



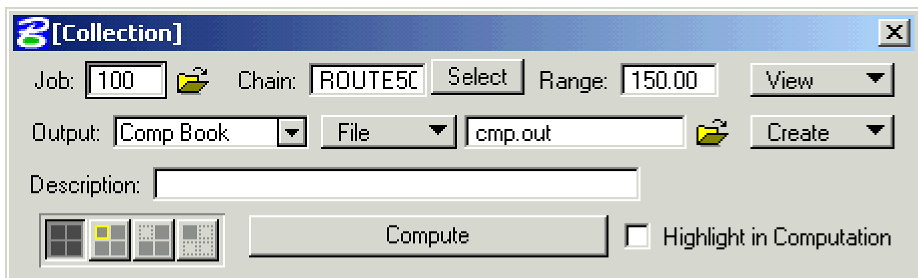

The **Set** mode allows you to assign attributes from the D&C Manager database to existing graphical elements in the file. The **Complex Chain** option automatically creates a chain from graphic elements and applies the attributes of the highlighted item in the content box. With the Complex Chain option is 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. This allows you to affect multiple elements with one Set command. **ID Element** is used to specify the complex chain to be changed. **Set** activates the command and changes the element attribute.

### 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.




Chosen items within either the **View** or a **Fence** are calculated, which is set in the upper right hand corner of the dialog. The other fields in the top row are discussed later.




There are six **Output** options:

**Comp Book** - calculates station/offset and coordinates for items defined in the Collection box within a **Range** left and right of a selected **Chain** in the specified **Job** as set by the first three fields in the top row of the dialog. The  icon can be used to select the job. The output file is ASCII format.

**Item Report** – a total quantity for each item is calculated. For this option, the job, chain, and range fields are inactive. The output file is ASCII format.

**Item Tables –** 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.

**SDF Item Report –** is similar to Item Report, except that the output file is in SDF (standard database format) or CSV (comma separated value) format.

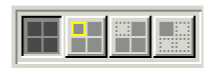
**SDF Comp Book –** produces a more detailed report that lists not only quantity summaries, but also geometric properties such as plan view coordinates and station/offsets for located elements. Format is in SDF or CSV format.

**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.

To the right of the Output field is the **Preview/File** option. If preview is chosen, a file is not created and the output is displayed in a GEOPAK window. If set to File, GEOPAK creates the file whose file format is based on the Output type and whose name is defined in the key-in field to the right of the File option. The name can be manually entered or selected via the Files (folder) icon. The user can either **Create** a new file or **Append** the output to an existing file by using the option button at the end of the second row. If desired, a full path may be specified, otherwise, the report will be found in the current directory. The  icon can be used to select an existing file.

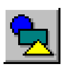
Any information keyed into the **Description**: field will be printed at the top of the report. There is a maximum of 48 characters supported for this field.

The four display options described in section 8.5.2 can be utilized using the buttons shown to the right.



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

**Compute** commences the computation process.

## 8.5.5 Shape 

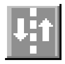
**Shape** mode provides tools for creating shapes to be used for area calculations such as pavement.

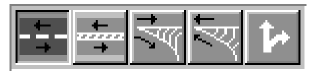

Three options are available for choosing the elements to create the shape.

**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.

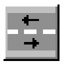
**Automatic –** creates the smallest shape possible. The user selects a data point inside the shape they are trying to create. GEOPAK then moves up until it intersects an element, then traces around intersecting elements to create the shape.

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

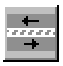
### 8.5.6 Pavement 



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.

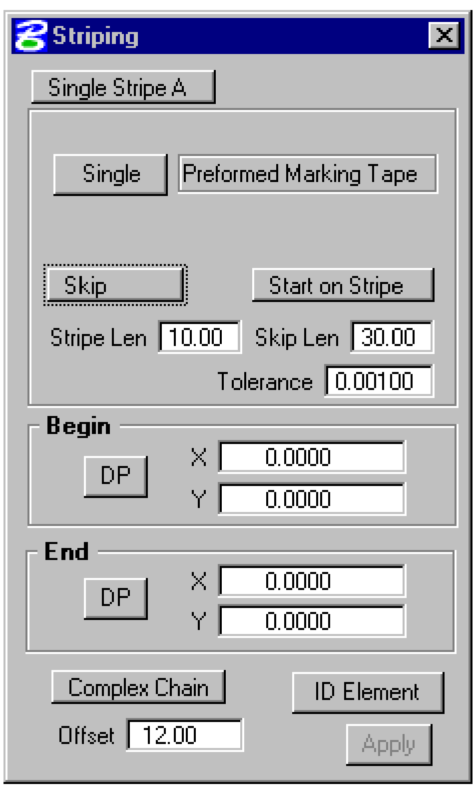
**Chevron Diverge –** allows the user to place pavement chevrons in areas of diverging traffic.

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

**Symbols –** allows the user to place pavement marking symbols with a specified pattern.

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.

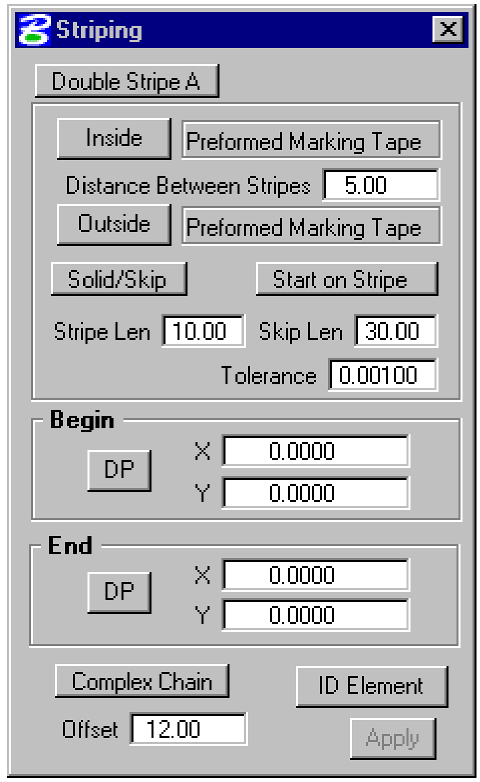
The pay item box will reflect the currently selected pay item in the **D&C Manager** dialog box; the user may change this at any time during the process.

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.

A beginning and ending point for the limits of striping are entered from digitized points on the screen.

The lower portion of the dialog box provides tools for identifying the reference element on which the striping will be based.

After clicking **Apply**, 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.*

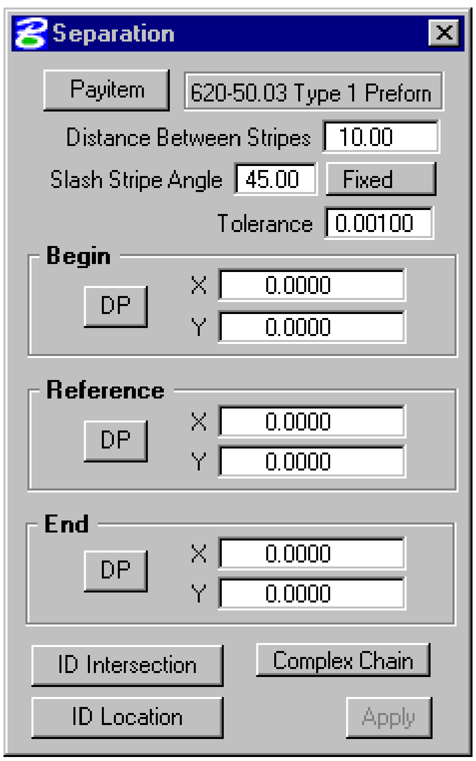



### 8.5.6.2 DOUBLE STRIPING

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.

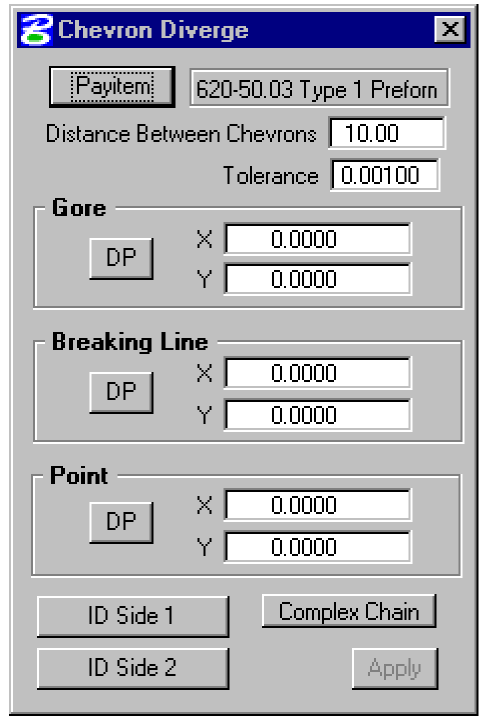
Once a pay item has been selected, the user may set the **Distance Between Stripes** and the **Slash Stripe Angle**. Tolerance functions the same as for striping.

A **Begin DP** and **End DP** should be issued before the **Reference DP** is identified. The Reference DP must fall between the **Begin DP** and **End DP**. 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. **ID Intersection** identifies the elements where the striping will terminate. **ID Location** is the set of elements from which the striping begins.

After the **Apply** 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, Breaking Line** and **Point.**

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

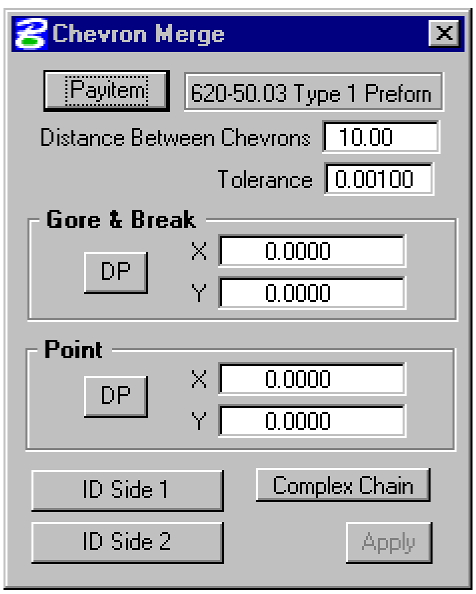
The **Breaking Line** point must fall between the two sides of the gore and sets the location of the point at which the chevron diverts in a different direction.

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

Use the two **ID** buttons to identify the sides of the gore.

Once the **Apply** 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 and Breaking Line, have been combined into one point that serves both functions.

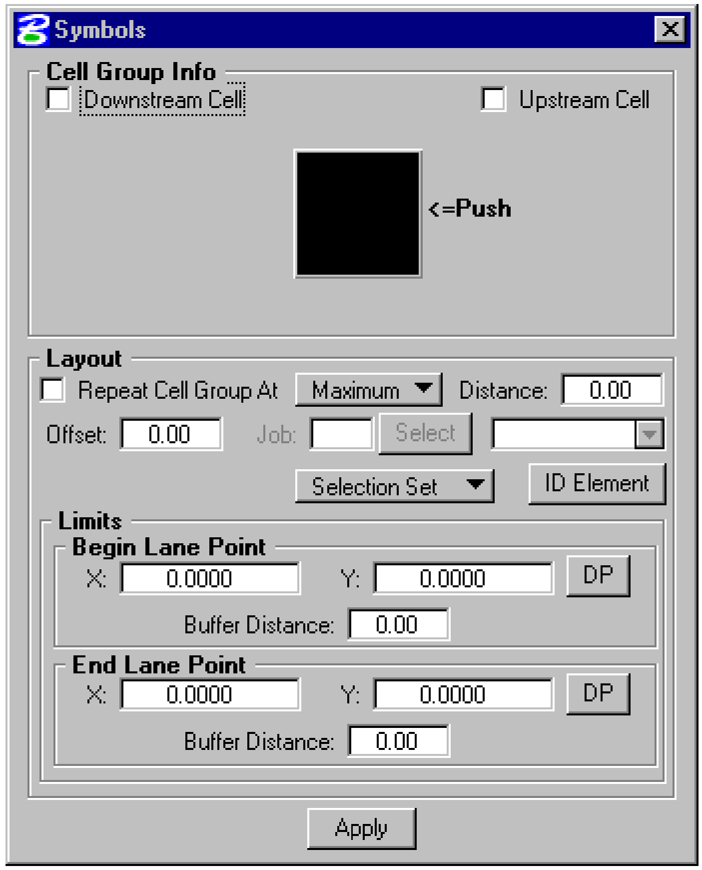
The **Gore and Break DP** should be located near the wide end of the chevron. It simultaneously sets the beginning of the pavement markings and the point at which the chevron will break.

The remainder of the process is as described above.

#### 8.5.6.6 SYMBOLS

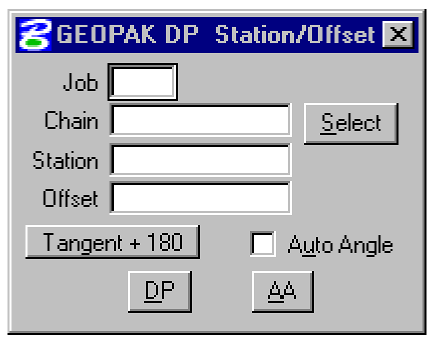
**Cell Group Info** defines the cells to be placed.

**Layout** allows the user to repeat the cells, and to set the locations of where the cells are placed.

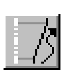



## 8.6 DP Station/Offset

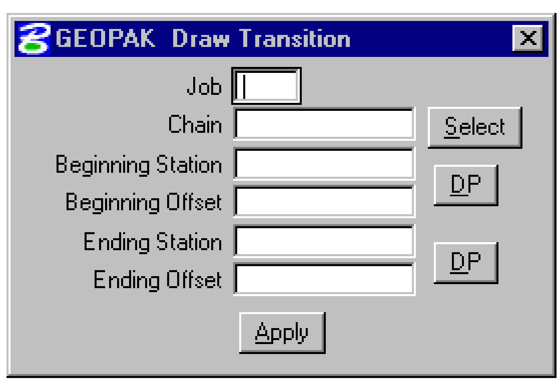
The **DP Station/Offset** command works in conjunction with Microstation commands and the D&C Manager. It can be used as the *data point* for any Microstation command. **DP Station/Offset** provides precision placement of elements based on a station and offset of a stored chain. Uses for this command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

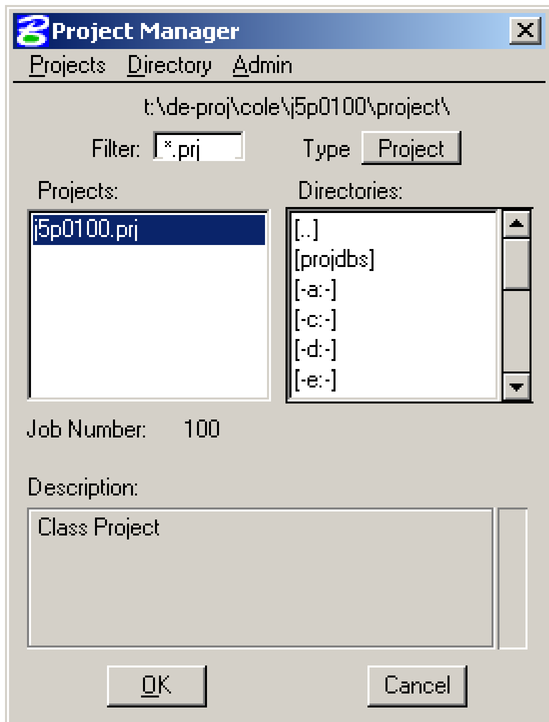


# Exercise 8-1

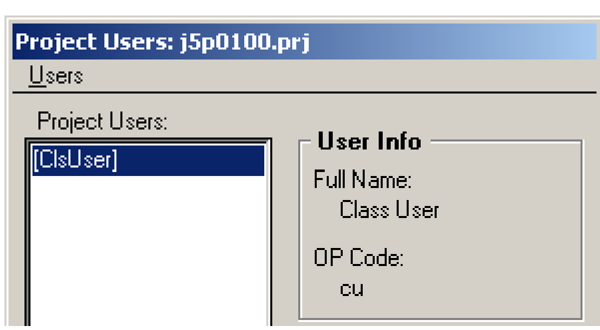
This exercise uses the GEOPAK Design and Computation Manager to plot the plan view items needed for the alignments of Route 50 (Chain ROUTE50) and Big Horn Dr. (Chain BIGHORN). Some of the items are needed for the plan sheets, while other items are needed only to process the proposed cross sections. Items needed for the plan sheets are plotted in the plan.dgn while those items not shown on the plan sheets are plotted in the patterern_shape.dgn. Different files are used for each alignment to get the geometry separate for the proposed cross section runs
.

1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\plan_j5p0100.dgn**. **Save** the file as **t:\de-proj\cole\j5p0100\data\rte50_plan_j5p0100.dgn**.

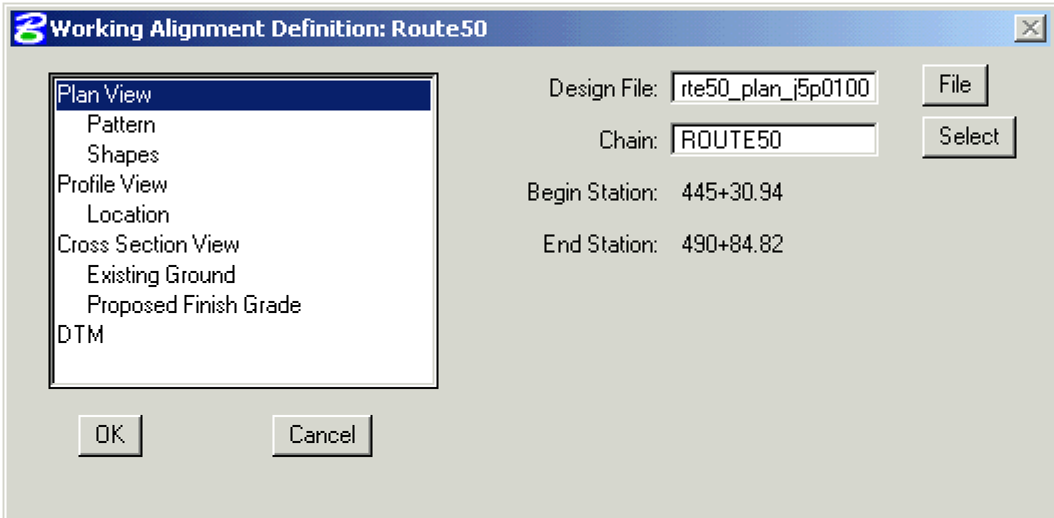
2. Open the GEOPAK project **t:\de-proj\cole\j5p0100\project\j5p0100.prj** using Job **100**.




Enter the project as **ClsUser**. Go into **Road**.



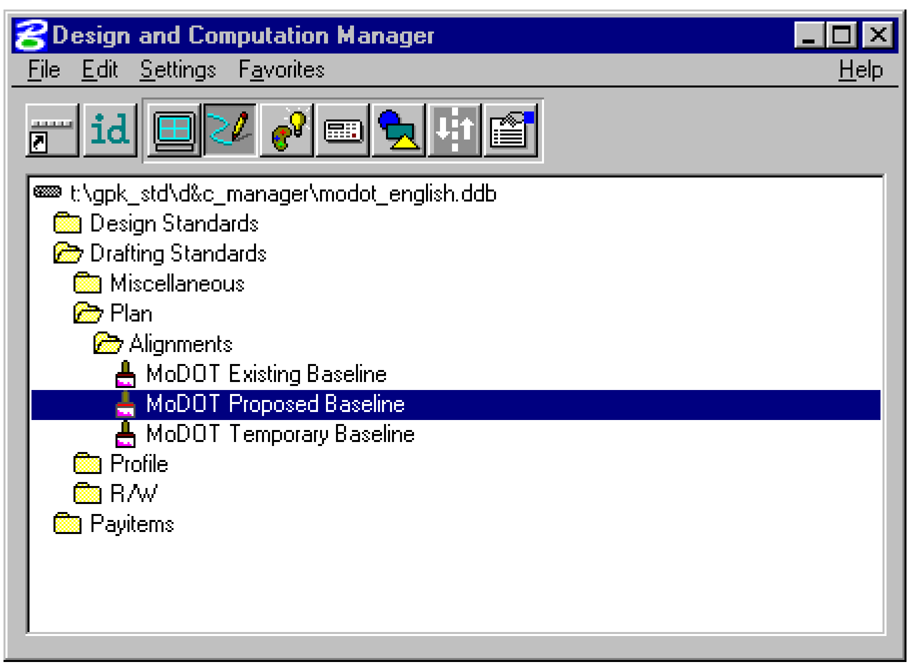

3. In the **Plan View** section of the Route50 **Working Alignment** (**Define** button) set the **Design File** to **rte50_plan_j5p0100.dgn**, and the **Chain** to **Route50**.




4. The first step is to plat the alignment. Open the **Design and Computation Manager** dialog.

   Select the item **English/Drafting Standards/Plan/Alignments/MoDOT Proposed Baseline**

   Select the **Draw Plan & Profile** button



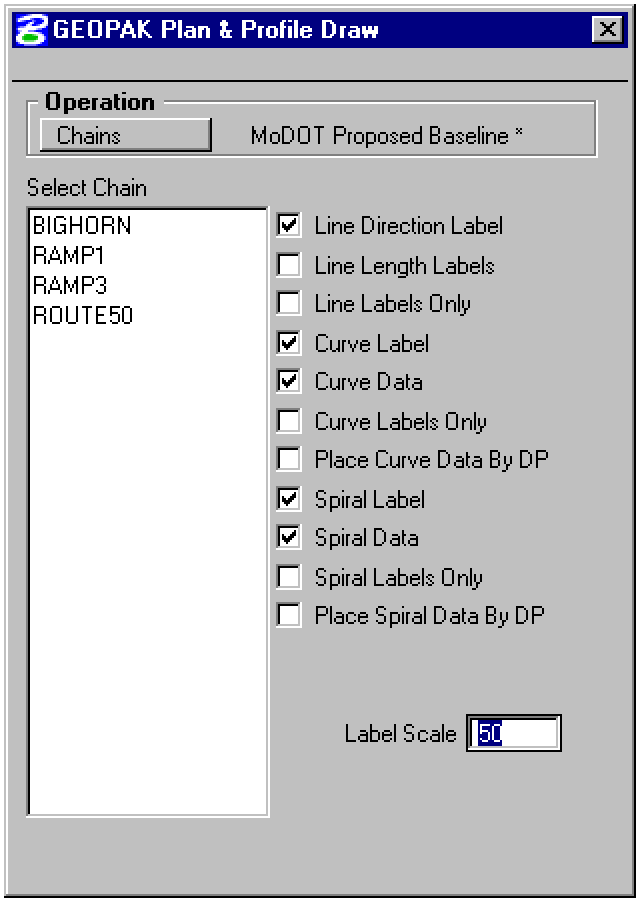

5. Select the **Chain** Operation.

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

   Turn on the following options:

   **Line Direction**
   **Curve Label**
   **Curve Data**
   **Spiral Label**
   **Spiral Data**

   Select the Chain **Route50**



6. Select the **Stationing** Operation.

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

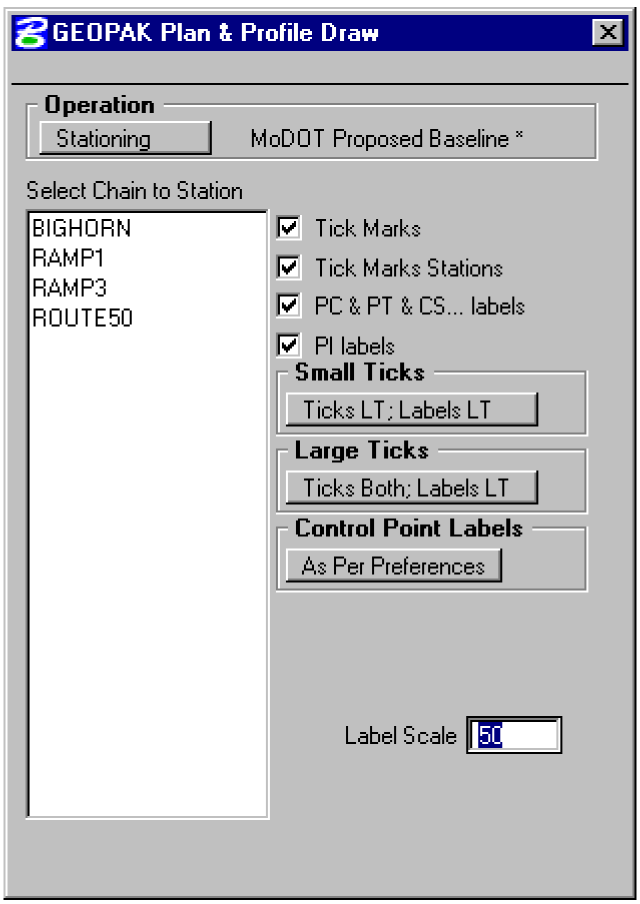
   Turn on the following options:

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

   Set the following options:

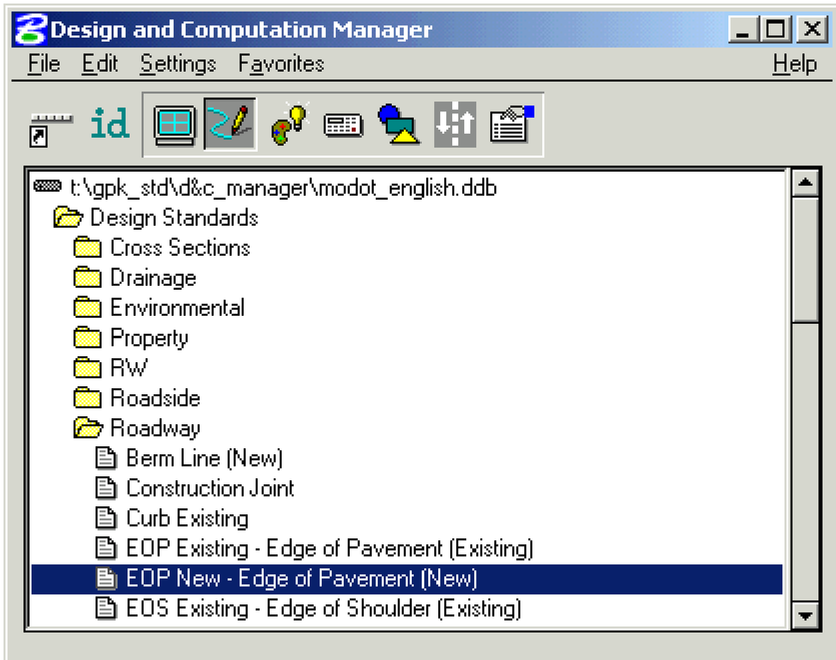
   Small Ticks: **Ticks LT, Labels LT**
   Large Ticks: **Ticks Both, Labels LT**
   Control Point Labels: **As Per Preferences**

   Select the chain **Route50**.



7. Use the **Draw Transition** tool to create the edges of pavement for **Route 50** with the following parameters.

   Use the **Design and Computation Manager** item:
   **Design Standards\Roadway\EOP New – Edge of Pavement (New)**.



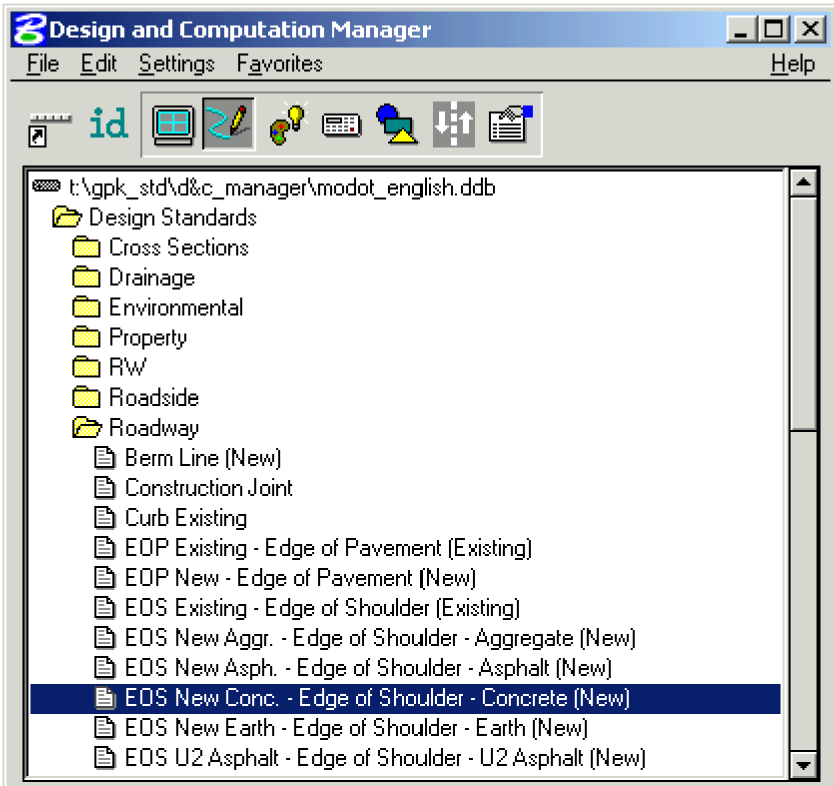

   Be sure that **Place Influence** is turned on.


   Use the following settings in the Draw Transition Tool:

| 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 |

8. Use the **Draw Transition** tool to create the edges of shoulder for **Route 50** with the following parameters.

Use the **Design and Computation Manager** item:
**Design Standards\Roadway\EOS New Conc. – Edge of Shoulder - Concrete (New)**.




Be sure that **Place Influence** is turned on.


Use the following settings in the Draw Transition Tool:

| 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 |

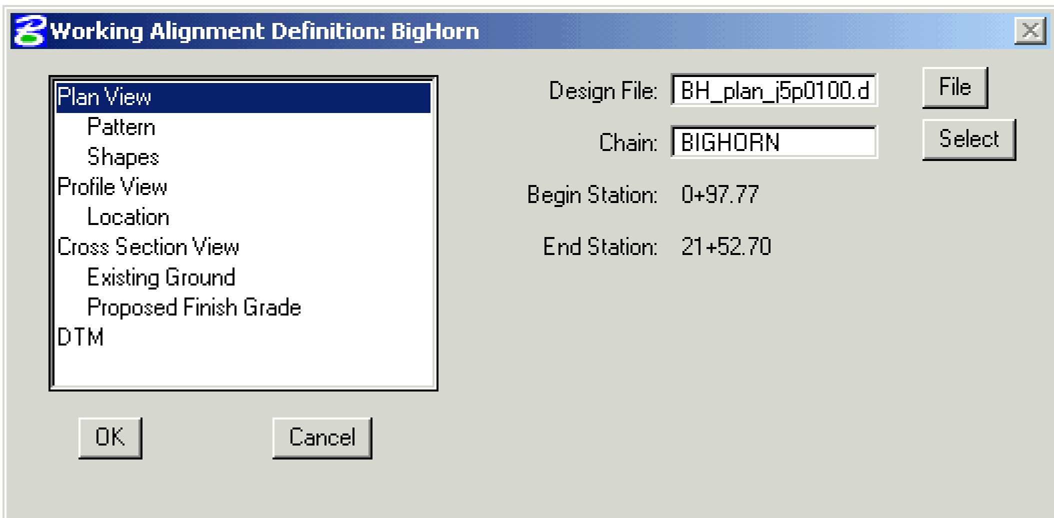
Save the changes to the DGN file.

This completes the work for the Route 50 alignment. The cross road is Big Horn Drive, which will also need to have the alignment and other plan view geometry plotted. This will be done in a separate working alignment and set of DGN files.

9. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\plan_j5p0100.dgn**. **Save** the file as **t:\de-proj\cole\j5p0100\data\BH_plan_j5p0100.dgn**.

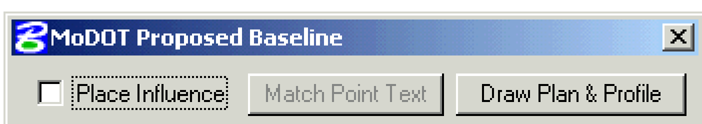
10. Create a working Alignment called BigHorn by copying the Route50 working alignment. (Click on the **Select** button and do a **Run > Copy > Run**.)

    In the **Plan View** section of the BigHorn **Working Alignment** set the **Design File** to **BH_plan_j5p0100.dgn**, and the **Chain** to **BIGHORN**.



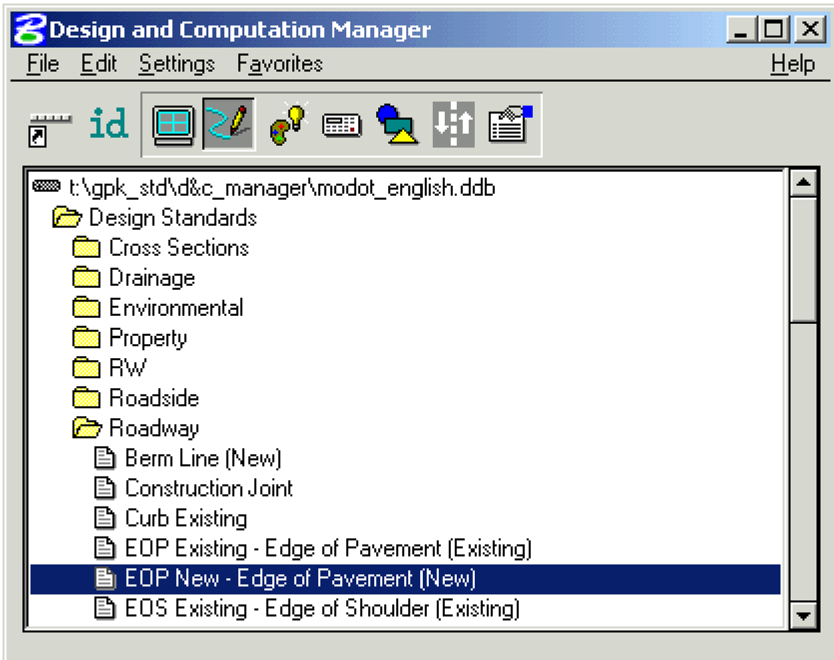

11. Use **Design and Computation Manager** to plot the **Chain** and **Stationing** for the **BigHorn** alignment using the same settings as were used for Route50.

    Be sure that **Place Influence** is turned off.



12. Use the **Draw Transition** tool to create the edges of pavement for **BigHorn** with the following parameters.

Use the **Design and Computation Manager** item:
**Design Standards\Roadway\EOP New – Edge of Pavement (New)**.



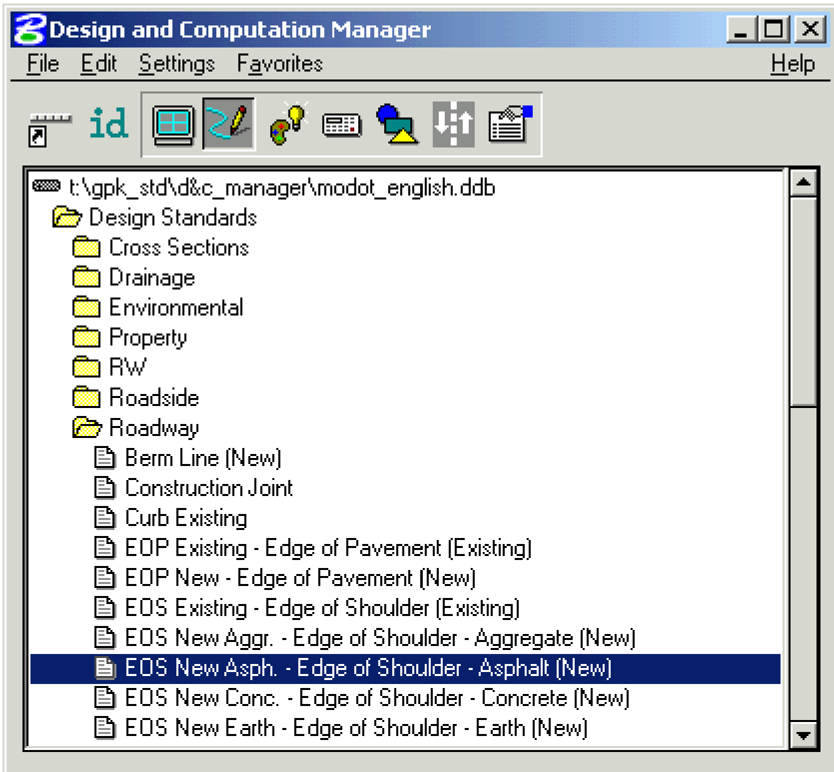

Be sure that **Place Influence** is turned on.


Use the following settings in the Draw Transition Tool:

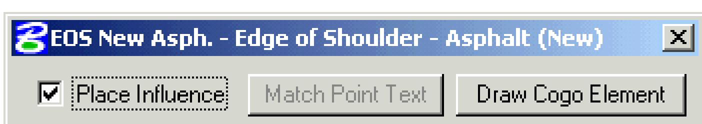
| Beginning Station | Beginning Offset | Ending Station | Ending Offset |
|---|---|---|---|
| Start of Chain | -16 | 17+31.61 | -16 |
| Start of Chain | 16 | 17+31.61 | 16 |
| 17+31.61 | -16 | 19+31.61 | -12 |
| 17+31.61 | 16 | 19+31.61 | 12 |
| 19+31.61 | -12 | End of Chain | -12 |
| 19+31.61 | 12 | End of Chain | 12 |

13. Use the **Draw Transition** tool to create the edges of shoulder for **BigHorn** with the following parameters.

Use the **Design and Computation Manager** item:
**Design Standards\Roadway\EOS New Asph. – Edge of Shoulder - Asphalt (New)**.




Be sure that **Place Influence** is turned on.

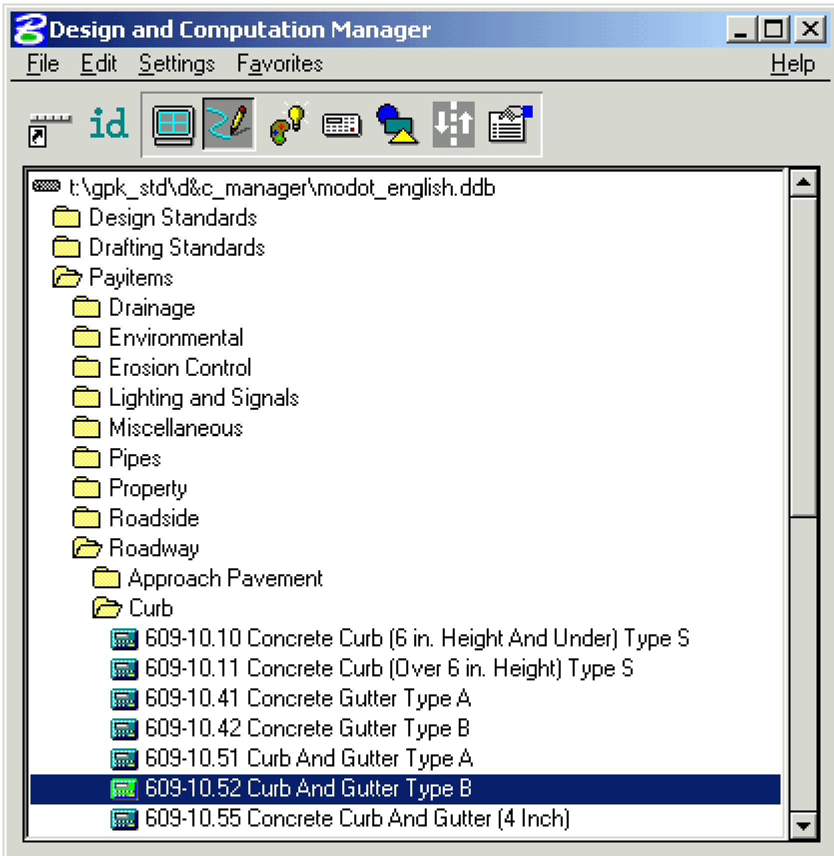



Use the following settings in the Draw Transition Tool:

| Beginning Station | Beginning Offset | Ending Station | Ending Offset |
|---|---|---|---|
| 17+31.61 | -24 | 19+31.61 | -20 |
| 17+31.61 | 24 | 19+31.61 | 20 |
| 19+31.61 | -20 | End of Chain | -20 |
| 19+31.61 | 20 | End of Chain | 20 |

14. Use the **Draw Transition** tool to draw the curb for **BigHorn** with the following parameters.

Use the **Design and Computation Manager** item:
**Payitems\Roadway\Curb\609-10.52 Curb And Gutter Type B**




Be sure that **Place Influence** is turned on.


Use the following settings in the Draw Transition Tool:

| Beginning Station | Beginning Offset | Ending Station | Ending Offset |
|---|---|---|---|
| Start of Chain | -19 | 17+31.61 | -19 |
| Start of Chain | 19 | 17+31.61 | 19 |

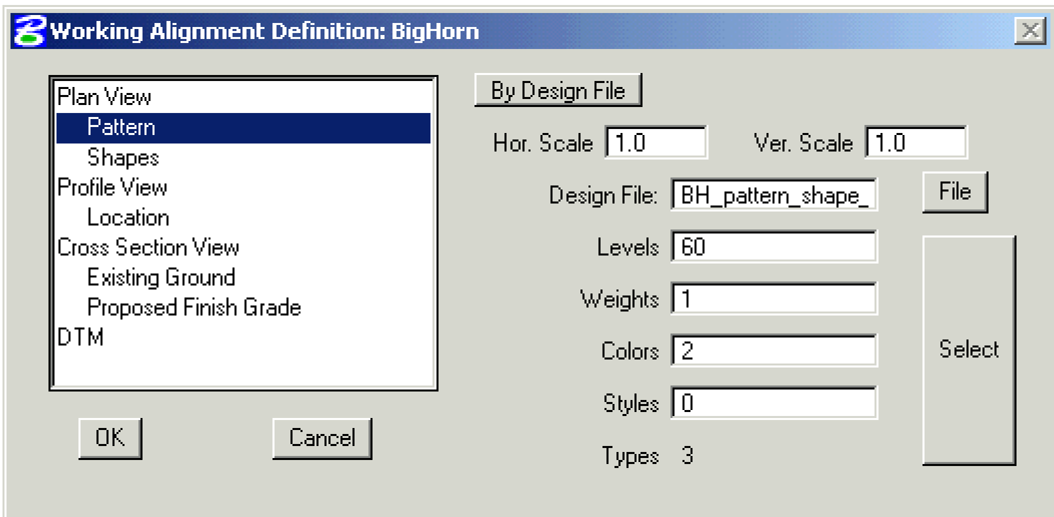
Save the changes to the DGN file.

This completes the lines needed to show the roadway in the plan sheets for Big Horn Dr. The typical section for Big Horn Dr. indicates that there is a five-foot berm behind the curb and gutter. One option for indicating the width of the berm is to draw a plan view element at the outside edge of the berm, which is the option that will be used. Since this line is not shown on the plan sheets, it will be plotted in a different file.

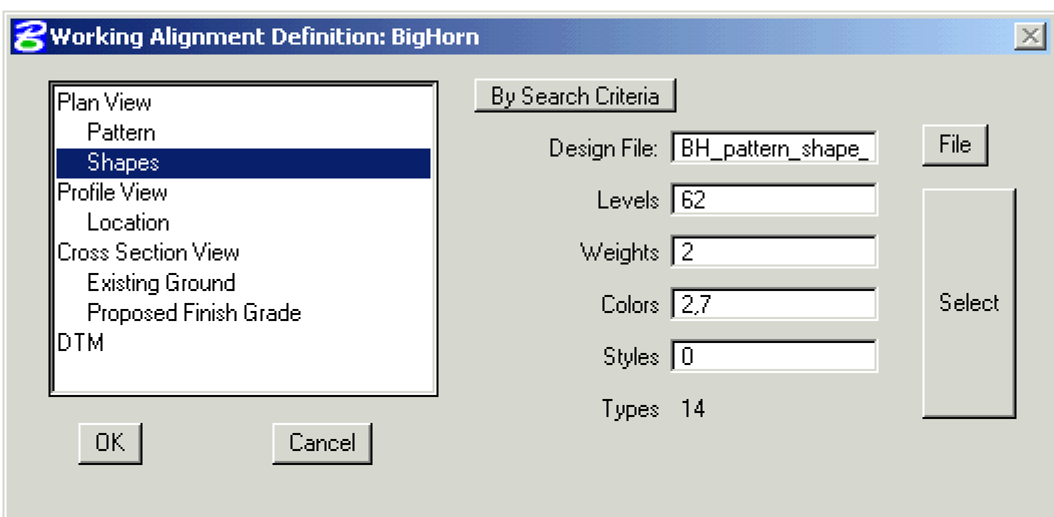
15. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\pattern_shape_j5p0100.dgn**. **Save** the file as **t:\de-proj\cole\j5p0100\data\BH_pattern_shape_j5p0100.dgn**. This file will be used to plot an needed plan view elements that are not to be shown of the plan sheets, including the edge of berm line, the pattern lines to indicate the location of the cross sections and the shapes used to indicate the pavement cross slope.

16. Enter the working alignment definition for BIGHORN

In the **Pattern** section of the BigHorn **Working Alignment** set the **Design File** to **BH_pattern_shape_j5p0100.dgn**, the **Levels** to **60**, and the **Colors** to **2** (as shown below).




Switch to the **Shapes** section and set the **Design File** to **BH_pattern_shape_j5p0100.dgn**, the **Levels** to **62**, and the **Colors** to **2,7** (as shown below).

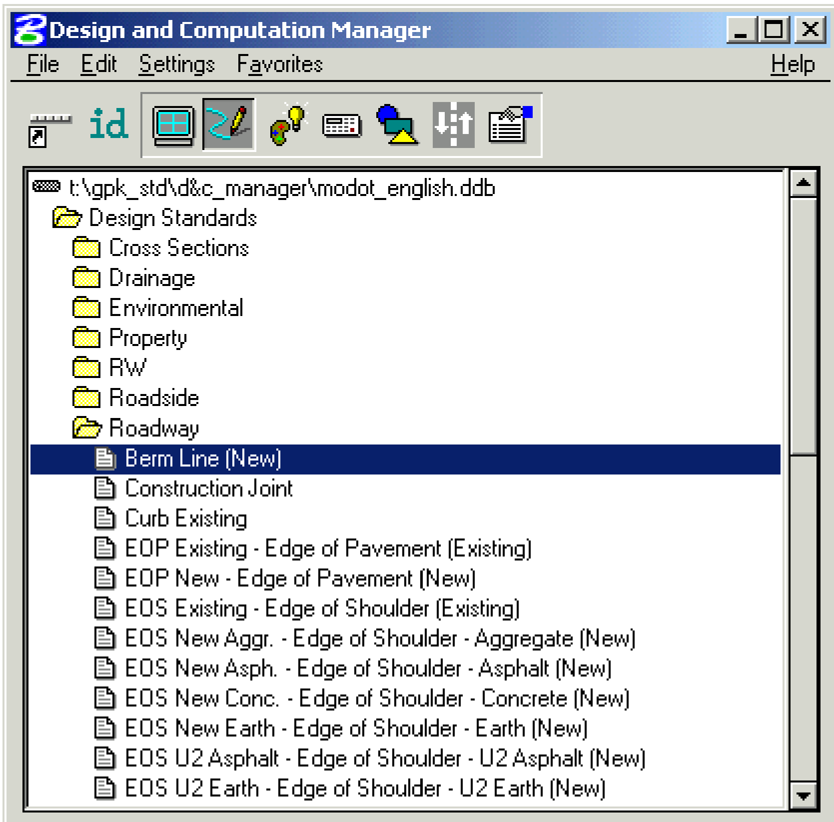



Accept the changes to the alignment definition by clicking OK. These changes will let GEOPAK keep track of which files are being used for the BIGHORN alignment.

17. Attach **BH_plan_j5p0100.dgn** as a reference file so you can see the plan view geometry for Big Horn Dr. that has already been plotted.

    Use the **Draw Transition** tool to draw the edge of berm line behind the curb for **BigHorn** with the following parameters.

    Use the **Design and Computation Manager** item:
    **Design Standards\Roadway\Bern Line (New)**




    Be sure that **Place Influence** is turned on.


    Use the following settings in the Draw Transition Tool:

| Beginning Station | Beginning Offset | Ending Station | Ending Offset |
|---|---|---|---|
| Start of Chain | -24 | 17+31.61 | -24 |
| Start of Chain | 24 | 17+31.61 | 24 |

    Save the changes to the DGN file.

# Chapter 9

# Labeling

## 9.1 Objectives

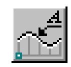
- Learn how to label information with Plan View, Profile View, and Cross-Section Labeler

## 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. The **Labeler** is available for plan view, profile view, cross-section view, and drainage elements.

## 9.3 Accessing

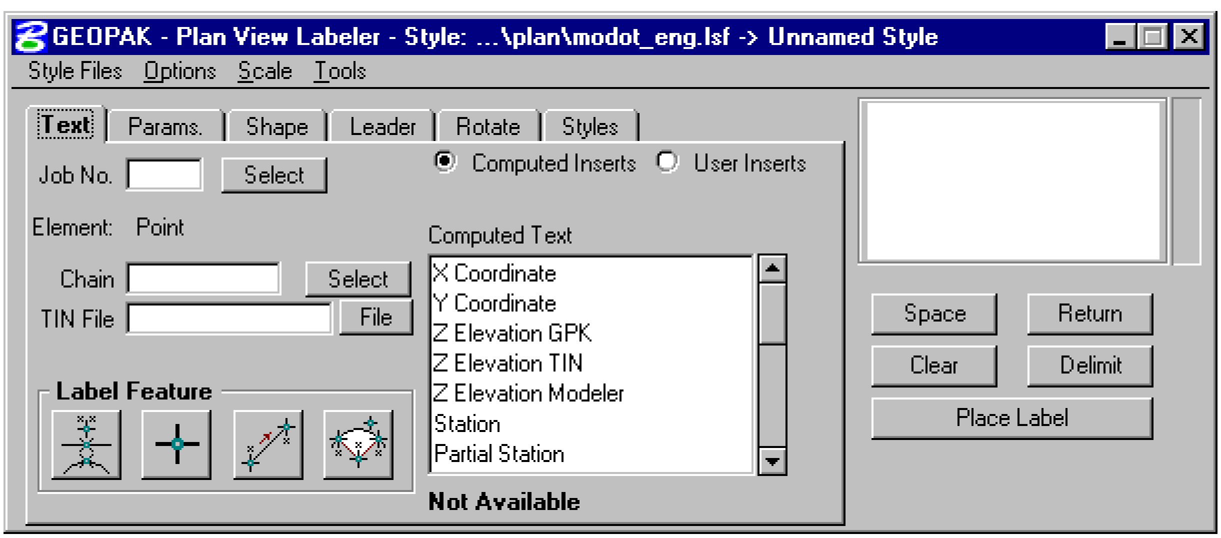
**Plan View Labeler** can be accessed from the **Plan View Labeling** icon. 

**Profile View Labeler** can be accessed from the **Profile View Labeling** icon. 

**Cross Section Labeler** can be accessed from the **Cross Section Labeling** icon. 

## 9.4 Dialog

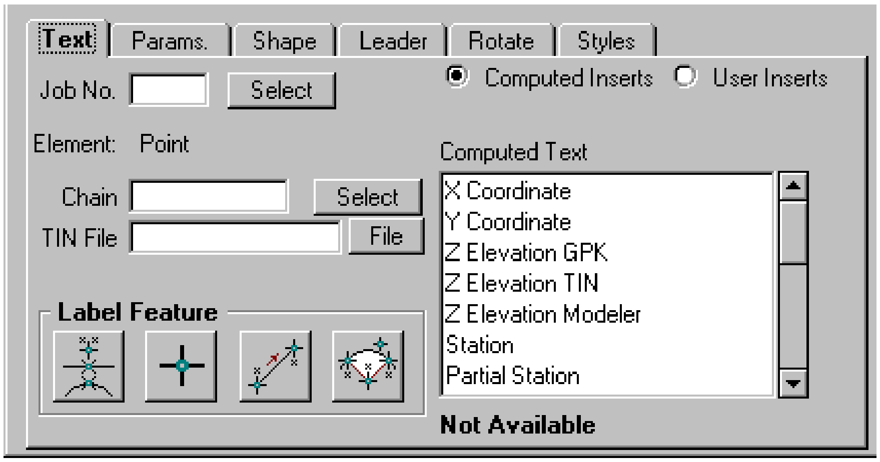
GEOPAK's labeling tools allow a user to place "smart" labels in a Microstation drawing. These labels have the ability to calculate XYZ coordinates, station, offset, direction, length, radius, degree of curvature, etc. of the element the label is attached to.




When the **Plan View Labeling** icon is selected, the above dialog appears. The label to be placed will be displayed in the box on the right side of the dialog. The **Space** button will put a space in the label at the cursor position. The **Return** button will start a new line of text. The **Clear** button will start a new label. The **Delimit** button will place a line above or below a line of text. The **Place Label** button will place the label on the cursor to be placed in the drawing.

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

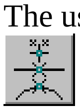
## 9.4.1 Text

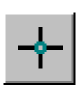


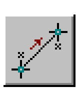

The **Text** screen allows the user to add computed text inserts, or user text inserts. For data to be computed, the job number and the chain need to be selected. If elevations are to be calculated, a .tin file needs to be chosen.

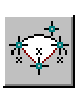
The **Computed Inserts** are items that Geopak has the ability to calculate for the chosen item. The list of **Computed Inserts** changes with the type of element that is chosen. If a line is chosen, the list of **Computed Inserts** will show inserts of bearing, and length. If a curve is chosen the list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

The user 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.

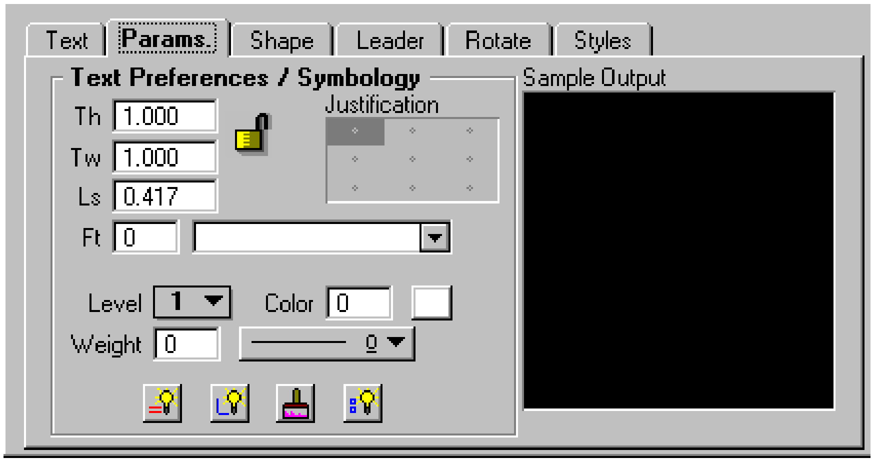
 Allows the user to data point a location on the screen.

 Allows the user to choose two visualized COGO points to represent a line.

 Allows the user to select the PC, PT, and either the center of curve or a point on curve using visualized COGO points.

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

## 9.4.2 Parameters




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

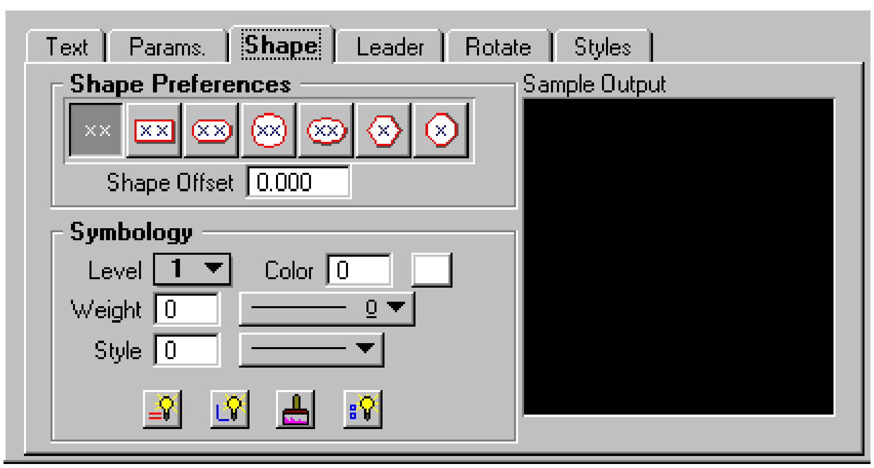
 Will set the symbology to the current Microstation settings.

 Allows the user to set the symbology by choosing a Microstation element.

 Will set the symbology using D&C Manager symbology

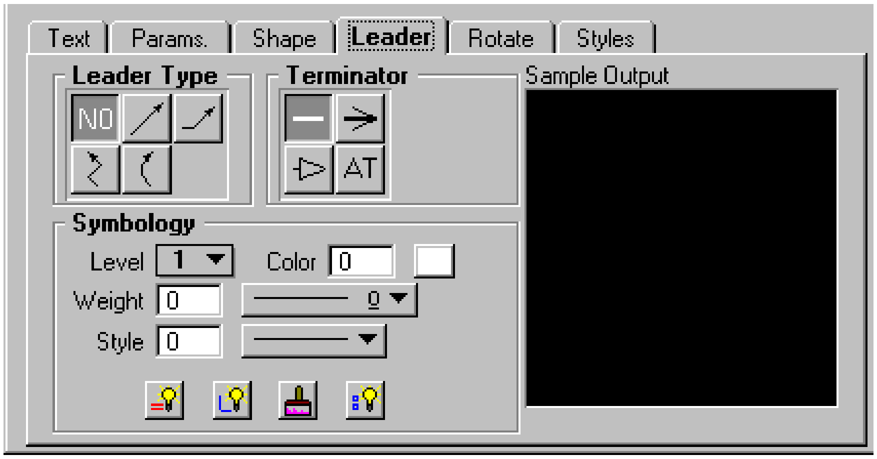
 Will set the symbology for all elements in the label (text, delimiters, leader lines, etc.).

## 9.4.3 Shape



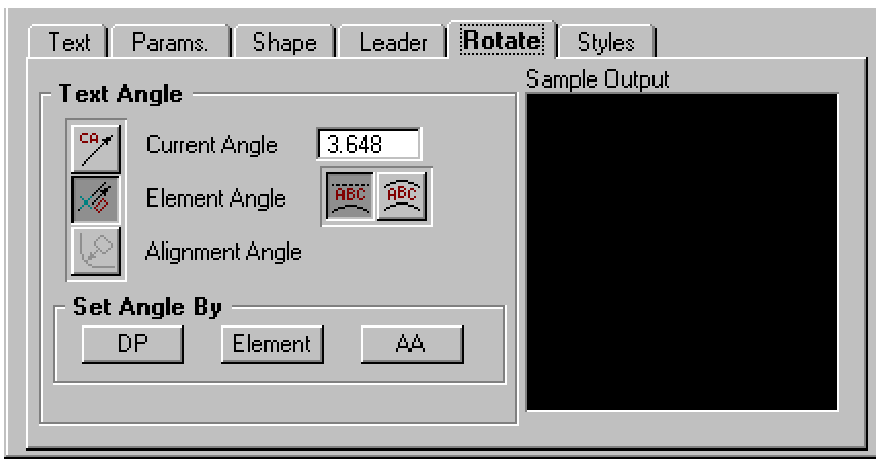

The **Shape** tab allows the user to place a shape around the label and set the symbology for the shape. The user can select the shape to be placed around the text. The **Shape Offset** is used to determine the distance between the shape and the text. The symbology icons are the same as those described under the Parameters tab.

### 9.4.4 Leader



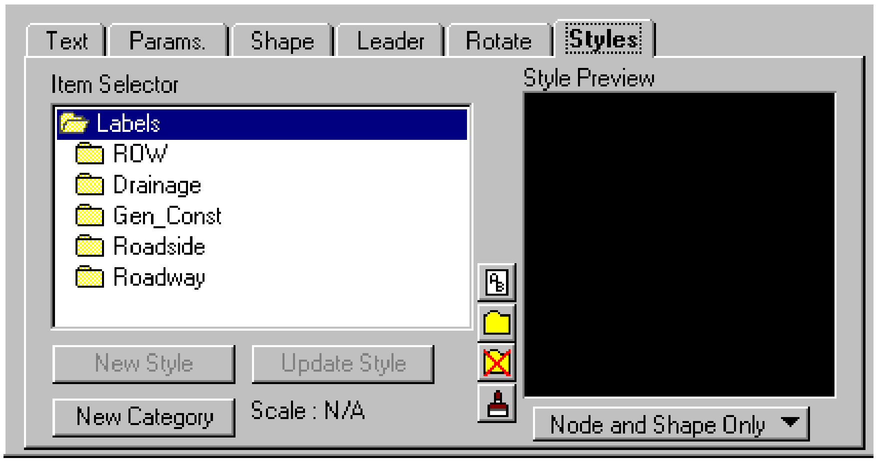

The **Leader** tab allows the user to attach a leader from the label to the point. Different leader types and terminators can be chosen. The active terminator can also be used. The symbology icons are the same as those described under the Parameters tab.

### 9.4.5 Rotate




The **Rotate** tab allows the label to be rotated. The rotation can be determined from the current angle, the angle of the element, or the alignment angle. Two data points or the active angle can also set the rotation.

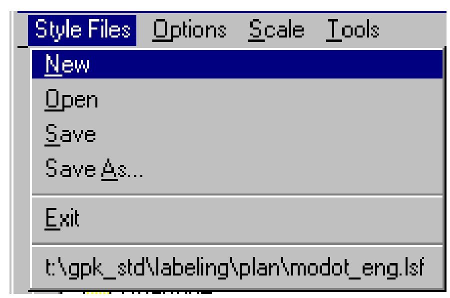
### 9.4.6 Styles

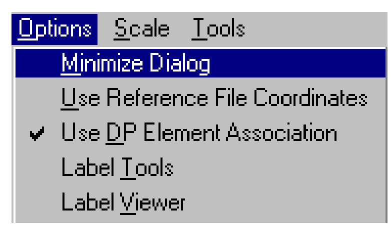



The **Styles** tab allows a user to choose label symbology from a library of pre-defined styles. When the user chooses the style, all of the symbologies, leaders, shapes, etc. is set up for the user.

## 9.5 Menus

The **Style Files** menu allows the user to open a new style library.



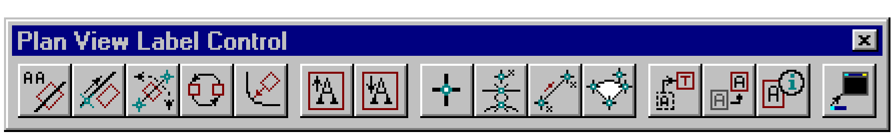




In the **Options** menu, **Minimize Dialog** will minimize the dialog box when **Place Label** is chosen.

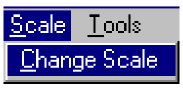
The **Use Reference File Coordinates** option will use the coordinates from the attached reference file when placing a label in a plan sheet.

The **Use DP Element Association** option will allow the user to associate the label with an element in the active drawing. When the element changes, the label can be updated with the **Label Updater**.

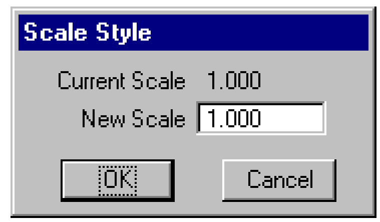
**Label Tools** will bring up the toolbox shown below that will allow the user to modify GEOPAK labels.



**Label Viewer** brings up a dialog that allows a user to view and place a label. **Automatic Label** will update the computed inserts in a label as a new data point or element is chosen.

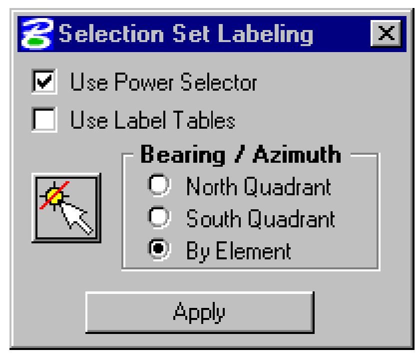



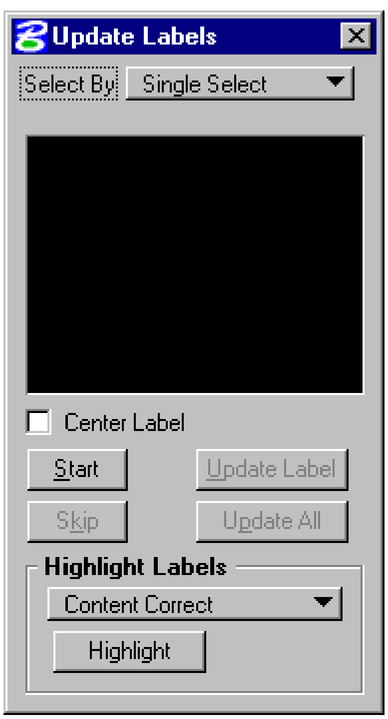

The **Label Scale** menu allows the user to choose a plan scale. All labels will be adjusted according to the plan scale. The user simply keys in a scale, and chooses a **Labeling Style**. The corresponding label will be placed at the correct size for the scale that was chosen.



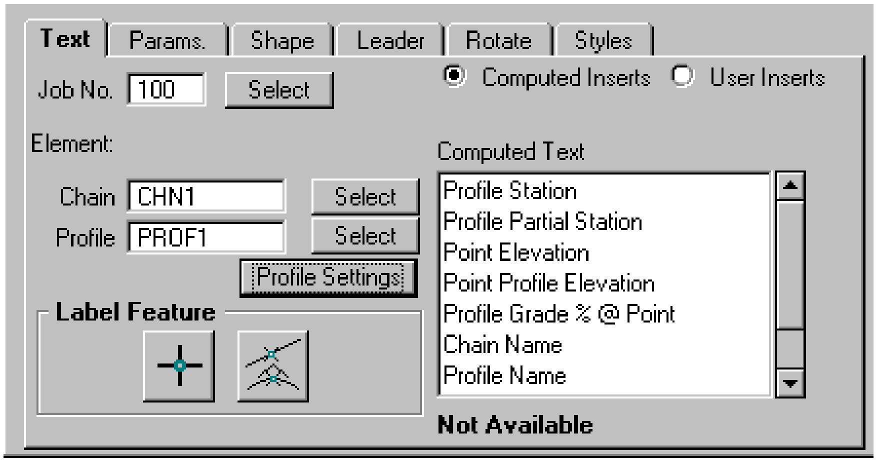


The **Tools** menu allows the user to use a selection set, or update existing labels. **Selection Set Labeling** allows the user to work with multiple labels using a Microstation selection set. The **Label Updater** will allow the user to update a label's computed inserts, symbology, etc.



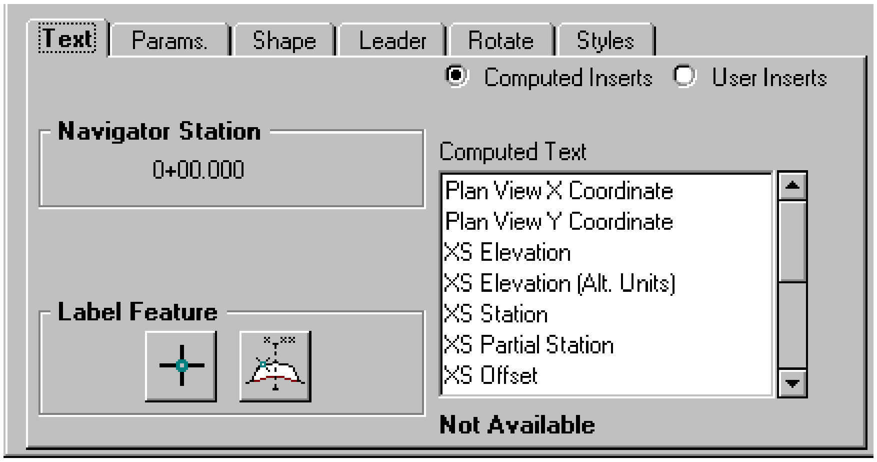



## 9.6 Profile Labeling




The **Profile Labeling** dialog differs from the **Plan View Labeling** dialog only on the text tab. The **Profile Labeling** dialog allows the user to select a chain and profile, and to set the profile settings. The **Computed** and **User Inserts** contain values and phrases related to profiles.

## 9.7 Cross-Section Labeling




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

## Chapter 10

# Existing Ground Profiles

## 10.1 Objectives

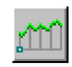
- Learn to calculate original ground profiles based on a DTM.

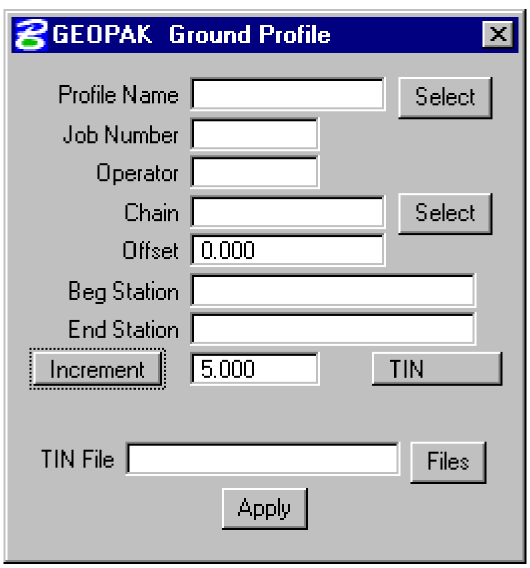
## 10.2 Definitions

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**, or choose the **Existing Ground Profile** icon. 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.

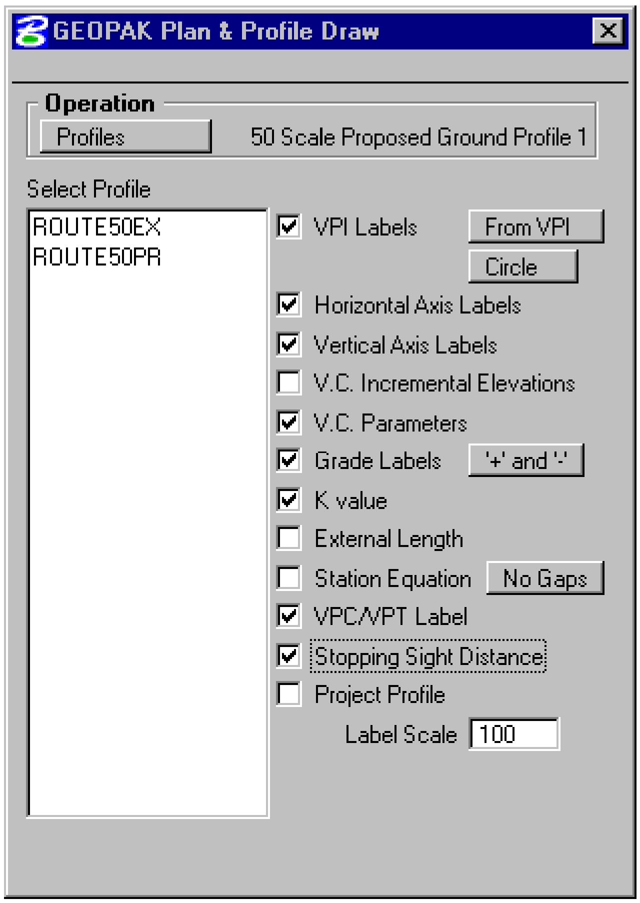
## 10.6 Plotting Profiles

1) Draw a diagonal line to serve as a reference point.

2) Start D&C Manager.

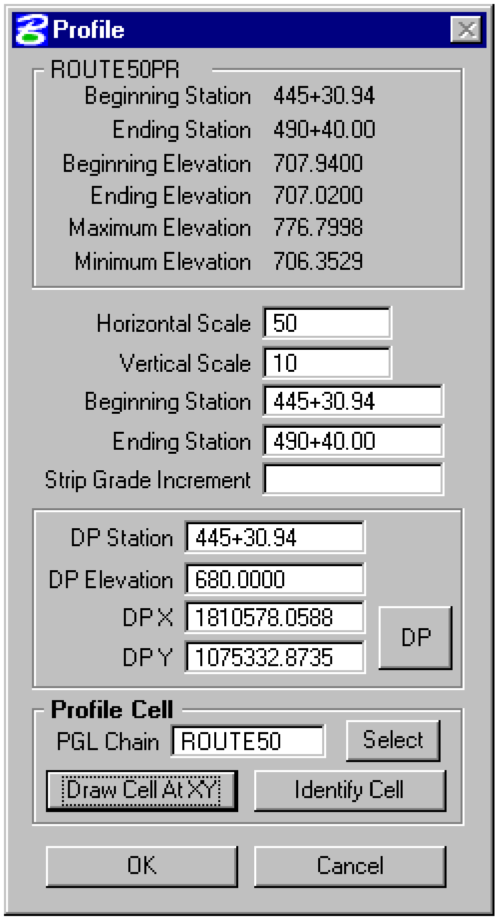
3) From D&C Manager, choose the appropriate scale from the category **Drafting Standards>>Profile>>Existing Ground Profiles** or **Drafting Standards>>Profiles>>Proposed Ground Profiles**.
4) Choose the **Draw Plan & Profile** button.

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.

## 10.7 Example 10-1

1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\BH_plan_j5p0100.dgn**.

2. Choose the **BigHorn** working alignment in the **J5P0100** project.

3. Choose **Existing Ground Profile** from the **Project Manager** dialog. Copy the **MoDOT** run and name the new run **BigHorn**.

4. Create an original ground profile for the project based on the following.

| | | | | |
|---|---|---|---|---|
| Profile Name: | **BigHornEx** | | Job Number: | **100** |
| Operator: | **cu** | | Chain: | **BIGHORN** |
| Offset: | **0** | | | |
| Beg. Station: | *Will be filled in when chain is chosen.* | | | |
| End Station: | *Will be filled in when chain is chosen.* | | | |
| Mode: | **Intersect** | **TIN** | TIN File: | **j5p0100.tin** |

5. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\profile_j5p0100.dgn**.

6. Attach as references the files **BH_plan_j5p0100.dgn** and **rte50_plan_j5p0100.dgn** from **t:\de-proj\cole\j5p0100\data** and fit the screen. Move to a blank area of the drawing.

7. Plot the existing ground profile using **Design and Computation Manager** item **Drafting Standards\ Profile\Existing Ground Profiles\1”=50’ Existing Ground Profile**.

   Be sure all options are turned off, and the **Labeling Scale** is set to **50**.

   Choose the profile **BigHornEx**.

   Set the following parameters:

| | | | |
|---|---|---|---|
| Horizontal Scale: | **50** | Vertical Scale: | **10** |
| DP Station: | **1+90.15** | DP Elevation: | **700** |
| DP X and Y: | *Data point on the screen in an open area* | PGL Chain: | **BIGHORN** |

   Draw the profile cell with the **Draw Cell at XY** button.

   Draw the profile by selecting **OK**.

   Save changes to the MicroStation drawing and update the Working Alignment Definition.

The example continues with material from Chapter 11.

8. Use the **Vertical Alignment Generator** to create the following proposed profile with the given settings.

   With the **Identify Cell** button, choose the profile cell plotted previously. The dialog should fill in as follows.

   | | | |
   |---|---|---|
   | VPI 1 | Sta. 1+94.00 | Elevation 741.54 |
   | VPI 2 | Dynamic placement | Back Grade –2% |
   | VPI … | Dynamic placement | Dynamic placement |
   | VPI n-1 | Dynamic placement | Ahead Grade 4.6% |
   | VPI n | Sta. 20+60 | Elevation 771.73 |

   Place vertical curves at each internal VPI.

   Make any adjustments needed to remove any errors.

   Save the profile as **BigHornPR**.

   Plot the Proposed Profile as demonstrated.

9. Complete the **Profile View** and **Location** sections of the **BigHorn Working Alignment**.

## Chapter 11

# Vertical Alignment Generator

## 11.1 Objectives

- Create and store vertical alignments using the **Vertical Alignment Generator**.

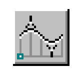
## 11.2 Definitions

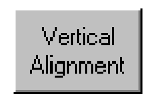
The **Vertical Alignment Generator** is a GEOPAK tool that can graphically create and modify proposed design profiles or modify an existing ground profile. These operations may be accomplished through a dialog box and/or by dynamic manipulation of graphic elements.

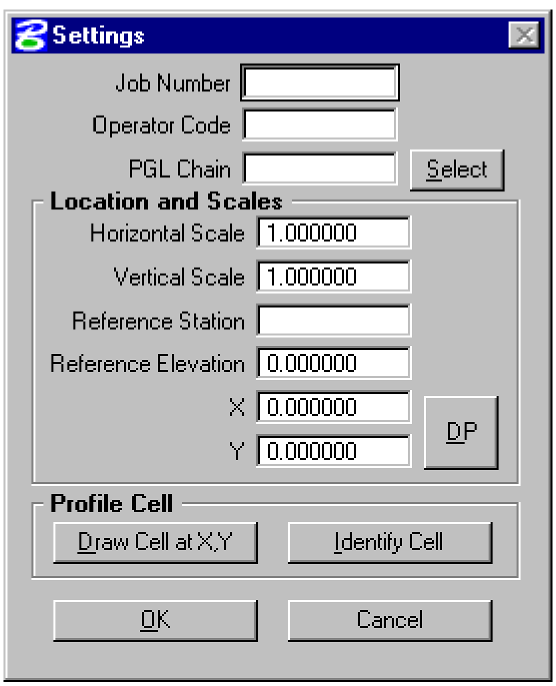
A profile may also be created with Coordinate Geometry (COGO) input.

## 11.3 Accessing

**Vertical Alignment Generator** may be invoked by **Project Manager >> Vertical Alignment** or by the **Vertical Alignment Generator** icon.





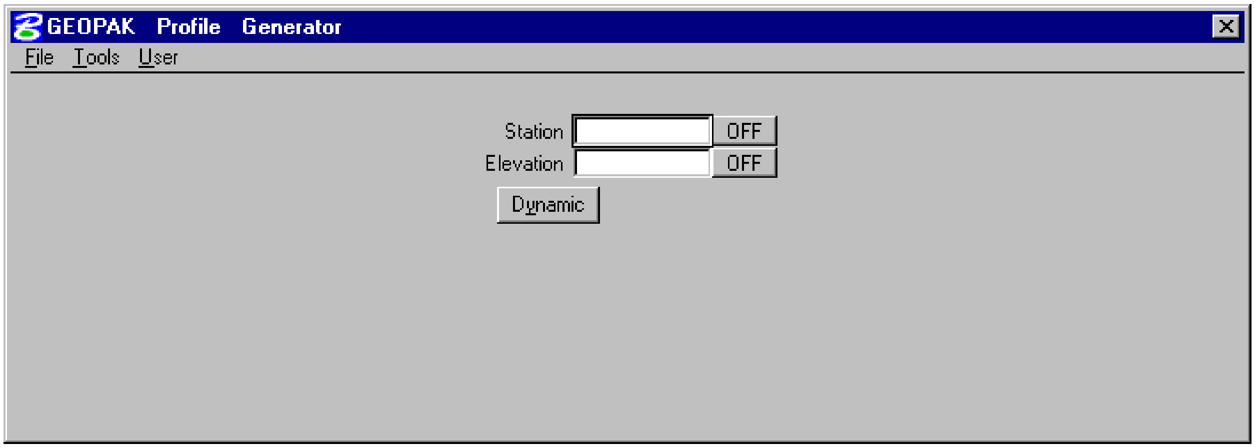



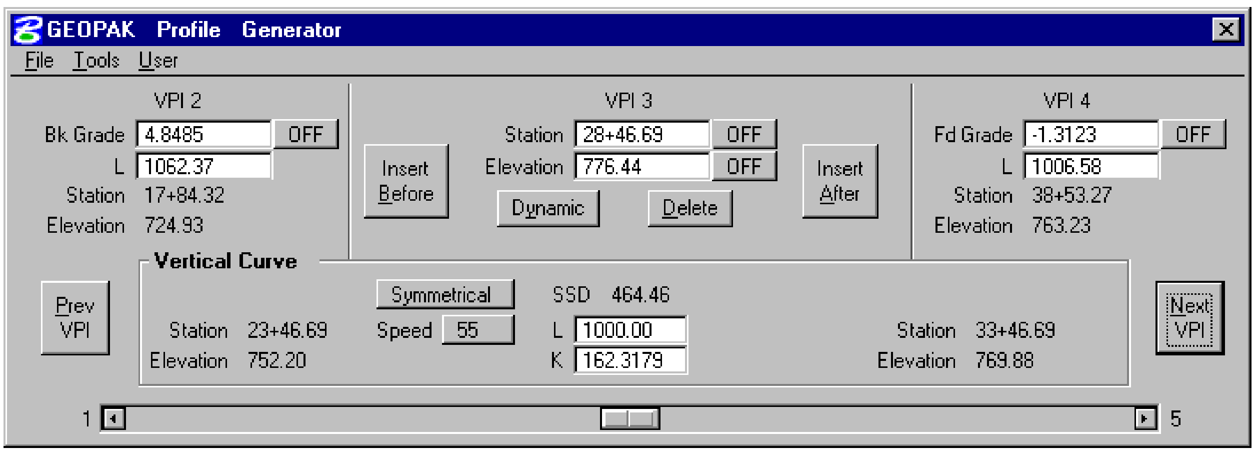

The first dialog box that appears is labeled **Settings**. The entries in this box set the parameters and define the location within the design file where the profile is to be displayed. All fields must be completed before the design process can begin. As the **OK** button is clicked, the Vertical Profile 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

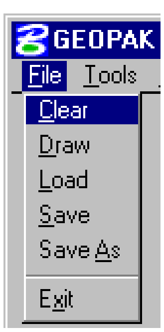
This tool allows a user to load a previously stored profile or create a new profile. You will notice changes in the configuration of this dialog box as you design a vertical alignment.




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.

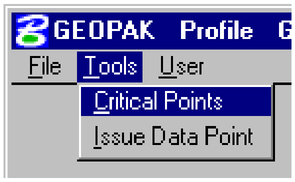
**Load -** retrieves a previously stored profile from the coordinate geometry database (.gpk)

**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.

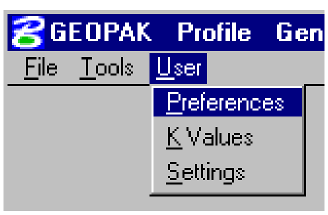
### 11.4.2 Tools




**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.

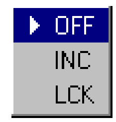
**Step 5 Adjusting Curve Lengths**

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.

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

## Exercise 11-1

1. Open the Microstation file **t:\de-proj\cole\j5p0100\data\rte50_plan_j5p0100.dgn**.

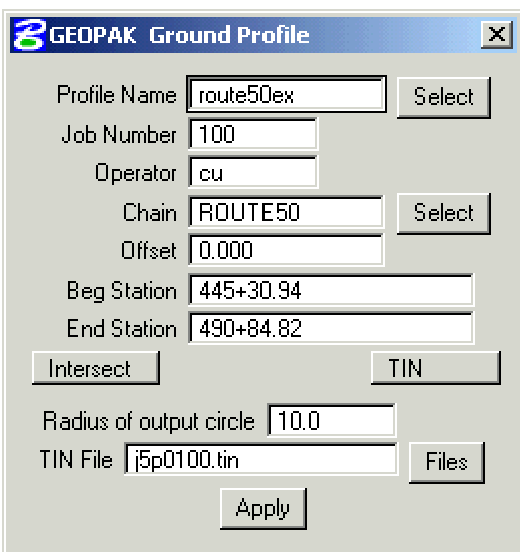
2. Choose the **Route50** working alignment.

3. Choose **Existing Ground Profile** from the **Project Manager** dialog.

   Copy the **MoDOT** run and name the new run **Route50**.

4. Create an original ground profile for the project.

| | |
|---|---|
| Profile Name: | **Route50Ex** |
| Job Number: | **100** |
| Operator: | **cu** |
| Chain: | **Route50** |
| Offset: | **0** |
| Beg. Station: | *Will be filled in when chain is chosen.* |
| End Station: | *Will be filled in when chain is chosen.* |
| Mode: | **Intersect** **TIN** |
| TIN File: | **j5p0100.tin** |



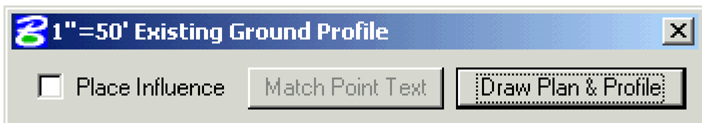

5. Open the Microstation file**t:\de-proj\cole\j5p0100\data\profile_j5p0100.dgn**.

6. If not already done, attach the files **rte50_plan_j5p0100.dgn** and **BH_plan_j5p0100.dgn** in **t:\de-proj\cole\j5p0100\data** as references and fit the screen.

   Move to a blank area of the drawing.

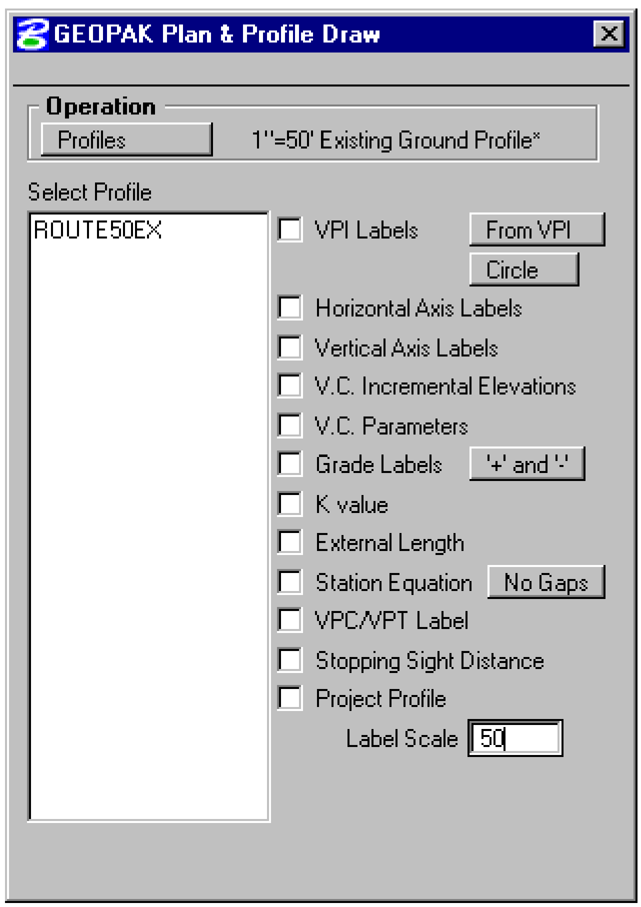
7. Plot the existing ground profile using **Design and Computation Manager** item **Drafting Standards\Profile\Existing Ground Profiles\1"=50' Existing Ground Profile**.

   After selecting the item in D&C Manager, Click on Draw Plan & Profile in the Operations box.




   Be sure all options are turned off, and the **Labeling Scale** is set to **50**.

   Choose the profile **Route50Ex**.



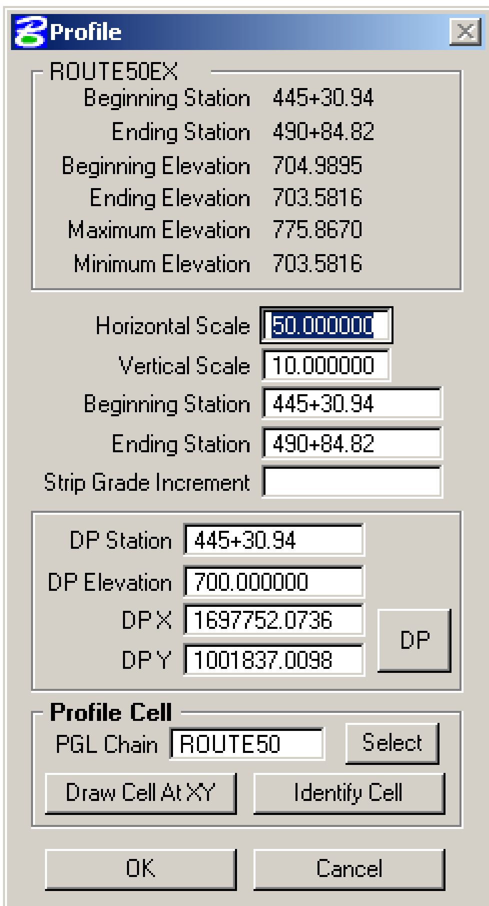
7. (Continued)

Set the following parameters:

| | |
|---|---|
| Horizontal Scale: | **50** |
| Vertical Scale: | **10** |
| DP Station: | **445+30.94** |
| DP Elevation: | **700** |
| DP X and Y: | *Data point on the screen in an open area.* |
| PGL Chain: | **Route50** |

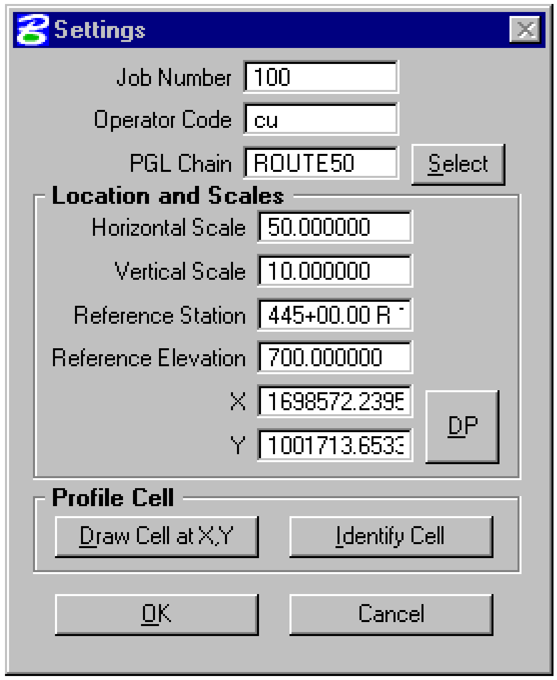
Draw the profile cell with the **Draw Cell at XY** button.

Draw the profile by selecting **OK**.



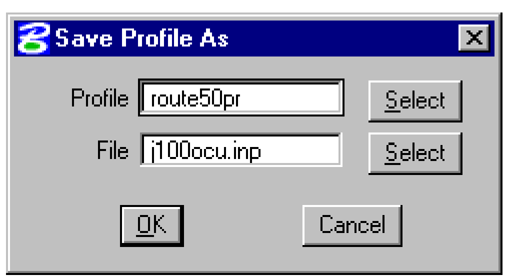
8. Use the **Vertical Alignment Generator** to create the following proposed profile with the given settings.

   With the **Identify Cell** button, choose the profile cell plotted previously. The dialog should fill in as follows.




| | | | |
|---|---|---|---|
| VPI 1 | Sta. 445+30.94 | Elevation 707.61 | |
| VPI 2 | Sta. 447+00 | Elevation 710.99 | Vertical Curve Length 200’ |
| VPI 3 | Sta. 467+00 | Back Grade 4% | Vertical Curve Length 1400’ |
| VPI 4 | Sta. 487+00 | Back Grade -4% | Vertical Curve Length 550’ |
| VPI 5 | Sta. 490+40 | Elevation 705.89 | |

Save the profile as **Route50PR**.



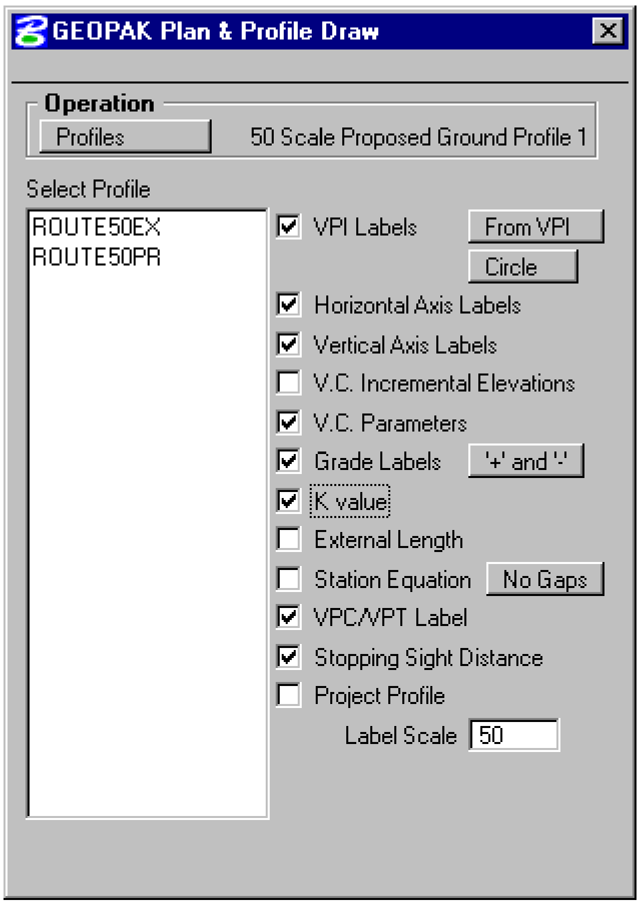

Exit the Vertical Alignment tool and save the settings.

9. Plot the proposed profile using **Design and Computation Manager** item **Drafting Standards\Profile\Proposed Ground Profiles\50 Scale Proposed Ground Profile 1”=50’ H & 1”=10’ V**.

Turn on the following options:

**VPI Labels**
**Horizontal Axis Labels**
**Vertical Axis Labels**
**V.C. Parameters**
**Grade Labels**
**K Value**
**VPC/VPT Label**
**Stopping Sight Distance**

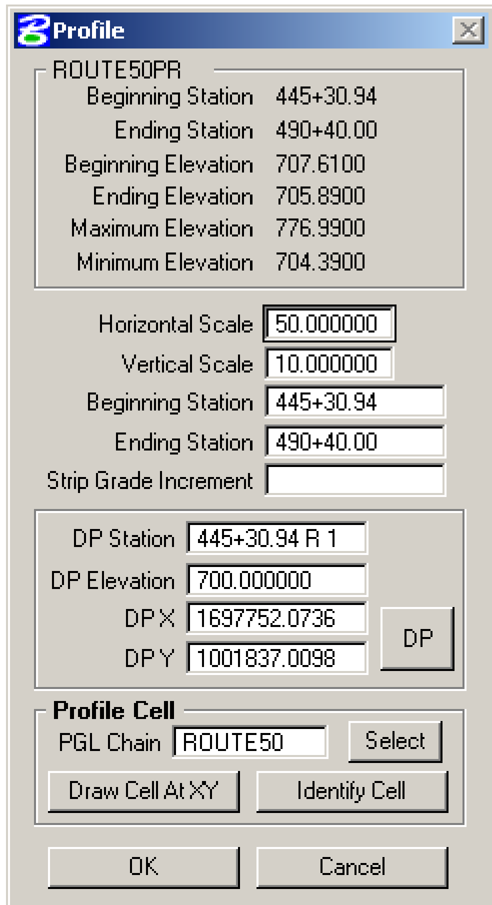
Choose the profile **Route50PR**.



9. (Continued)

Use the **Identify Cell** button to select the profile cell placed in step 6.

Plot the profile **Route50pr** by selecting the **OK** button.

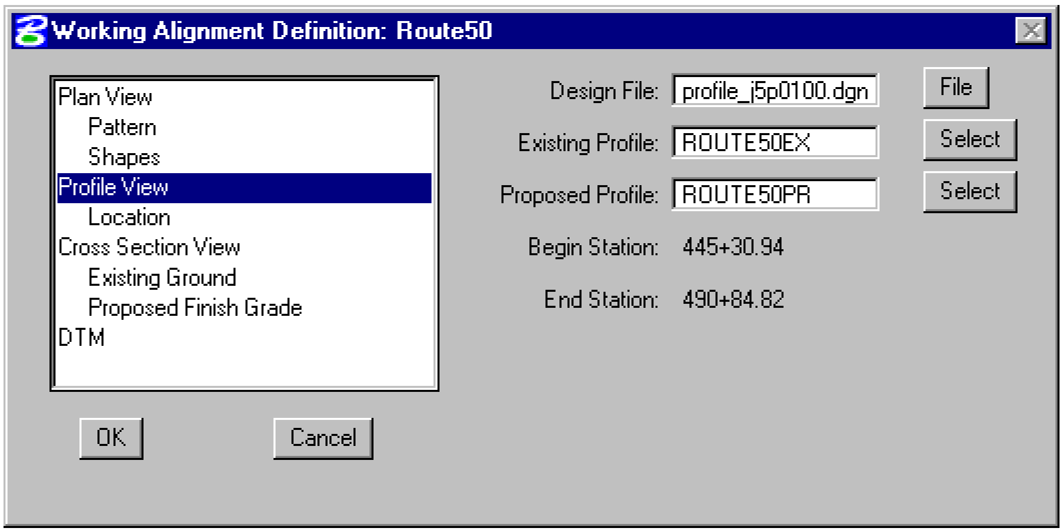


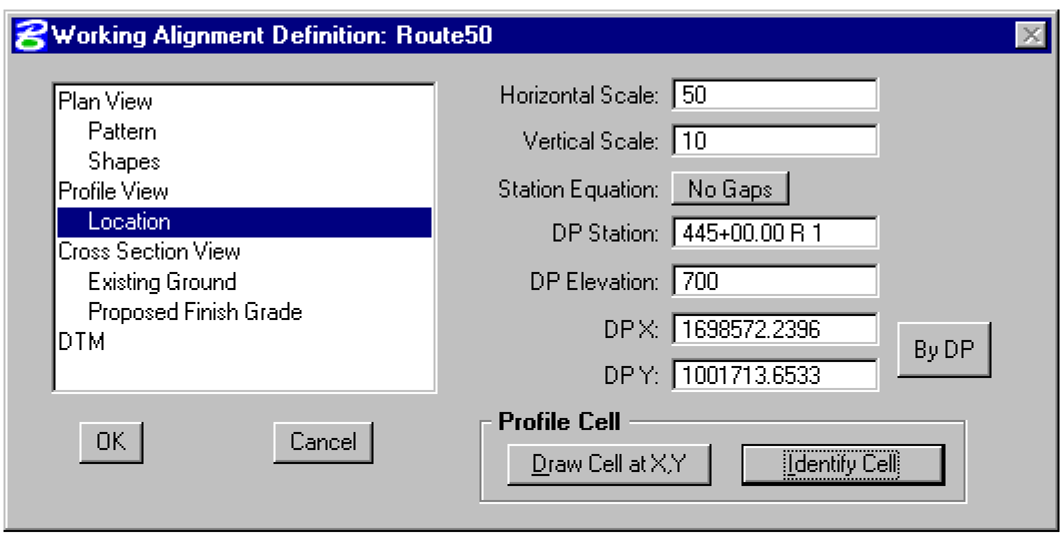

Exit D&C Manager and save the changes to the MicroStation Drawing.

10. Complete the **Profile View** and **Location** sections of the **Route50 Working Alignment**.

Design File: **profile_j5p0100.dgn**
Existing Profile: **Route50EX**
Proposed Profile: **Route50PR**

For the **Location** section, use the **Identify Cell** button to choose the profile cell.



Chapter 12

# Plan & Profile Sheets

## 12.1 Objectives

- Understand and be able to use the GEOPAK 2001 Plan & Profile Sheet Generator

## 12.2 Definitions

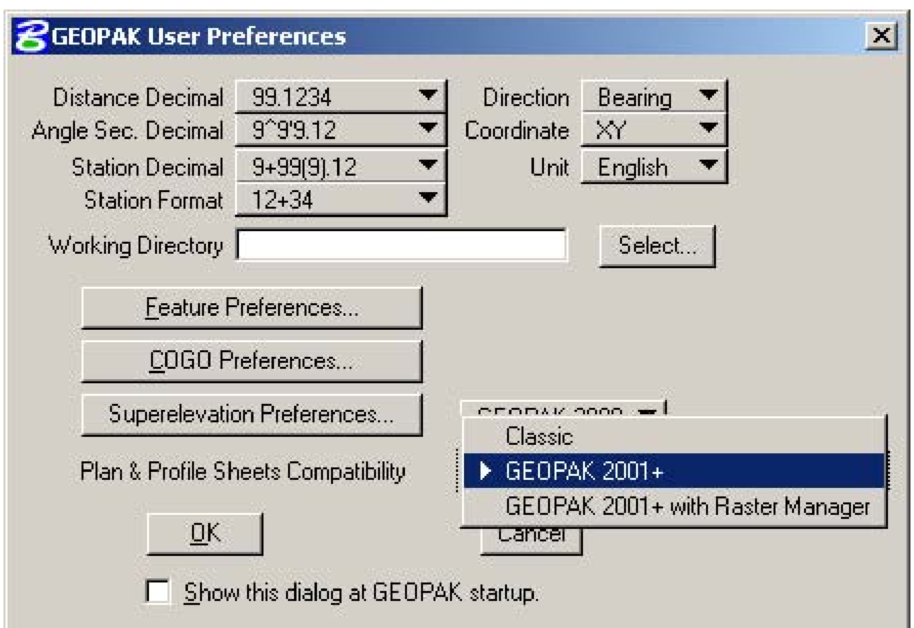
Based on user-defined parameters and sheet size, sheet borders will be placed into a design file relative to a specific alignment. Modifications may be made to sheet size and location. Once the sheet boundaries are in the proper location, the designer may then place the sheet(s) into a design file(s) 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.

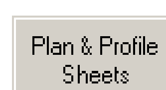
## 12.3 Accessing

To be able to access the GEOPAK 2001 Plan/Profile Sheets, the Plan & Profile Sheets Compatibility will need to be switched to the **GEOPAK 2001+** in the GEOPAK User Preferences.

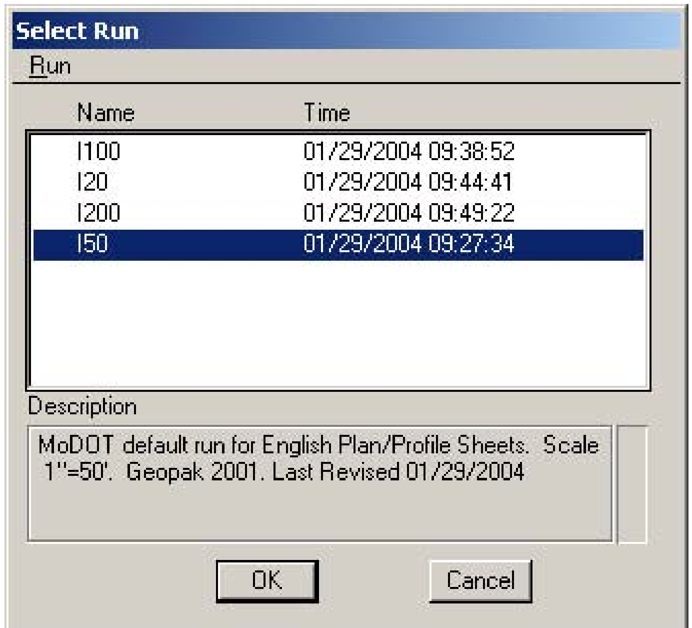
**Applications** >> **GEOPAK Road** >> **User Preferences**. The User Preferences dialog appears.




To make use of the MoDOT default runs, the Plan and Profile Sheets Generator must be invoked via the **Road Project** flow chart button **Plan & Profile Sheets** shown to the right.



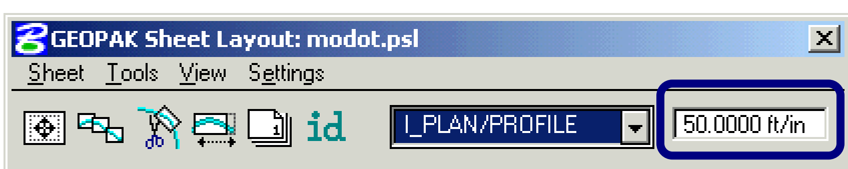
When the button is pushed the **Plan & Profile Sheets Run Picker** dialog appears.




The user will copy the run that represents the scale in which he/she is interested. Each run is configure 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 |

Upton 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

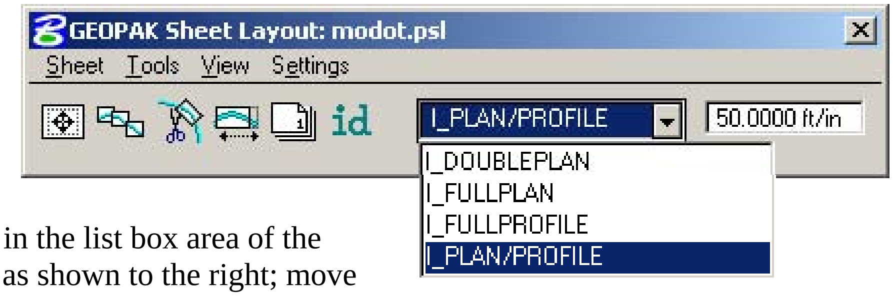
A sheet library must be attached to the current session. CADD Support has set up the tool so the MoDOT sheet library (modot.psl) is automatically attached.

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.  They are:

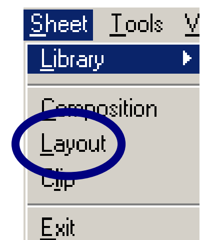
- Double Plan
- Full Plan
- Plan/Profile
- Full Profile



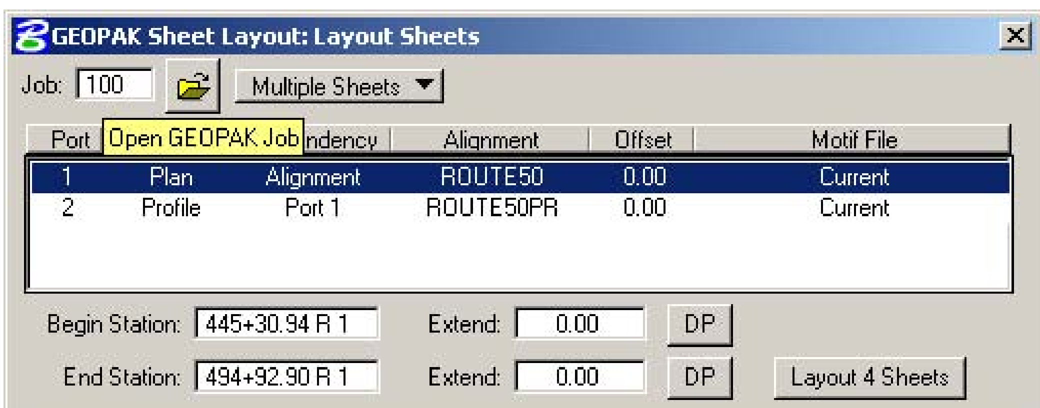

To select a sheet type, click in the list box area of the dialog, causing it to expand as shown to the right; move the cursor to the type of sheet desired; and click again.

## 12.6 Sheet Layout

Once the type of sheet has been selected, the user is ready to layout the sheets.  The layout process can be accessed by selecting the layout icon from the dialog box or via the pull down menu **Sheet >> Layout**


The **Layout Sheets** dialog appears.




### 12.6.1 Job Number

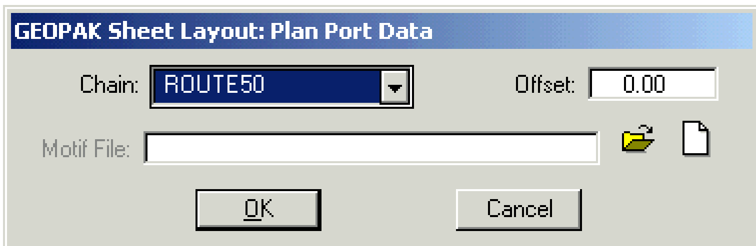
The user first needs to select the **Job** number by clicking in the open folder icon.  Once the job number is selected, the user is ready to set up each port.

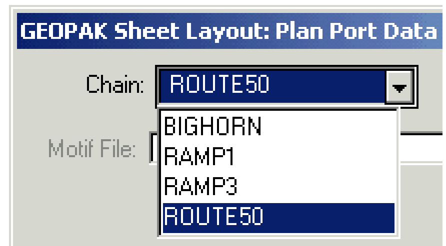
## 12.6.2 Ports

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.

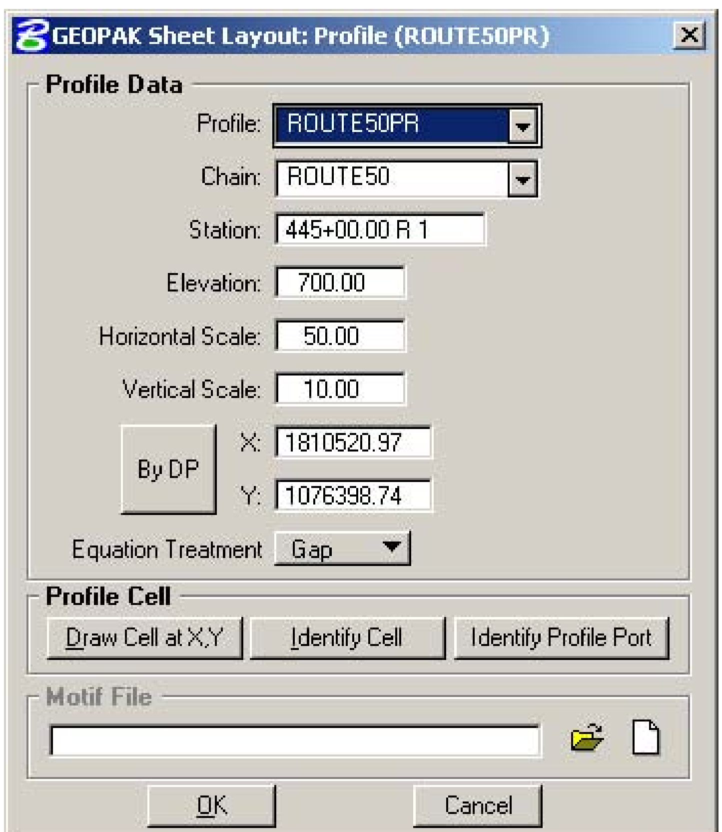
The job specific data for each port must be set. If there are two ports, it is important to enter the data for Port 1 first. Double click on a port to enter the data for the port.

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.

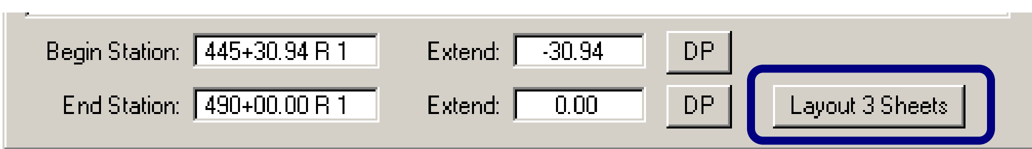
The X and Y coordinates can be typed in or set by choosing the **By DP** button and data pointing in the MicroStation drawing to set the origin point. If the profile has a station equation, the profile can be plotted with gaps or with no gaps.

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.

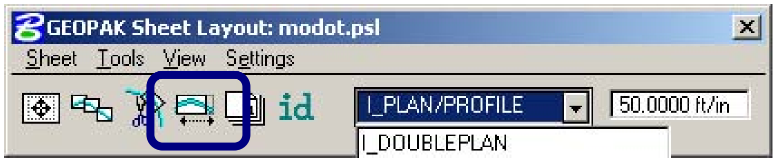



Based upon the begin and end station information the dialog will indicate how many sheets will be laid out as shown above. The user then selects the **Layout Sheets** button to layout the sheets.

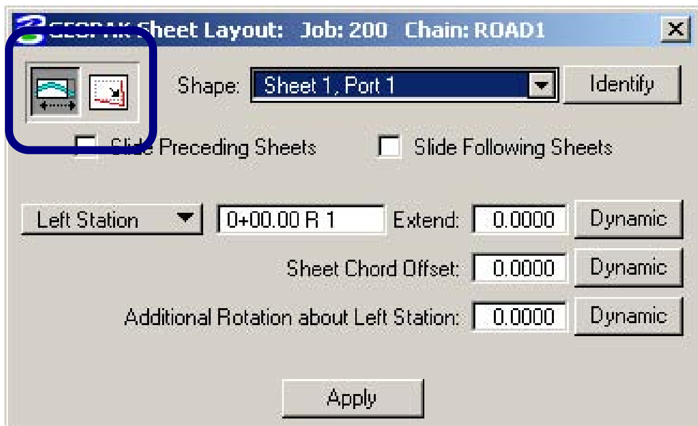
## 12.7 Modify

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>>Modify**.

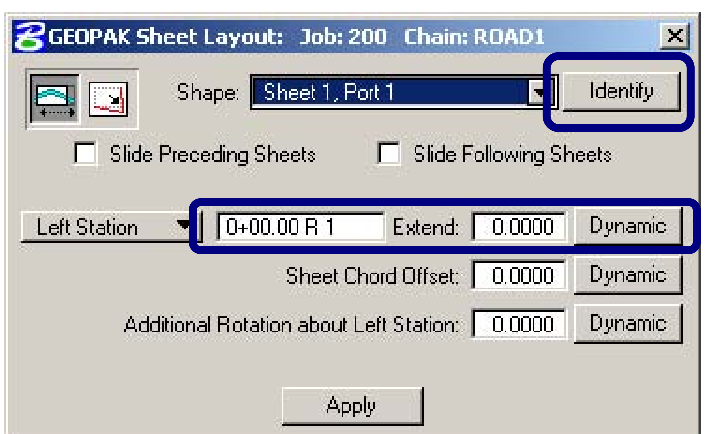



Two major modifications are supported and are selected via icon in the upper left corner of the dialog box shown below. The user has the options of **Slide Sheets** or **Modify Drawing Area.** As the modification type is selected, the dialog changes to reflect the selection.




**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 **Identify** 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.**

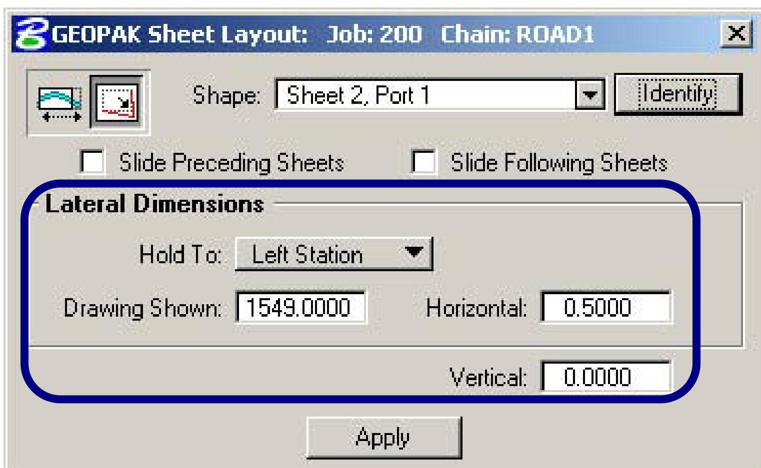
The sheets can be moved dynamically or by value. The station of the sheet is populated when the sheet was selected. To move the sheet along the alignment, enter the value (in terms of master units) in the **Extend** field or just enter the new station value. If entering a value in the **Extend** field, 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.

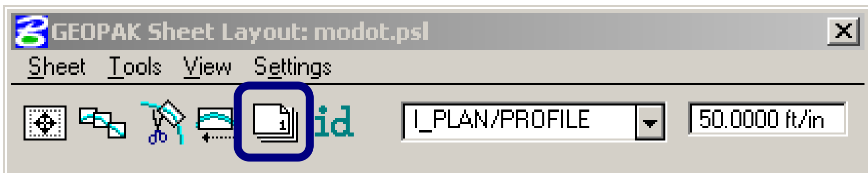
When the sheet is identified, the fields in the **Lateral Dimensions** are automatically populated. The user has the option to hold the **Left Station**, the **Right Station** or the **Center Station**. Only one station can be held while the other two are adjusted to the revised drawing parameters. Set the desired values andpress the **Apply** button to commence redrawing.

**Note:** There are no dynamic options when changing the drawing area.

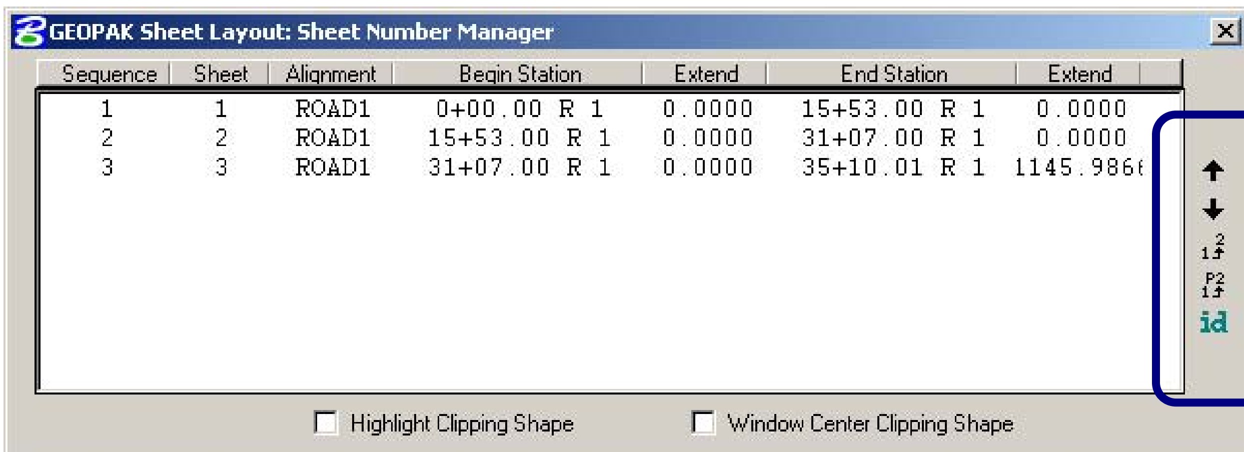
## 12.8 Sheet Number Manager

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.

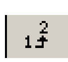


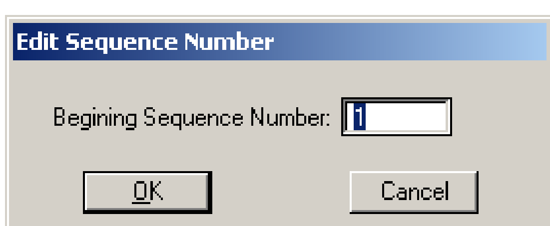

Once the tool is selected the dialog below appears.



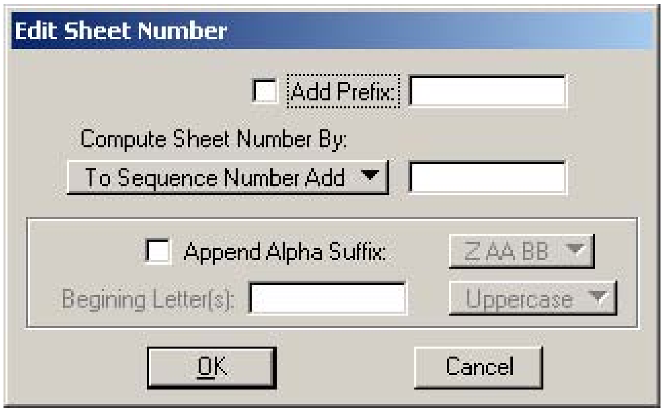

The dialog lists all the sheets in the order they will be drawn. By default the sequence of the sheets matches the sheet number. If the sequence of the sheets needs to be adjusted, the user can highlight the sheet and use the **up and down arrows** on the right hand side of the dialog.

The **id** icon allows the user to select a clip shape from the MicroStation file. The associated line in the list box is highlighted.

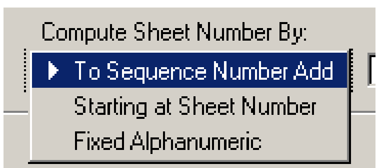
The **Edit Sequence** tool  may be used in the case that there are too many sheets to move with the arrows. Highlight the sheet to be moved and press the icon. **The Edit Sequence Number** dialog opens.



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:



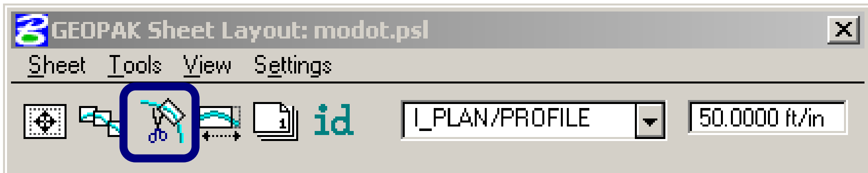

**To Sequence Number Add –** It renumbers the sheet by adding a value to the original sheet number. For example, if the original sheet number was 1 and sequence add number is 100; the new sheet number becomes 101.

**Starting at Sheet Number –** The user specifies a given number from where to start.

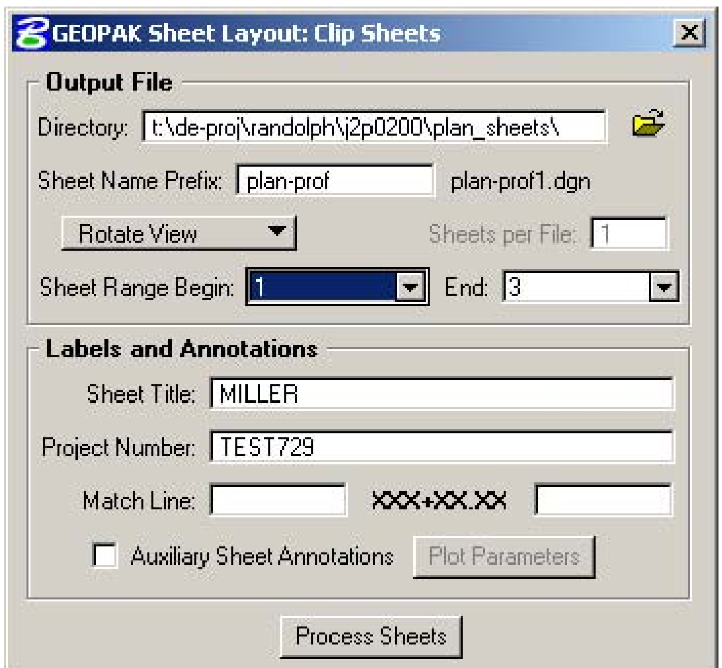
**Fixed Alphanumeric -** This field is used in combination with the bottom entries in the dialog. The user specifies to hold a fixed alphanumeric value and toggles the **Append Alpha Suffix.**

## 12.9 Clip Sheets

The **Clip Sheets** process can be accessed via pull down **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.

**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)

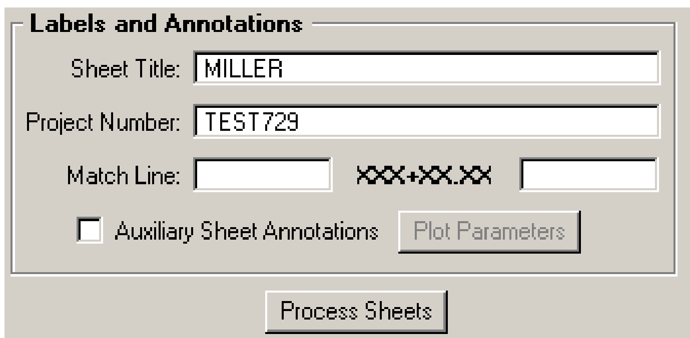
**Sheet Range –** Allows the user to choose which sheets to clip by selecting a **Begin** and **End** range.

### 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 Plot Parameters button will become available, and the user can define them accordingly.




**Process Sheets -** Once all the fields in the dialog box are entered, selecting the **Process Sheets**, initiates the sheet(s) creation.

## 12.10 Sheet Menu Options

**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.

**Layout –** Opens the Layout sheet dialog.

**Clip –** Opens the Clip sheet dialog.

**Exit –** Exits the Plan/Profile Sheets application.

## 12.11 Tools

**Modify –** Opens the Modify sheet dialog

**Sheet Number Manager –** Opens the Sheet Number Manager.

## 12.12 Settings

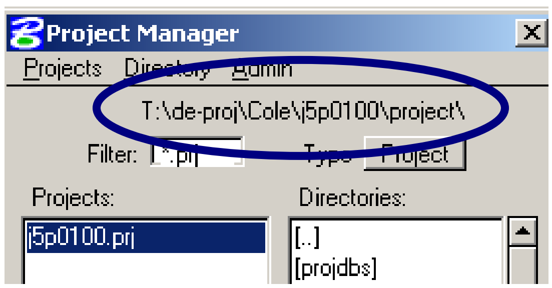
**Sheet Layout –** These settings allow the user to set up the Sheet Layout Progression, Profile Stair Stepping, and Sheet View Attributes.

## 12.13 Example 12-1

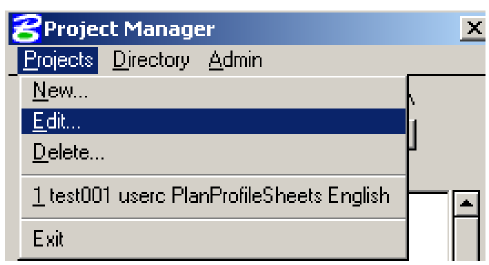
1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\rte_50plan_j5p0100.dgn**.

2. Attach the file **t:\de-proj\cole\j5p0100\data\profile_j5p0100.dgn as a reference file**.

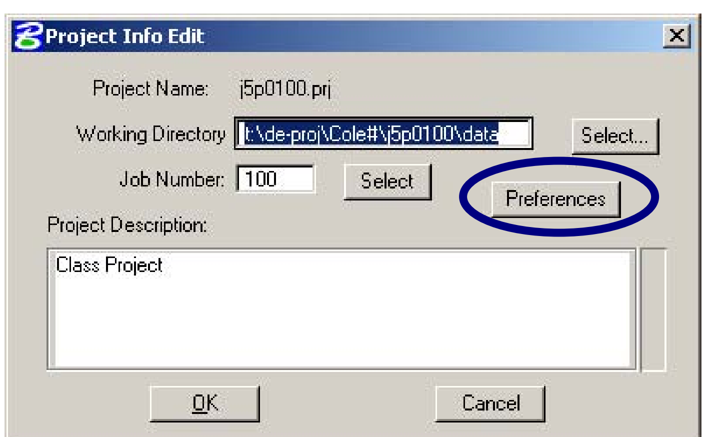
3. Select **Project Manager**, and navigate to the **j5p0100** project.



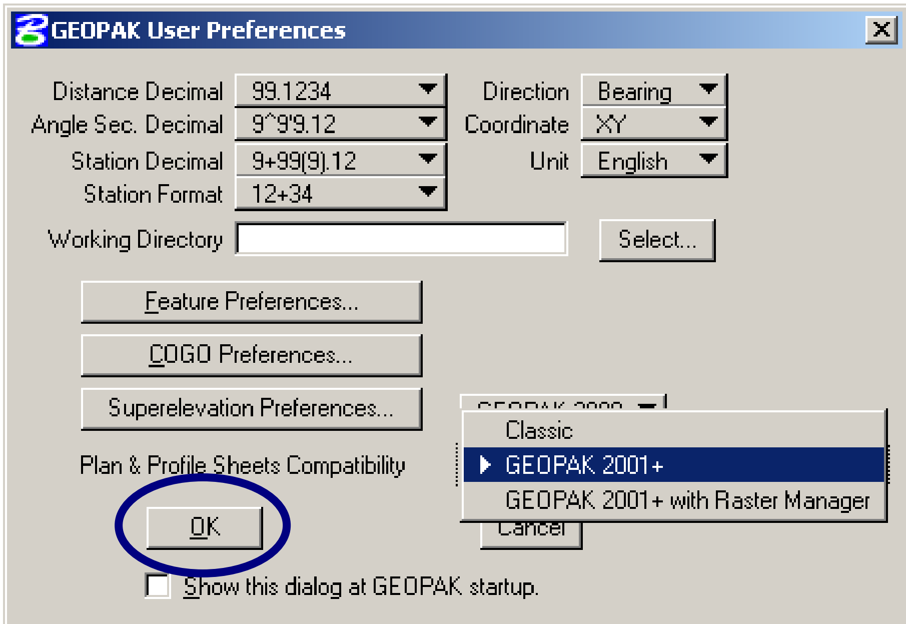

4. Select Projects >> Edit




Select Preferences



5. In the Geopak User Preferences, set the **Plan & Profile Sheets Compatibility** to **Geopak 2001+** as shown below.

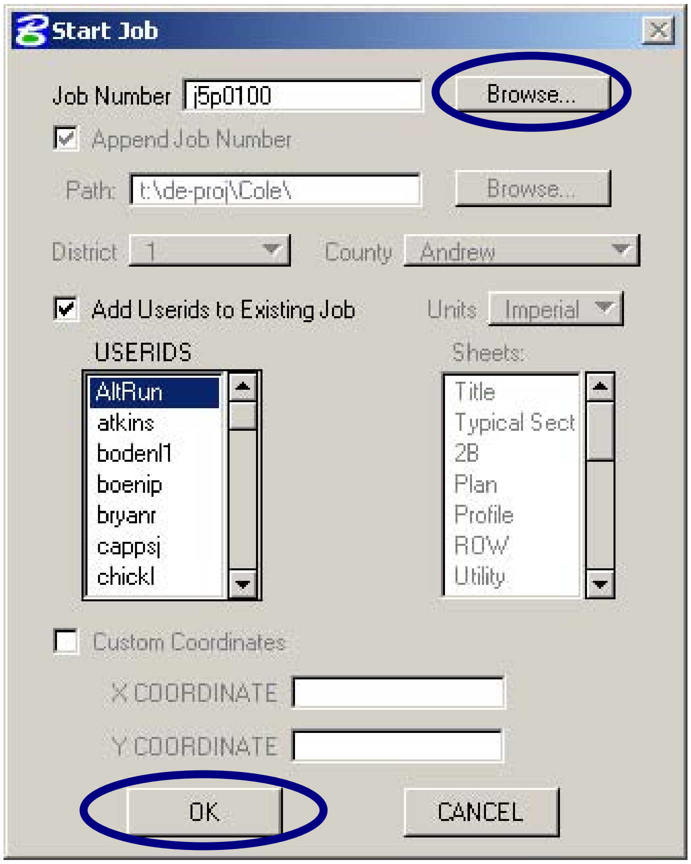



Select **OK**.

6. Enter the project, select **ClsUser**, an enter **Road**.

7. Select the **Start Geopak Job/Add User** tool from the MoDOT pull down menu to add user AltRun to the existing j5p0100 project.

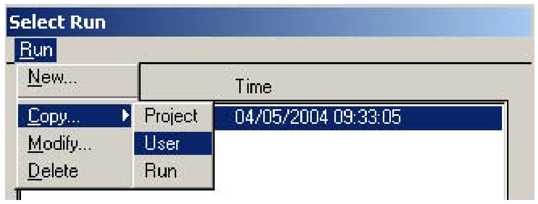
8. Check the **Add Userids to Existing Job** box. Click on the **Browse** button to navigate to the job folder. Select from USERIDS list **AltRun,** and click **OK**.



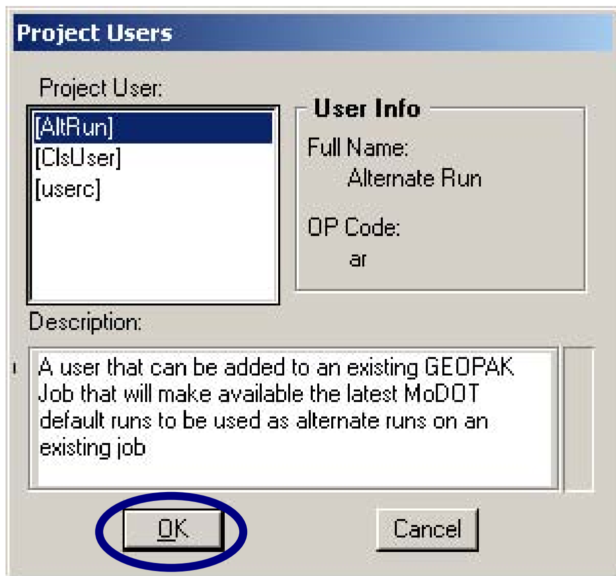

9. Select **Plan & Profile Sheets** from the **Road Project** flow chart


10. You will get an **Untitled** run as shown below. Delete the Untitled run.

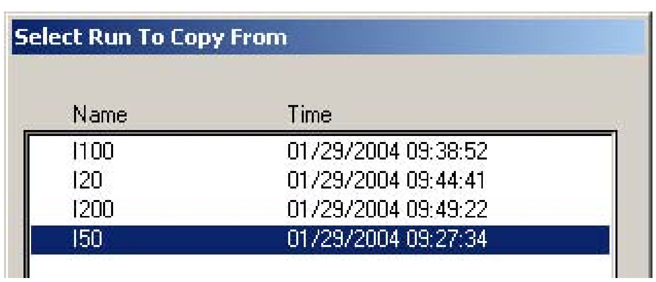
11. **Select Run >> Copy >> User**.




12. **Select** the **AltRun** user and click **OK**




13. Copy the **I50** run




Name the new run **Route50**. Enter the new run.

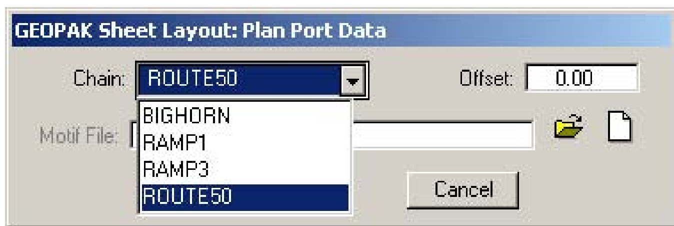
14. Select the **Plan/Profile Sheet** from the pull down.


Select the **Layout Sheets** via icon as shown above or by pull down menu **Sheet>>Layout**.

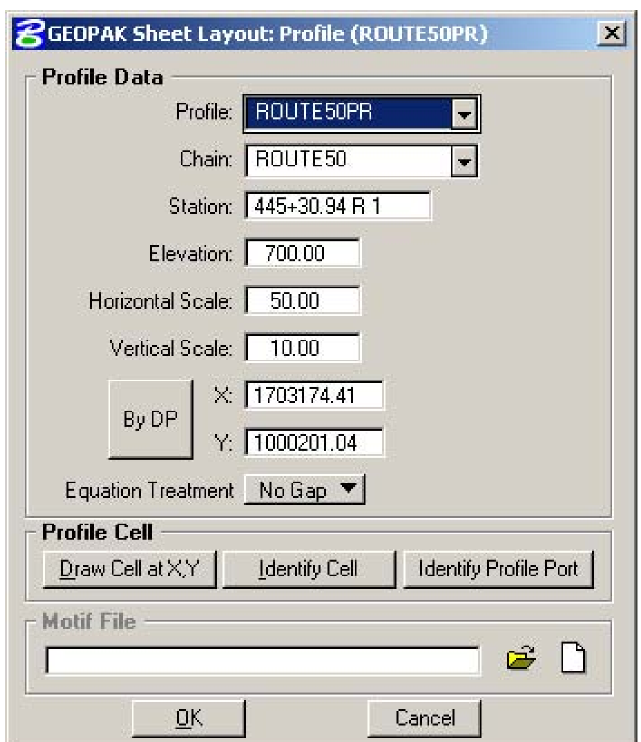
15. Set up the **Layout Sheets** dialog with the information for the Route50 working alignment:

Select Job **100** by clicking on the open folder icon, as shown to the right.


Double click on **Port 1**. Select the **Route50** chain from pull down.

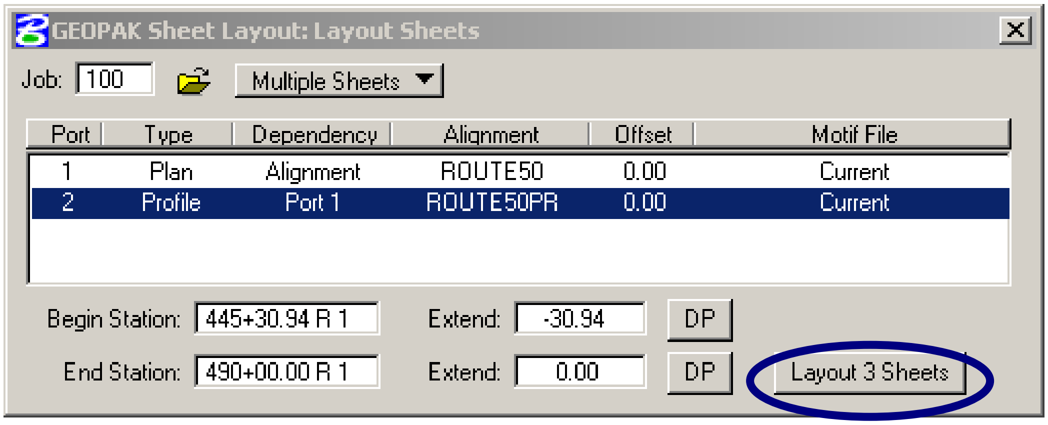



Double click on **Port 2**. Select the Profile **ROUTE50PR** and populate the rest of the dialog using the **Identify Cell**.



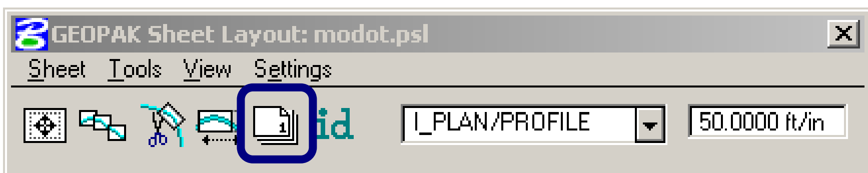
16. Once the ports are populated as shown below, enter the following:

Begin Station **445+30.94 R1** Extend: **-30.94**
End Station **490+00.00 R1**

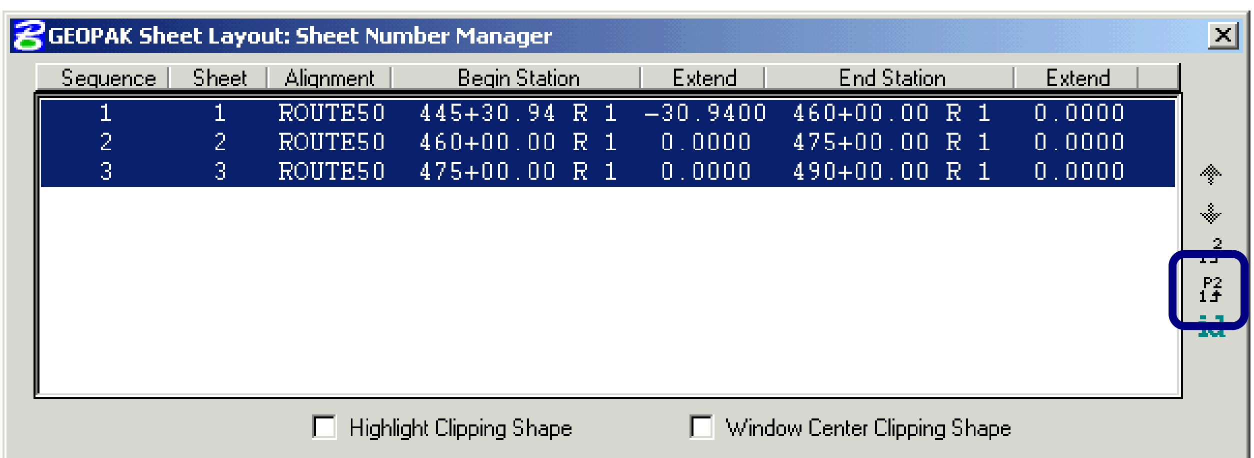



Once the dialog is completed as shown above, select the **Layout Sheets** button.

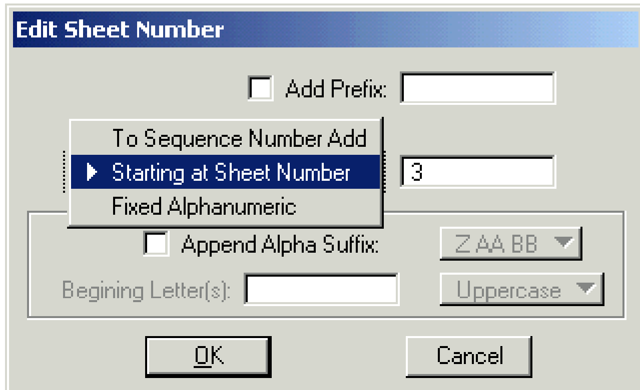
17. Select the **Sheet Number Manager** icon outlined below.




Highlight the three sheets in the Sheet Number Manager, a shown below. Click on the **Edit Sheet Number** icon outlined in the figure.



17. (Continued) Change the Compute Sheet Number By: option to **Starting at Sheet Number** and set its value to **3**, as indicated in the following figure.

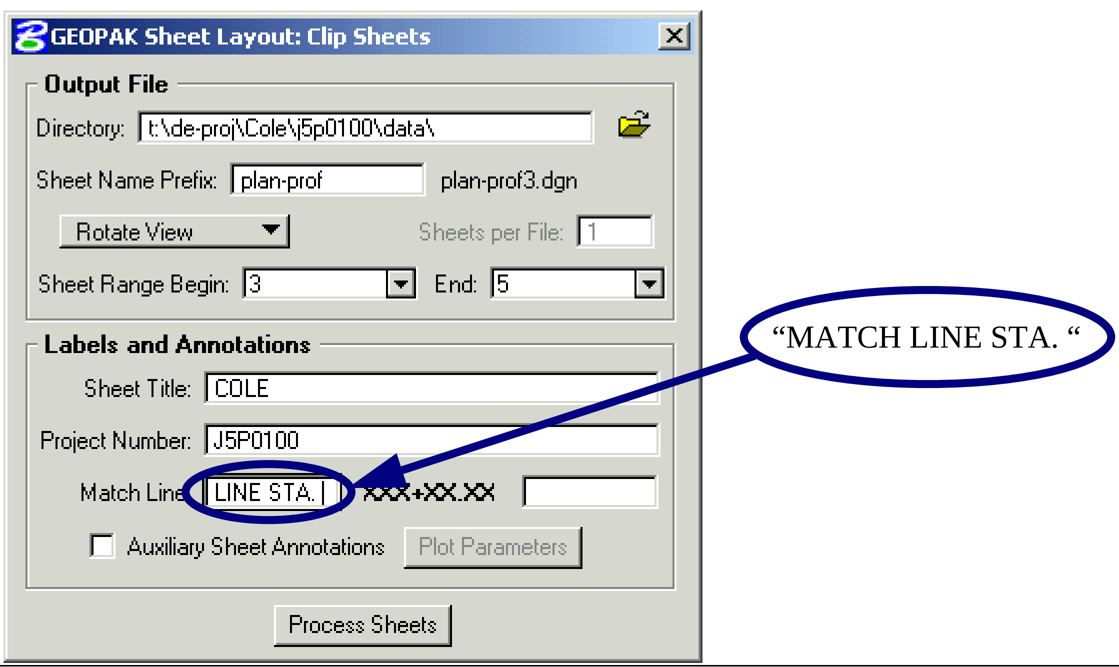



Click **OK** to change the sheet number and **close** the **Sheet Number Manager**. Save the changes.

18. Go to the **MicroStation** pull down **Workspace** >> **Preferences**. In the **Operations** section of the dialog check on **Immediately Save Design Changes**.

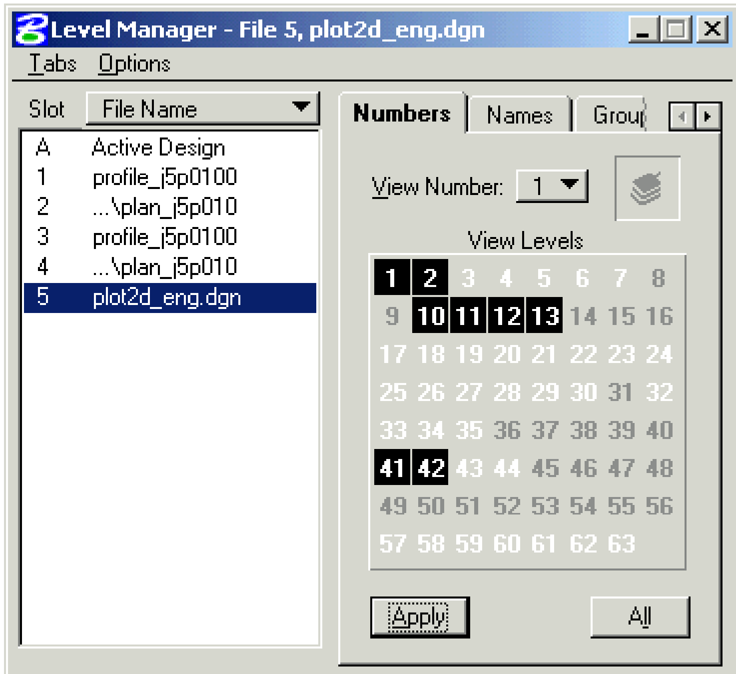
19. Select the **Clip Sheets** icon or via pull down menu **Sheet** >> **Clip** and set up


Populate the Clip Sheets dialog as shown below (The text "**MATCH LINE STA.**" goes in the Match Line field) and select **Process Sheets**.



20. Use the MicroStation **Level Manager** and **Reference** tools to clean up the sheets.

21. Using the **Level Manager**, turn on Levels **41** and **42** in the **plot2d_eng.dgn** reference file to see the grid for the profile port.




22. Go back to **Workspace** >> **Preferences** >> **Operations** and uncheck **Immediately Save Design Changes**.

## Chapter 13

# Original Ground

# Cross Sections

## 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

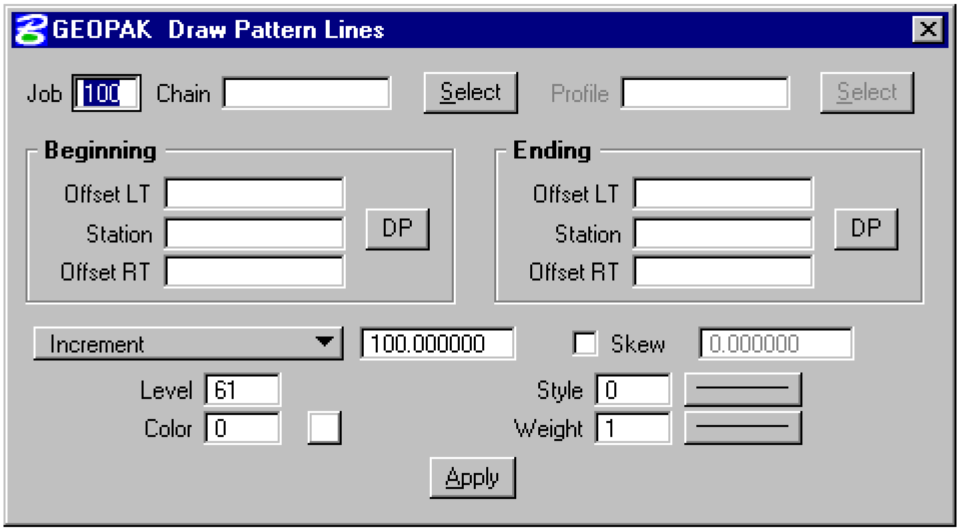
To access the **Draw Pattern Lines** dialog box, go to **Project Manager >> Draw Pattern** or choose the **Draw Pattern** icon.

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 **Offset LT** and **Offset RT** 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.)

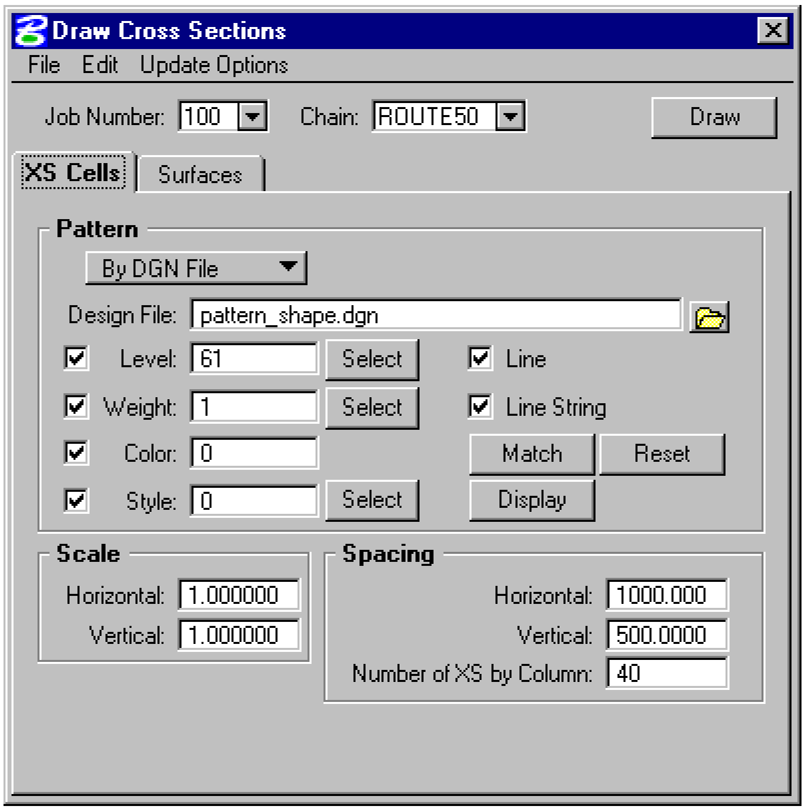
The cross section **skew** can be set using the **skew** toggle. The pattern line is skewed by the specified angle from the standard pattern line (perpendicular to the baseline). A positive skew angle will rotate the pattern line clockwise, and a negative skew angle will rotate the pattern line counter-clockwise.

Once all the key-in fields have been completed and the **Apply** 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.

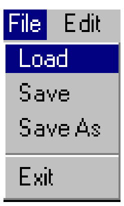
The user can use the Microstation **Place Smartline**, or **Place Line** command to draw additional pattern lines as needed.

## 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.

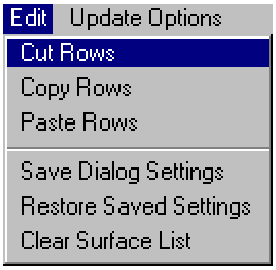



### 13.5.1 File Menu



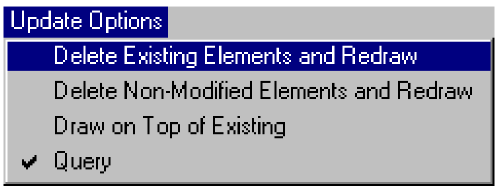

The **File** menu allows the user to save the dialog settings for each chain. The user sets the parameters for each chain, and then selects **File>>Save**. The next time the user accesses this dialog, the current information is completed from the resource files. The user can select **File>>Load** to 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



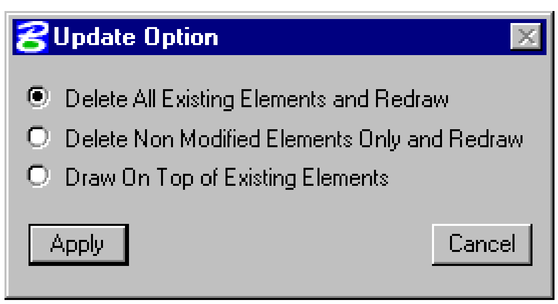

The **Update Options** dialog determines how previously cut original ground section elements will be handled when drawing new original ground section elements on the same cross section cells.

**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.

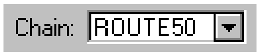
**Query –** brings up the following dialog when the **Draw** button is pressed. The user can choose which option to use.




### 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.

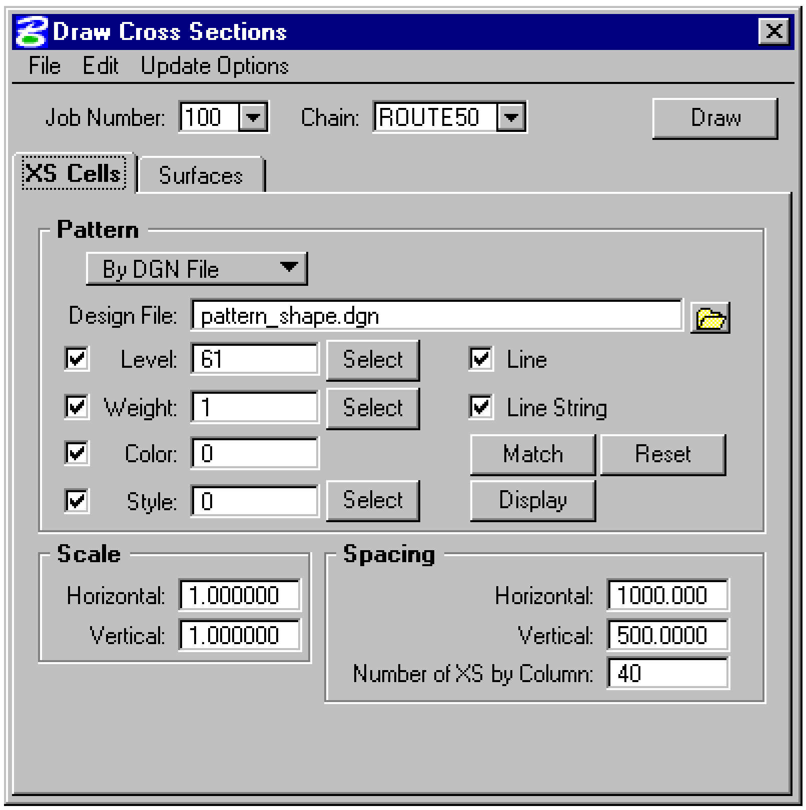
## 13.5.5 Chain




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.

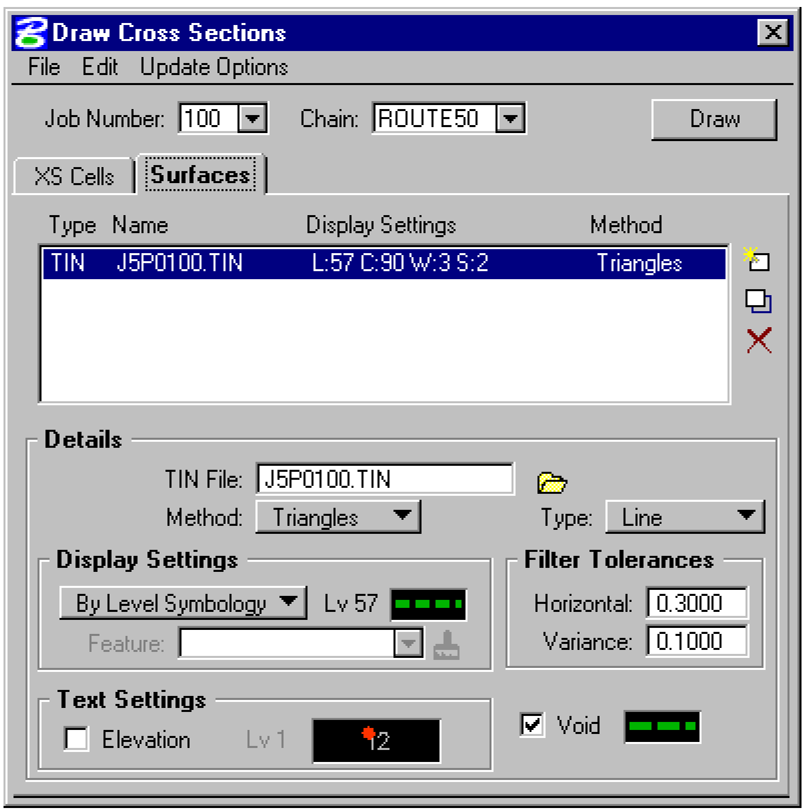
**In Existing Only** – this option uses the only the cross section cells drawn in the current Microstation Design File.

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.



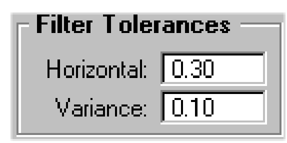

The top portion of the dialog lists the surfaces to be cut, and the symbology to be used when drawing the cross sections for the given surface. The icons on the right allow surfaces to be added, modified, or deleted.

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 | 57 | 90 | 3 | 2 |
| Void Areas | 57 | 40 | 3 | 2 |
| Top of Rock | 58 | 8 | 3 | 2 |
| Bottom of Rock (for rock seam) | 58 | 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.



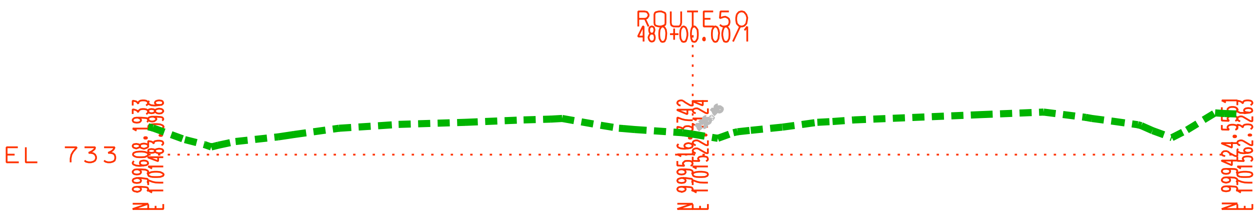

The existing ground elevation at the baseline can be plotted using the **Text Settings** portion of the dialog. To use the text settings option, turn on the **Elevation** toggle. Choosing the symbology box located next to the elevation toggle can set the text symbology.


### 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.



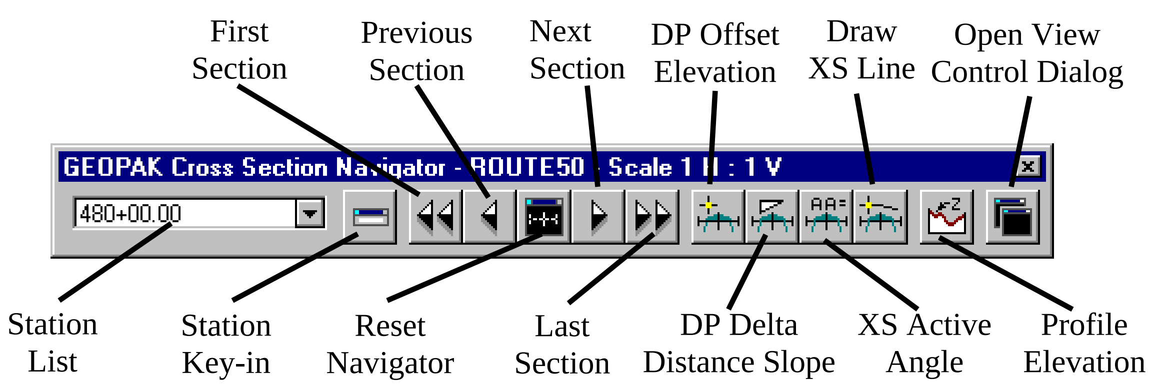

The intelligence of the cross section is built into the cross section cell. This cell is located on level 63. The cell consists of the baseline name, the station and region, the end coordinates for the cross section location, and the coordinates for the location at which the cross section intersects 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

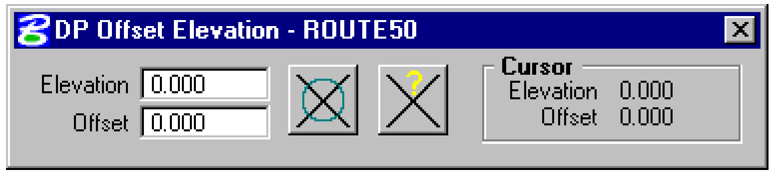
The **Cross Section Navigator** is a tool used to view and move between cross-sections. It can also be used to draw cross-section information.

The user can access **Cross Section Navigator** by the **Cross Section Navigator** icon. When the icon is chosen, the following dialog appears.

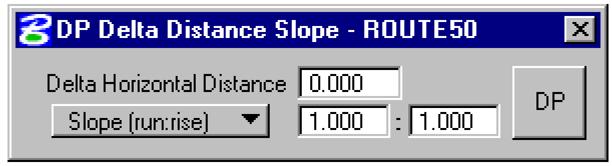



The user can move through the cross-sections by either choosing the station from the pull-down list, by typing the station value into the **Station Key-in** dialog, or by using the **First Section**, **Previous Section, Next Section,** or **Last Section** icons. The **Reset Navigator** icon will center 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.

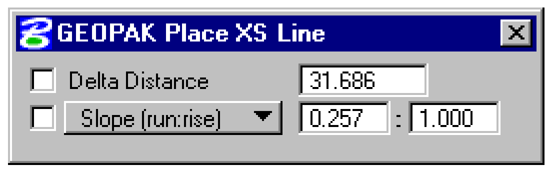



**DP Delta Distance Slope –** draws a line at a given horizontal distance and slope.

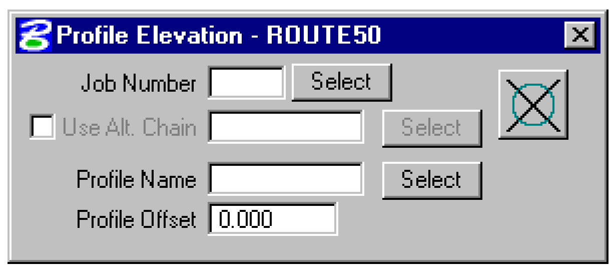



**XS Active Angle Tool** – sets the active angle to the given value. If a Microstation tool is used with the active angle option, this value will be used.

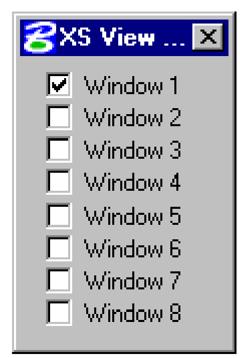

**Draw XS Line –** draws a cross-section line. An offset or a slope can be specified.




**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

1. Open the MicroStation file **t:\de-proj\cole\j5p0100\data\pattern_shape_j5p0100.dgn**.

   Save the file as file as **t:\de-proj\cole\j5p0100\data\rte50_pattern_shape_j5p0100.dgn**.

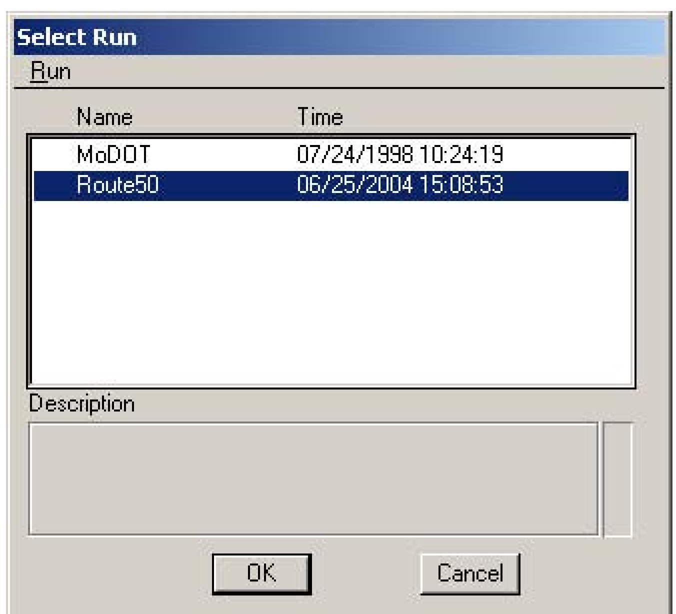
2. Attach **t:\de-proj\cole\j5p0100\data\rte50_plan_j5p0100.dgn** as a reference file.

   Fit the view and turn off levels 60 and 62 in the reference file.

3. Select the **Route50** working alignment in the **t:\de-proj\Cole\j5p0100\project\j5p0100.prj** project.

4. Choose **Draw Patterns** from the **Road Project** dialog.


   Copy the **MoDOT** run to **Route50**, and open the **Route50** run.

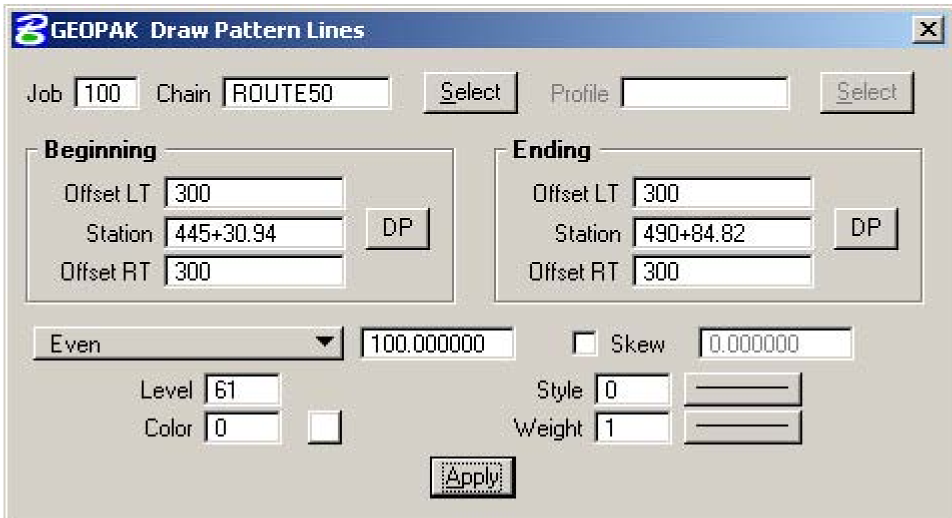


5. Create pattern lines for the **Route50** alignment.

Job: **100**
Beginning
Offset LT: **300**
Station: *Beginning of Chain*
Offset RT: **300**

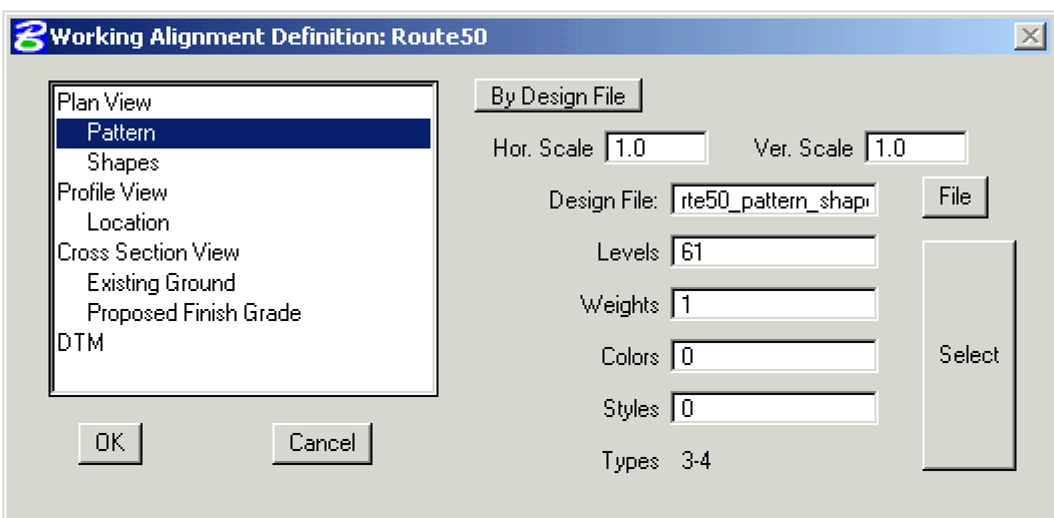
Chain: **Route50**
Ending
Offset LT: **300**
Station: *Ending of Chain*
Offset RT: **300**

Even 100




**Exit** Draw Pattern Lines and **Save** the settings.

6. In the **Pattern** section of the Route50 **Working Alignment** set the **Design File** to **rte50_pattern_shape_j5p0100.dgn**.



7. Open the Microstation file **t:\de-proj\cole\j5p0100\data\xs_j5p0100.dgn**. Save the file as file **t:\de-proj\cole\j5p0100\data\rte50_xs_j5p0100.dgn**.

8. Choose **Existing Ground Cross Sections** from the **Project Manager** dialog.

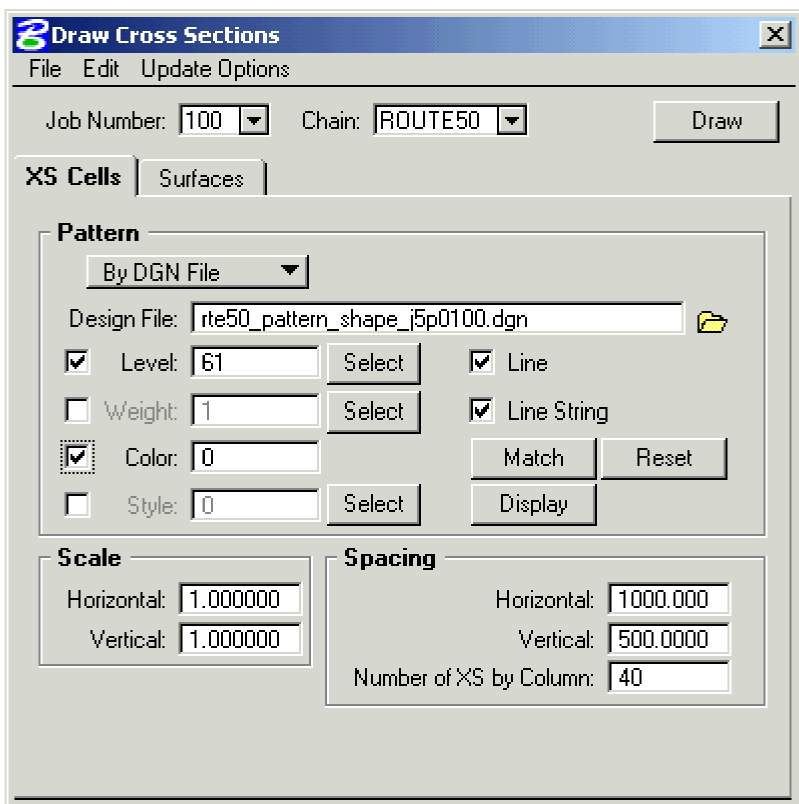

Copy the MoDOT run to **Route50**, and open the **Route50** run.

9. Cut the existing ground cross-sections with the following parameters.

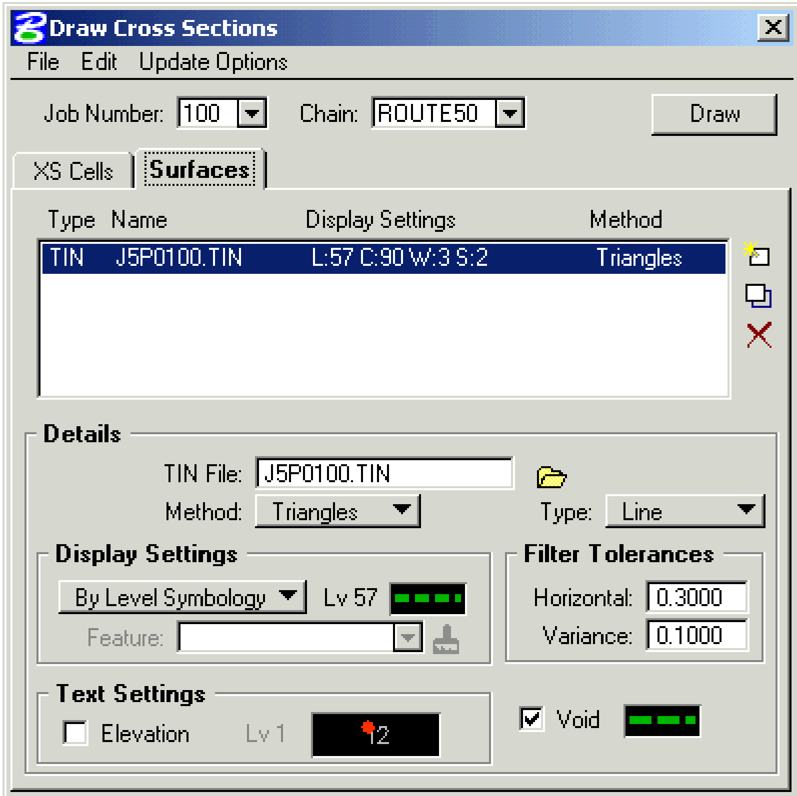
In the **XS Cells** tab:

Job Number: **100**
Chain: **Route50**
Pattern: **By DGN File**
Design File: **rte50_pattern_shape_j5p0100.dgn**

**Toggle** on **Level**, **Color**, **Line**, and **Line String**. Leave the rest of the settings as shown below.



9. (Continued) Switch to the Surfaces tab and set the list box as shown below with the tin file set to **j5p0100.tin**.

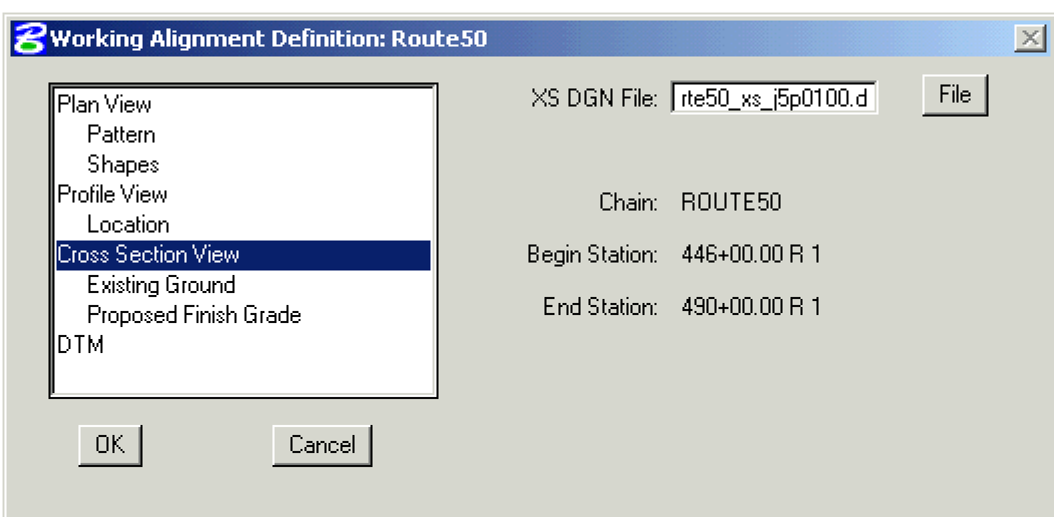



Click on Draw to create the cross sections.

Once the cross sections are drawn, exit the Draw Cross Sections tool and save the settings.

Save the changes to the MicroStation drawing.

10. In the **Cross Section View** portion of the Route50 **Working Alignment** set the **XS DGN File** to **rte50_xs_j5p0100.dgn**.



Chapter 14

# Superelevation

## 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.

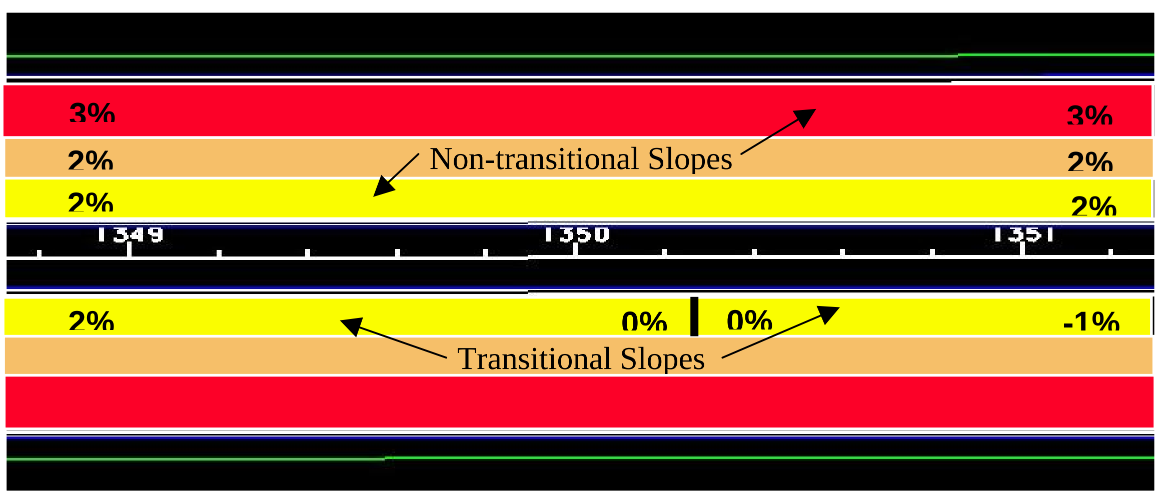
## 14.2 Definitions

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.



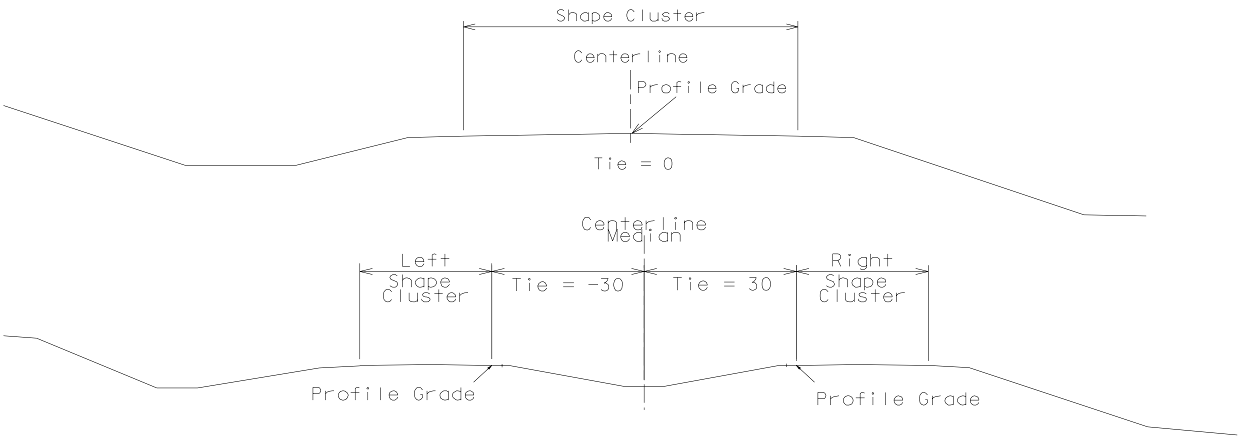
### 14.2.2 Shape Clusters

Four attributes are associated with each shape depending on the definition of the profile grade line.

**Baseline** – roadway baseline

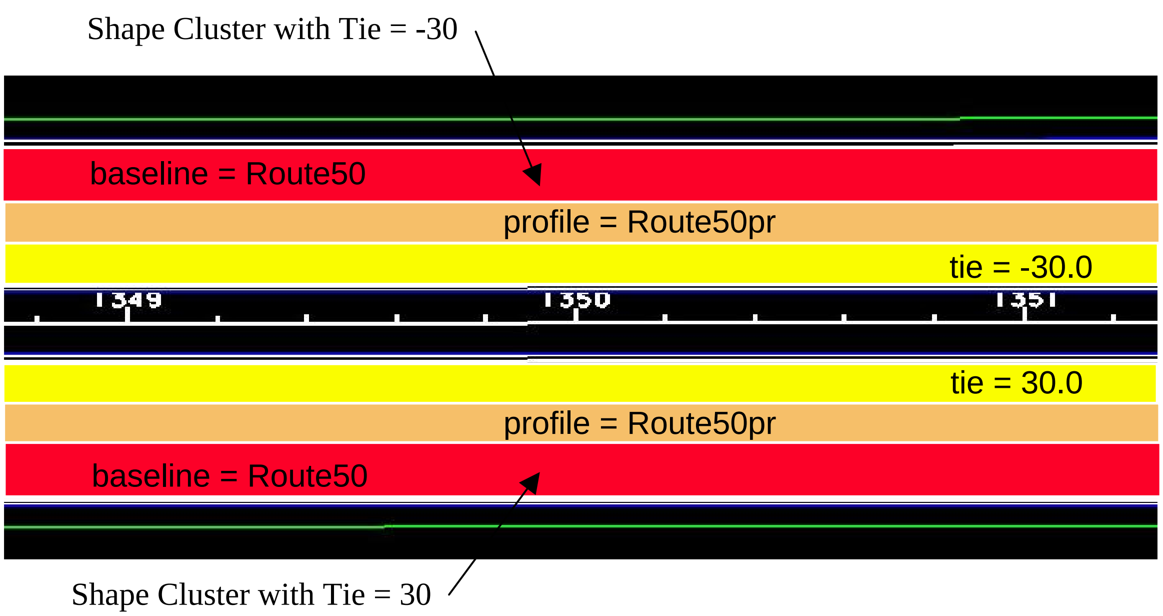
**Profile** – roadway profile

**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.)

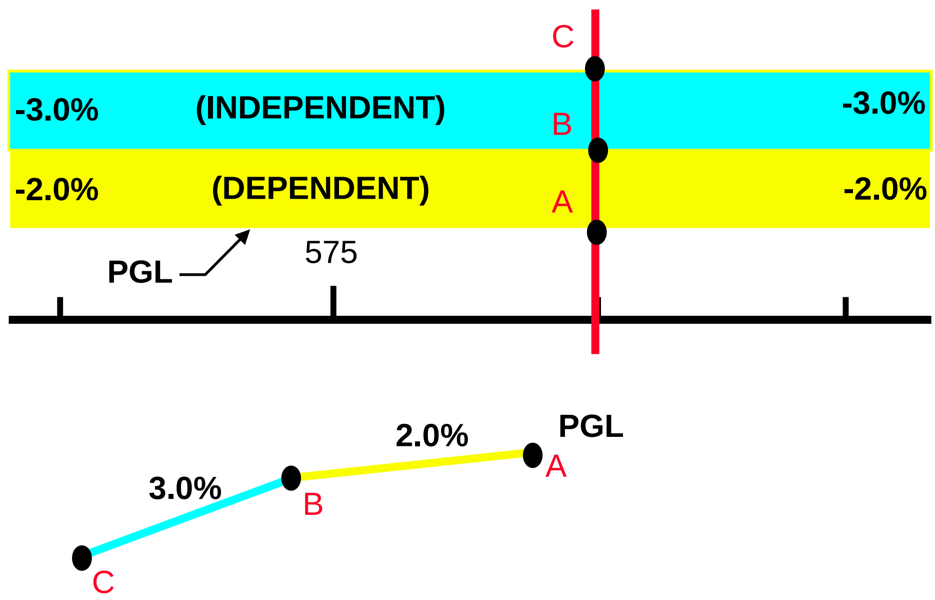
A group of shapes with the same shape attributes is called a "Shape Cluster".



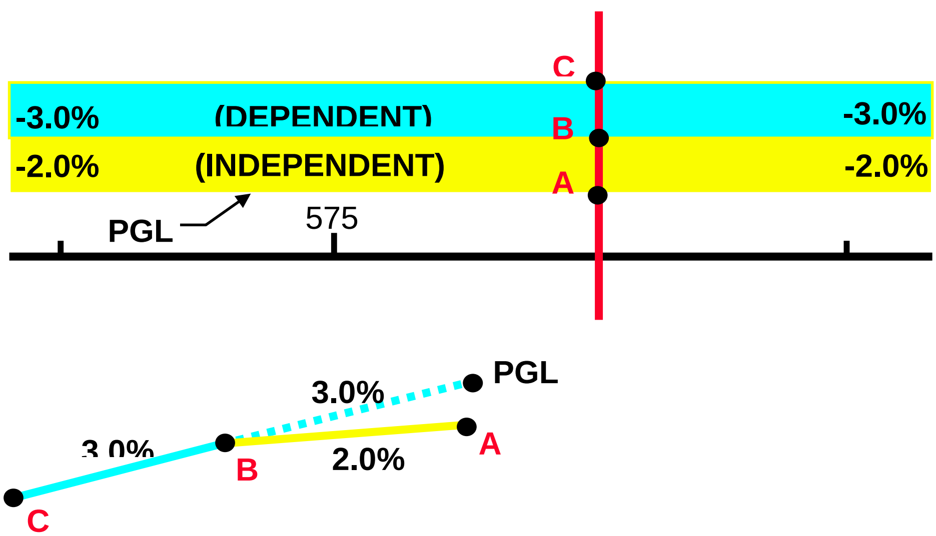
### 14.2.3 Shape Class

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.

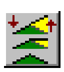
### 14.2.4 Shape Elements

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**.

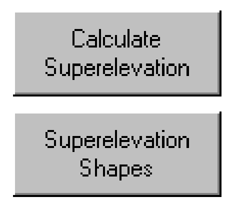
**Longitudinal Edges** - Typically, these consist of the roadway edges of pavement or lane lines. These lines do not represent slopes.

**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



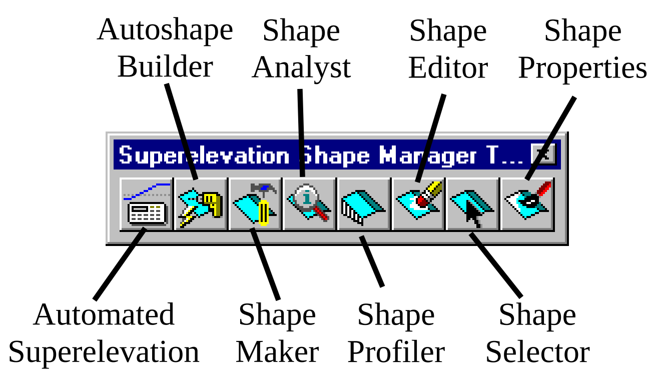
The superelevation tools can be accessed from the cross section toolbox by choosing the **Superelevation Shape Manager** tool. When selected, the superelevation toolbox will be displayed.




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**.

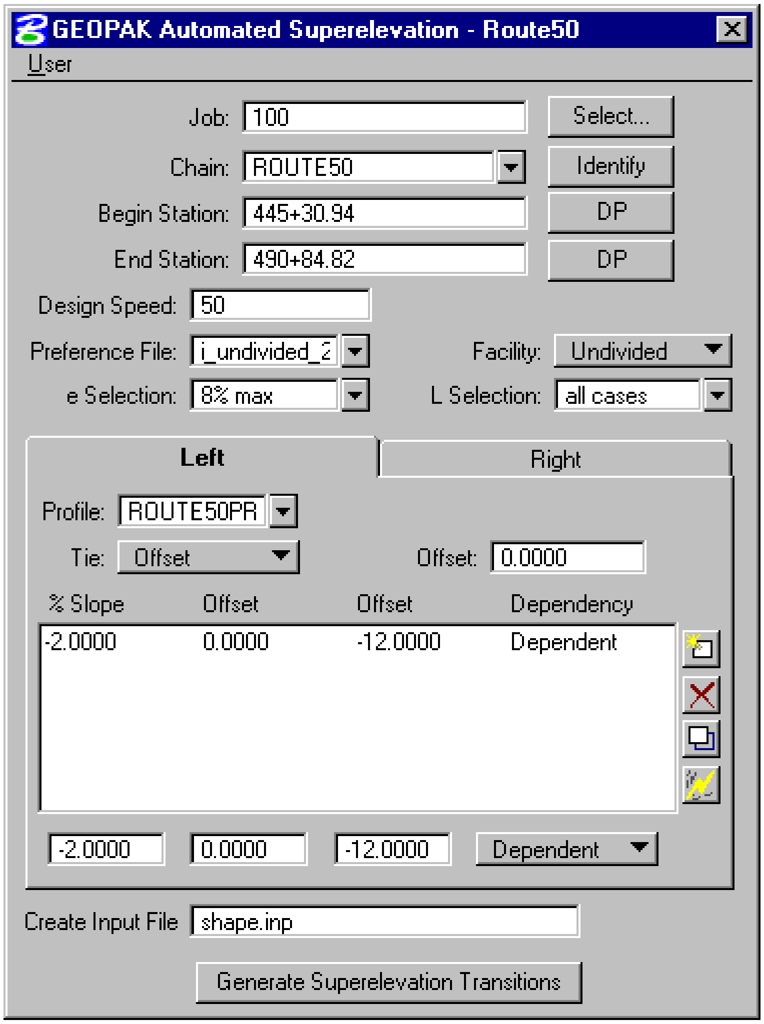
## 14.4 Dialog

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 **Beginning** and **Ending 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.

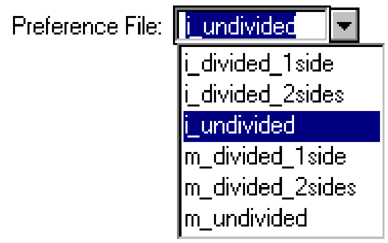
**Chain** – Baseline chain name for the project. This may be the centerline of roadway for an undivided roadway, the centerline of median for a divided roadway, or the edge of pavement for a ramp.

**Beginning Station** – station to begin the shapes.

**Ending Station** – station to end shapes.

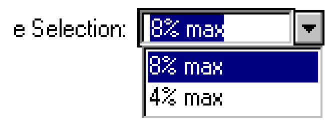
**Design Speed** - the design speed for the project that determines the rate of superelevation for curves.

**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.

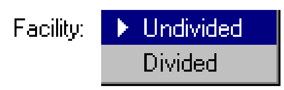



- **i_divided_1side** – imperial, divided roadway, using standard 203.21G, when calculating only 1 side of the median
- **i_undivided** – imperial, undivided roadway, using standard 203.20E
- **m_divided_1side** – metric, divided roadway, using standard M203.21G, when calculating only 1 side of the median
- **m_undivided** – metric, undivided roadway, using standard M203.20E

**e Selection** – the maximum superelevation value to be used for the alignment.




**Facilitiy** – set according to if the roadway is Undivided or Divided

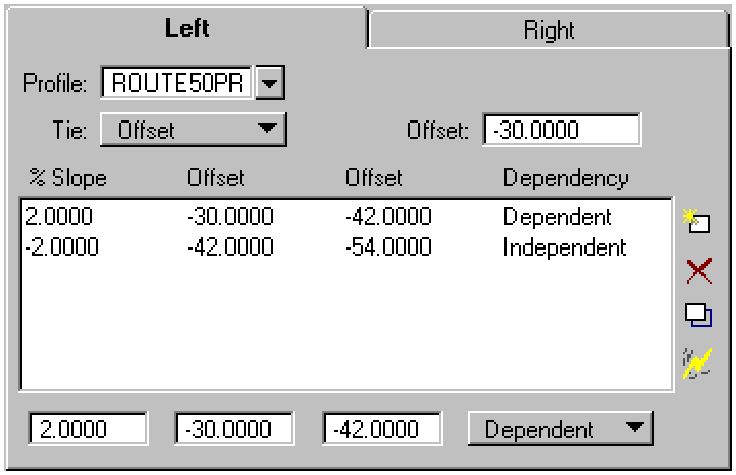



**L Selection** – this should be set to **All Cases** for all situations.


**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.



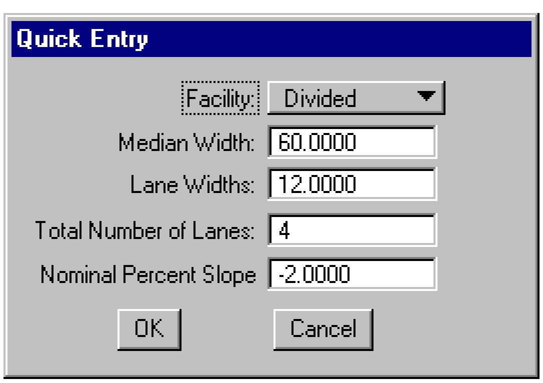

**% Slope** – define as the normal slope for this section of roadway.

**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.

**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.


Shapes can be added by specifying the % Slope, offsets, and dependency, then pressing the add button. Once listed, the shapes can be deleted , or modified using the respective buttons.




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.

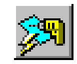
When the **Automated Superelevation** dialog has been completed, the user presses the **Generate Superelevation Transitions** button. This will create the input file specified in the **Create Input Field** dialog.

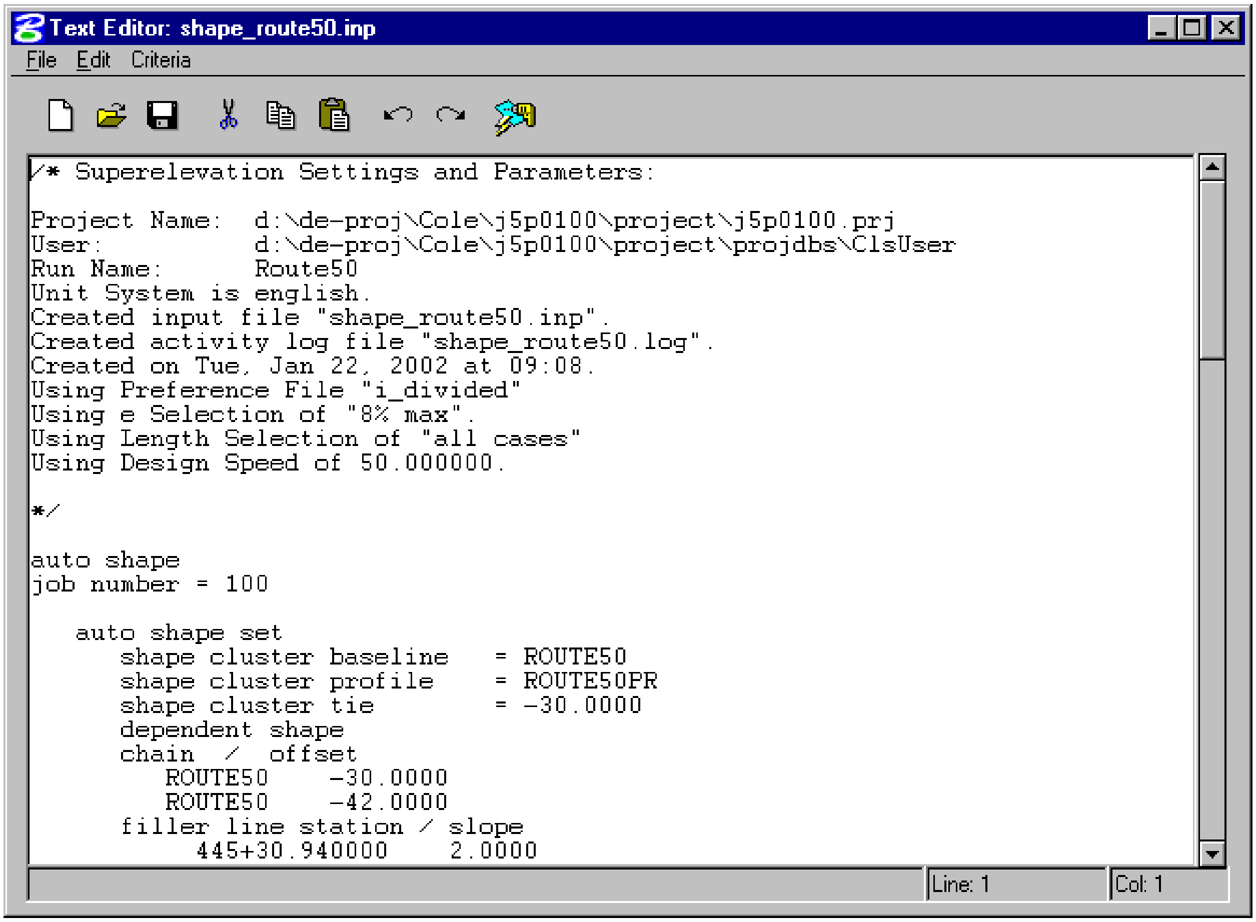
### 14.4.2 Superelevation Input File

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:
Unit System is english.
Created input file "shape.inp".
Created activity log file "shape.log".
Created on Mon, Oct 08, 2001 at 20:49.
Using Preference File "i_divided"
Using e Selection of "8% max".
Using Length Selection of "8% max"
Using Design Speed of 50.000000.
*/

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    -30.0000
      ROUTE50    -42.0000
    filler line station / slope
       445+30.940000    2.0000
       462+89.133015    2.0000
       465+18.080384   -3.8000  /* Curve ROUTE50-1 */
       488+24.816494   -3.8000  /* Curve ROUTE50-1 */
       490+53.763863    2.0000
       490+84.817000    2.0000

  auto shape set
    shape cluster baseline   = ROUTE50
    shape cluster profile    = ROUTE50PR
    shape cluster tie        = -30.0000
    independent shape
    chain  /  offset
      ROUTE50    -42.0000
      ROUTE50    -54.0000
    filler line station / slope
       445+30.940000   -2.0000
       464+47.027752   -2.0000
       465+18.080384   -3.8000  /* Curve ROUTE50-1 */
```

```
        488+24.816494   -3.8000  /* Curve ROUTE50-1 */
        488+95.869125   -2.0000
        490+84.817000   -2.0000

  auto shape set
    shape cluster baseline   = ROUTE50
    shape cluster profile    = ROUTE50PR
    shape cluster tie        = 30.0000
    dependent shape
    chain  /  offset
      ROUTE50    30.0000
      ROUTE50    42.0000
    filler line station / slope
        445+30.940000    2.0000
        464+47.027752    2.0000
        465+18.080384    3.8000  /* Curve ROUTE50-1 */
        488+24.816494    3.8000  /* Curve ROUTE50-1 */
        490+53.763863    2.0000
        490+84.817000    2.0000

  auto shape set
    shape cluster baseline   = ROUTE50
    shape cluster profile    = ROUTE50PR
    shape cluster tie        = 30.0000
    independent shape
    chain  /  offset
      ROUTE50    42.0000
      ROUTE50    54.0000
    filler line station / slope
        445+30.940000   -2.0000
        462+89.133015   -2.0000
        465+18.080384    3.8000  /* Curve ROUTE50-1 */
        488+24.816494    3.8000  /* Curve ROUTE50-1 */
        490+53.763863   -2.0000
        490+84.817000   -2.0000

  Plot Parameters
    Dependent Shape
      lv = 63
      co = 6
      lc = 0
      wt = 2
    Dependent Text
      lv = 63
      co = 6
    Independent Shape
      lv = 63
      co = 1
      lc = 0
      wt = 2
    Independent Text
      lv = 63
      co = 1

Write shapes into dgn = d:\de-proj\Cole\j5p0100\data\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. 




```
/* Superelevation Settings and Parameters:

Project Name:  d:\de-proj\Cole\j5p0100\project\j5p0100.prj
User:          d:\de-proj\Cole\j5p0100\project\projdbs\ClsUser
Run Name:      Route50
Unit System is english.
Created input file "shape_route50.inp".
Created activity log file "shape_route50.log".
Created on Tue, Jan 22, 2002 at 09:08.
Using Preference File "i_divided"
Using e Selection of "8% max".
Using Length Selection of "all cases"
Using Design Speed of 50.000000.

*/

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     -30.0000
         ROUTE50     -42.0000
      filler line station / slope
           445+30.940000    2.0000
```

## 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.**

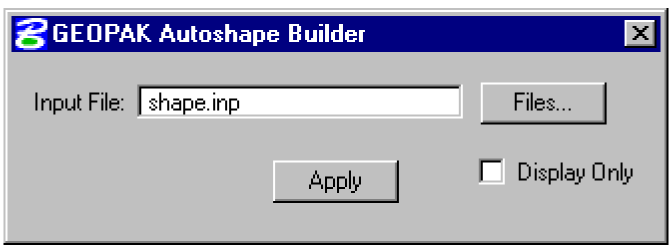
**Superelevation Calculation Complete.**
**Output written to file "shape.inp"**

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.

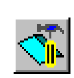


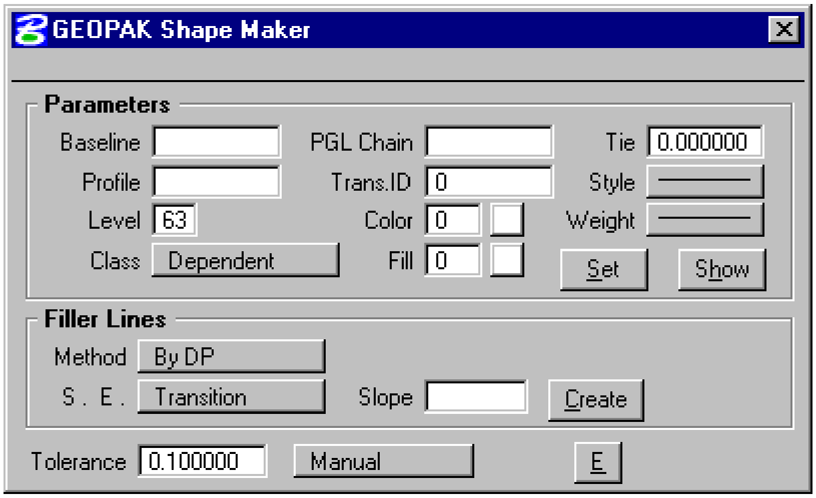

The user selects the input file to process, then presses the **Apply** button to execute the input file. The **Display Only** toggle can be turned on to temporarily plot the shapes into the Microstation design file. When the view is updated, the temporary graphics will be deleted.

## 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.

**Level -** Microstation level on which shape will be placed.

**Class -** dependent or independent, as previously discussed

**PGL Chain -** chain to define the profile location if the tie distance varies.

**TransID -** determines linear or parabolic transition.  Use 0 for linear transition.

**Tie -** distance between the profile and the baseline.

**Set -** used to change the parameters of an existing shape

**Show -** used to display the parameters of an existing shape.

## 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

**S.E.:**

**Transition -** 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

**Tolerance -** user specified acceptable maximum gap between the Microstation elements that make up the shape

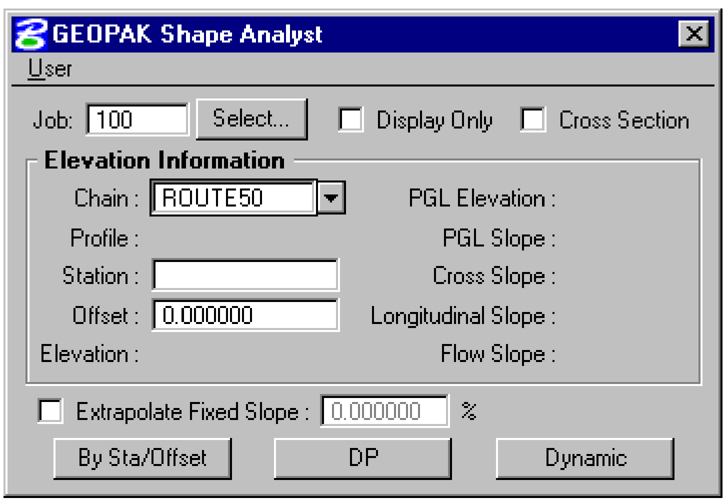
**Complete Shape:**

**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.

# 14.6 Additional Superelevation Tools

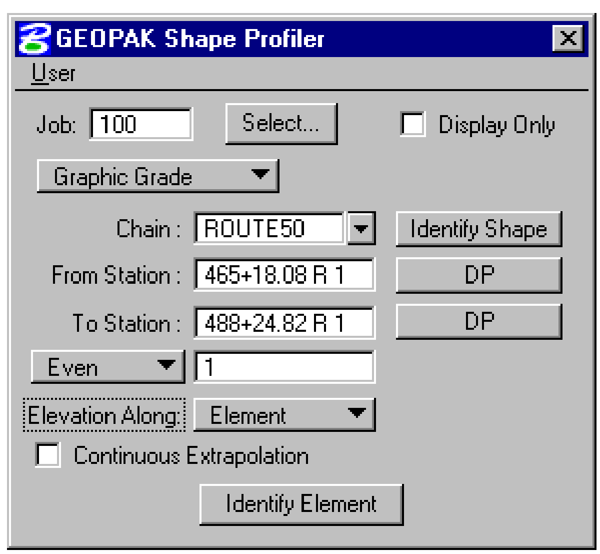
## 14.6.1 Shape Analyst

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.



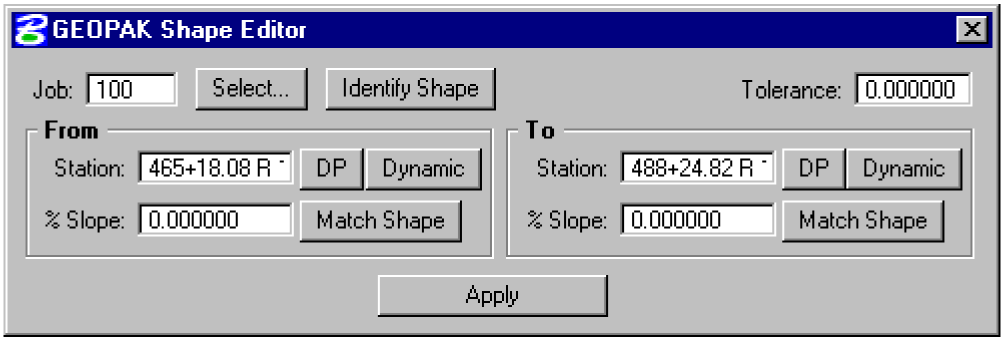

## 14.6.2 Shape Profiler

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.



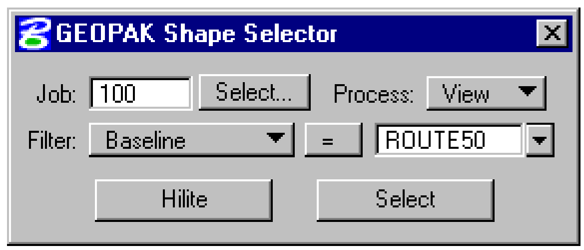
### 14.6.3 Shape Editor

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.

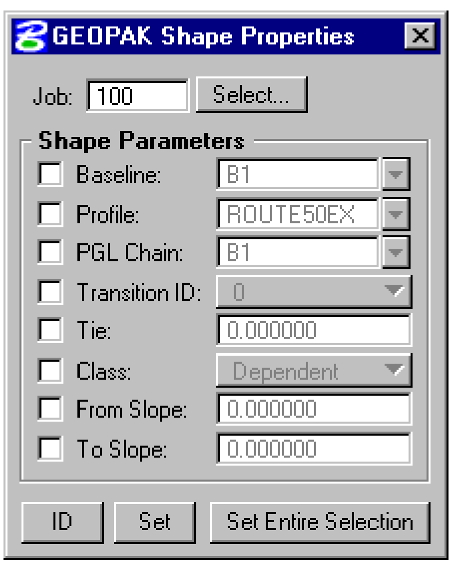



### 14.6.4 Shape Selector

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.

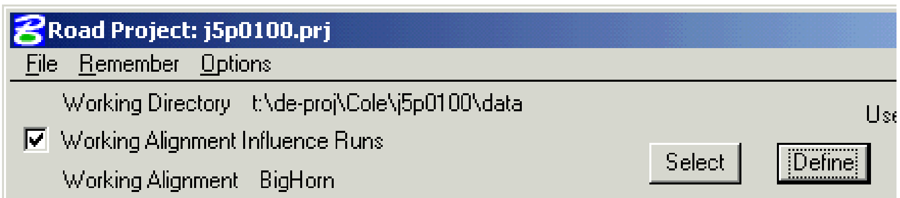
## 14.7 Example 14-1

1. Open the Microstation file **t:\de-proj\cole\5p0100\data\BH_pattern_shape_j5p0100.dgn**.

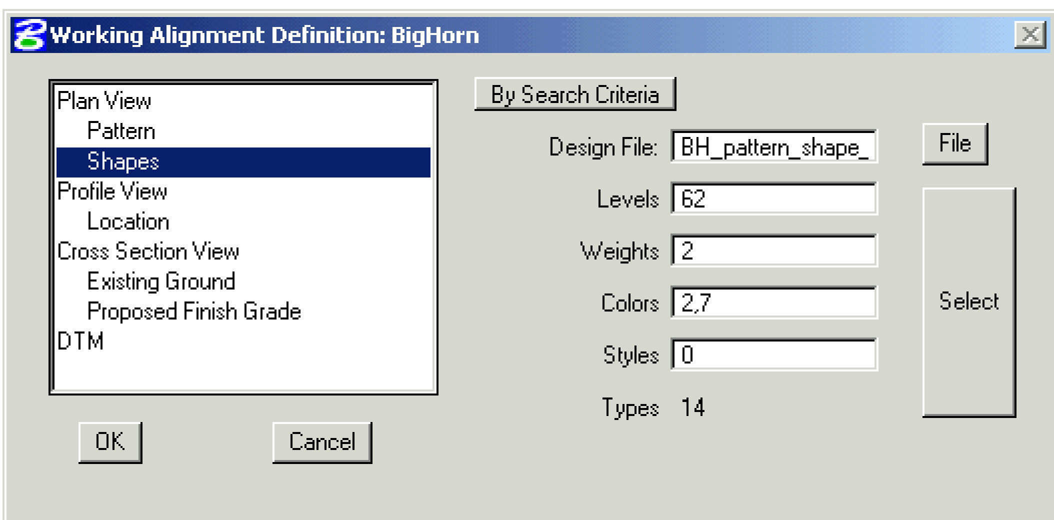
2. Open the project **t:\de-proj\cole\5p0100\project\j5p0100.prj**.

   Select the user **ClsUser** and enter **Road**.

3. Select the **BigHorn** working alignment and click on Define to enter the Working Alignment Definition.

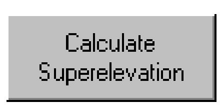



   Switch to the Shapes section and notice that the design file is already set and that the symbology is set to Level 62 and Colors 2,7, as shown below.




   Close the Working Alignment Definition dialog by clicking on **OK**.

4. Choose Calculate Superelevation from the Road Project dialog.

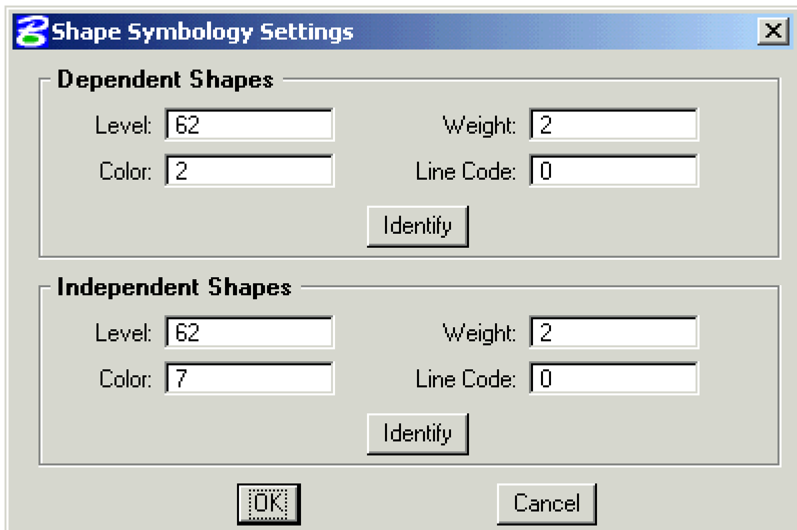



   Copy the **MoDOT** run to **BigHorn**, and open the **BigHorn** run as demonstrated.

5. In the **Automated Superelevation dialog**, go to **User > Symbologies**.


Make the following changes as shown in the picture of the dialog.

| | | |
|---|---|---|
| Dependent Shapes | Level: **62** | Color: **2** |
| Independent Shapes | Level: **62** | Color: **7** |




6. Setup the superelevation using the following parameters.

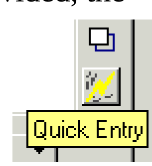
Job: **100**
Chain: **BIGHORN**
Begin Station: ***Beginning of Chain***
End Station: ***End of Chain***

Design Speed: **30**
Preference File: **i_undivided**
e Selection: **8% max**

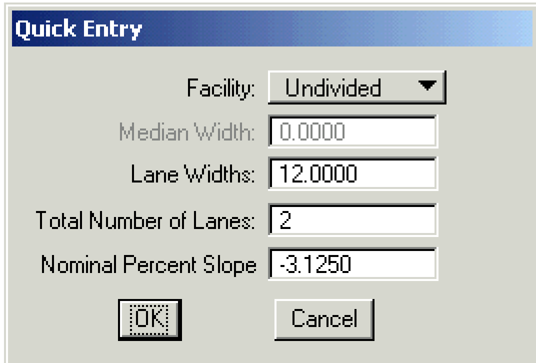
Facility: **Undivided**
L Selection: **all cases**

Enter **BIGHORNPR** as the profile for the **Left** tab. Because the facility is undivided, the same profile is automatically added to the Right tab.

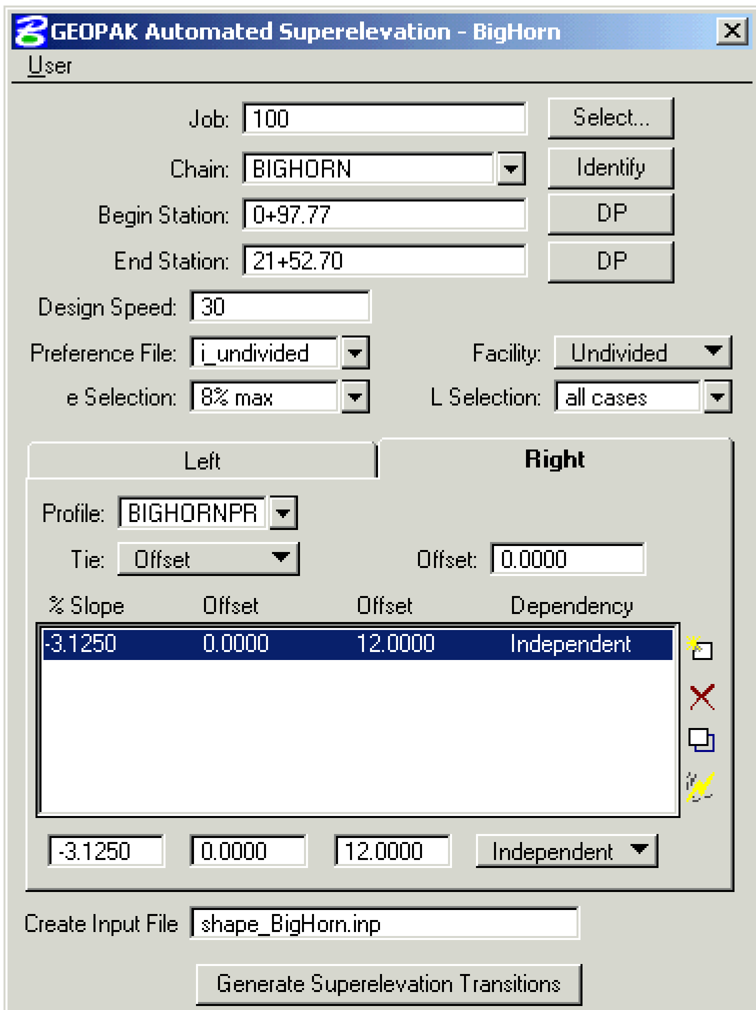
Select the **Quick Entry icon** shown to the right to bring up the Quick Entry dialog shown on the next page.



6 (Continued) Enter the information in the **Quick Entry** dialog as shown below.



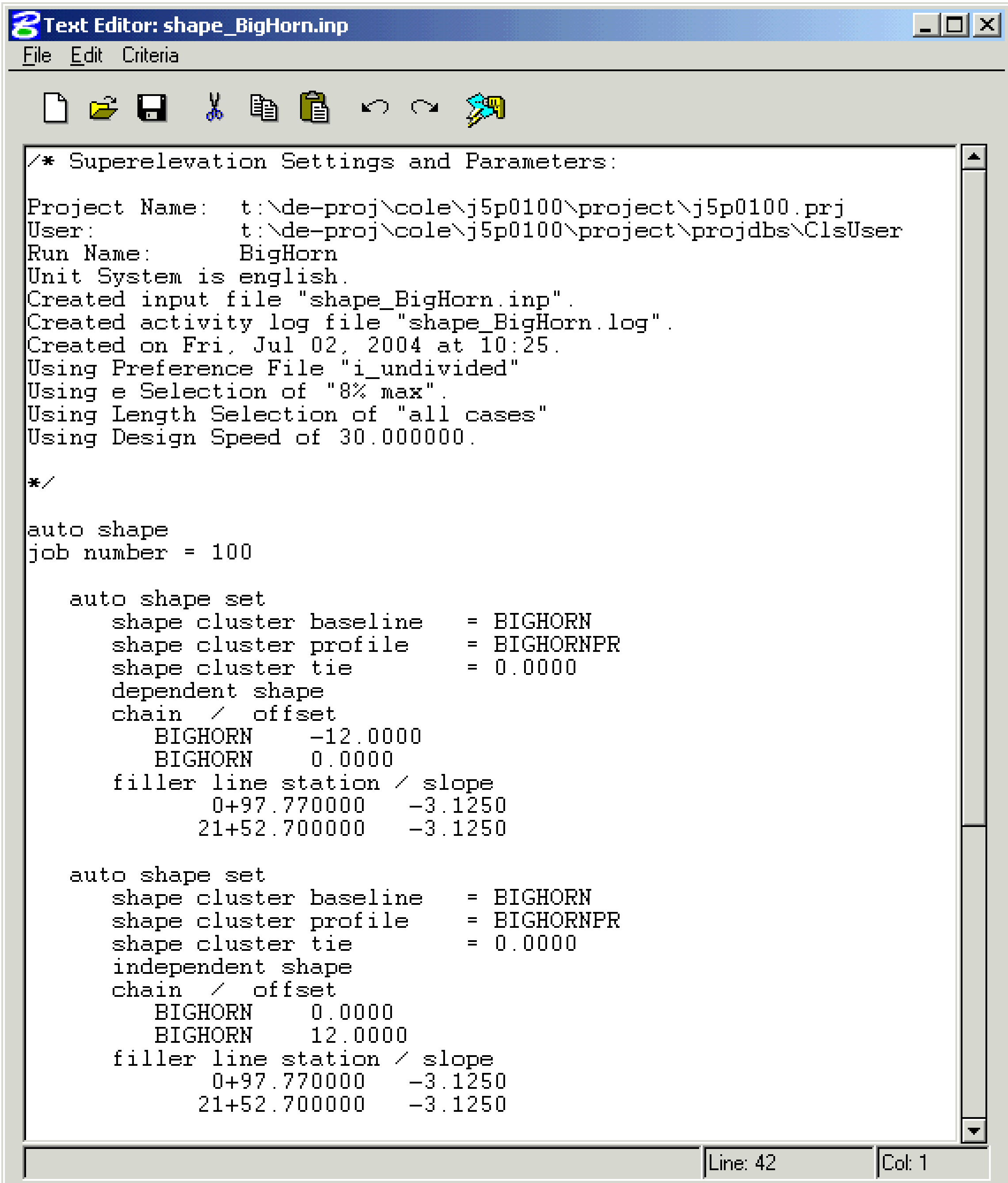

After entering the information in the dialog, click OK and edit the **Right** list box so that its Dependency is set to **Independent** as show below.



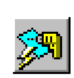

Create Input File: **shape_BigHorn.inp**

7. Review the **shape_BigHorn.log** for any errors.

8. Because of the low speed of the road, normal crown is used along the entire length of the roadway. Consequently, delete all but the first and last filler line for each auto shape set as shown 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 Fri, Jul 02, 2004 at 10:25.
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
```

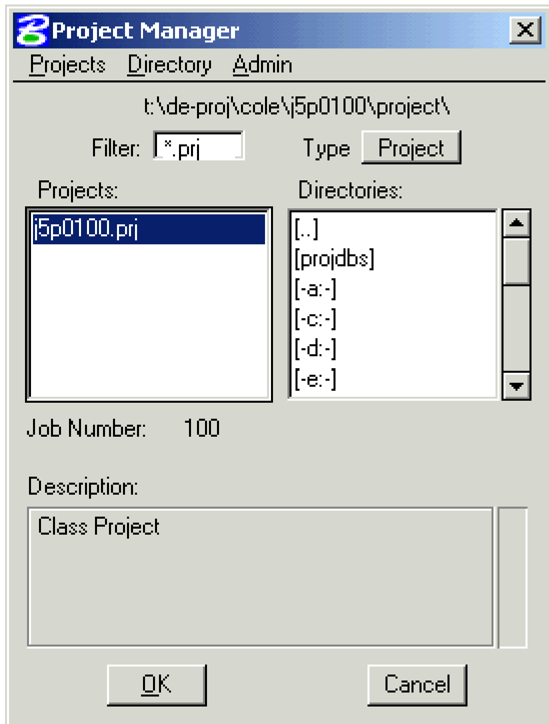
Save the changes to the input file in the GEOPAK Text Editor, and choose the **Create Superelevation Shapes** button shown to the right to process the input file. 

Save the changes to the MicroStation file and exit the superelevation dialogs.

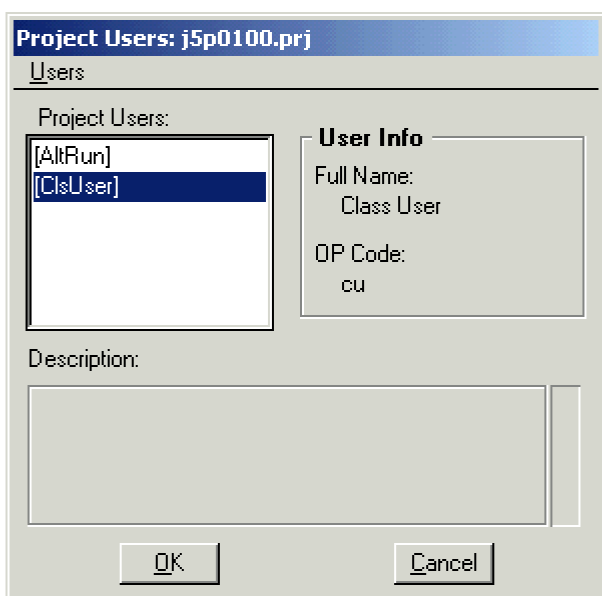
# Exercise 14-1

1. Open the Microstation file **t:\de-proj\cole\5p0100\data\rte50_pattern_shape_j5p0100.dgn**.

2. Open the project **t:\de-proj\cole\5p0100\project\j5p0100.prj**.



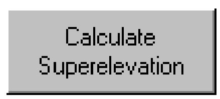

3. Select the user **ClsUser**.



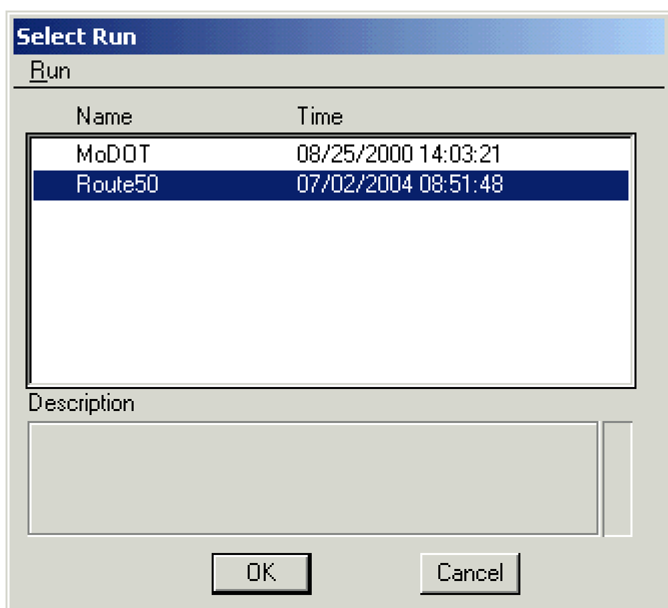
4. Enter **Road**.


5. Select the **Route50** working alignment.


6. Choose **Calculate Superelevation** from the **Road Project** dialog.




Copy the **MoDOT** run to **Route50**, and open the **Route50** run.

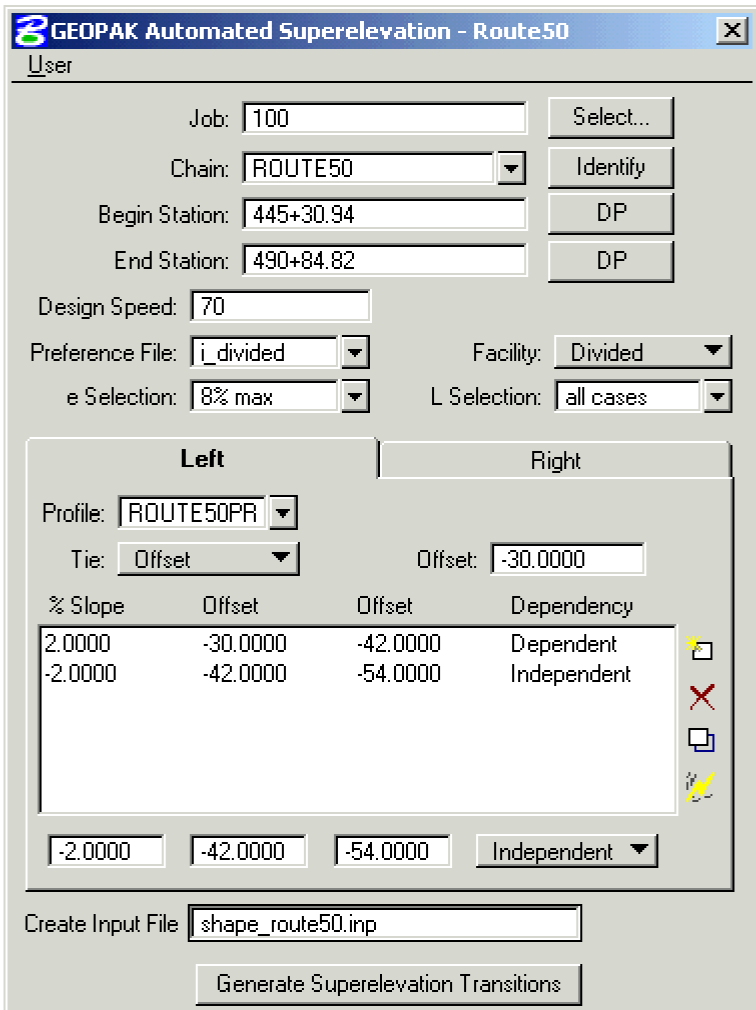


7. Setup the superelevation using the following parameters.

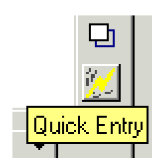
Job: **100**
Chain: **ROUTE50**
Begin Station: ***Beginning of Chain***
End Station: ***End of Chain***

Design Speed: **70**
Preference File: **i_divided**
e Selection: **8% max**

Facility: **Divided**
L Selection: **all cases**

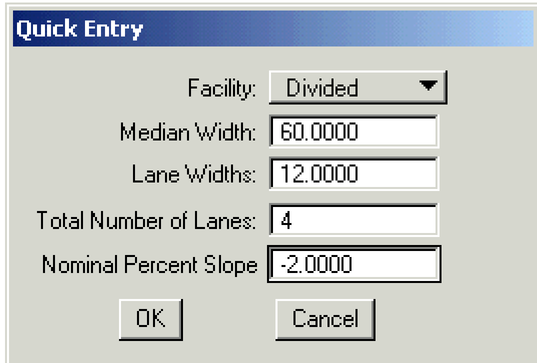



Enter **ROUTE50PR** as the profile for the **Left** and **Right** tabs.




Select the **Quick Entry icon** shown to the right to bring up the Quick Entry dialog shown on the next page.

7 (Continued) Enter the information in the **Quick Entry** dialog as shown below.

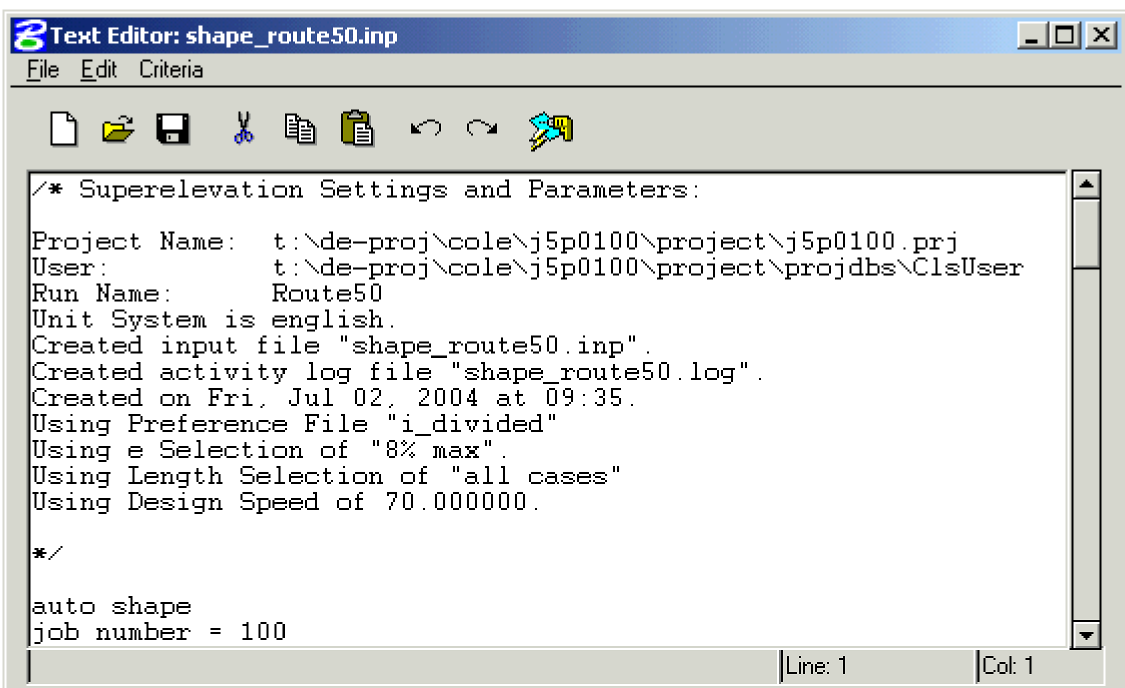



After entering the information in the dialog, click OK and edit Left and Right list box so that it agrees with the following information. Hint: All you should have to do is modify the slopes to the correct signs.

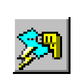
| Left: | | | | Right: | | | |
|---|---|---|---|---|---|---|---|
| % Slope | Offset | Offset | Dependency | % Slope | Offset | Offset | Dependency |
| **2.0** | **-30** | **-42** | **Dependent** | **2.0** | **30** | **42** | **Dependent** |
| **-2.0** | **-42** | **-54** | **Independent** | **-2.0** | **42** | **54** | **Independent** |

Create Input File: **shape_route50.inp**

8. Review the **shape_route50.inp** and the **shape_route50.log** for any errors.




Save any changes to the input file in the GEOPAK Text Editor, and choose the **Create Superelevation Shapes** button shown to the right to process the input file.



Save the MicroStation file, exit the superelevation dialogs update the working alignment.

## Chapter 15

# Proposed Cross Sections & Typical Section Generator

## 15.1 Objectives

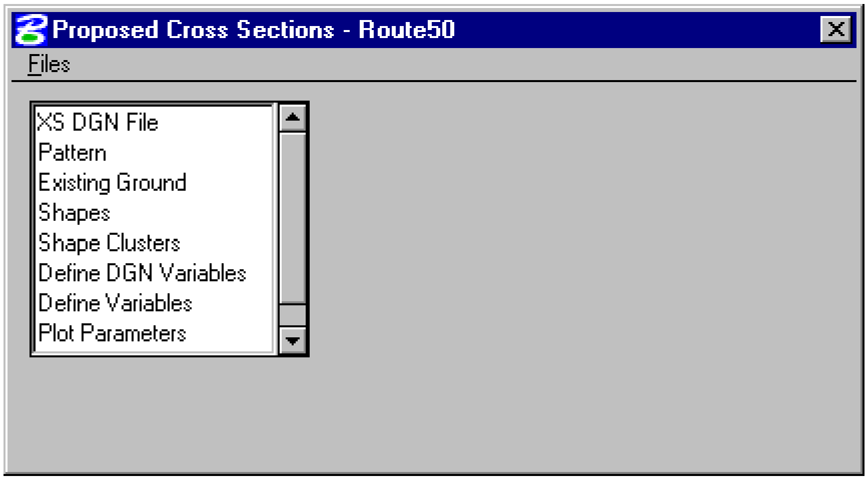
- Use Project Manager to create proposed cross-sections using the Typical Section Generator Tool.
- Understand what criteria files are and how Geopak Typical Section Generator uses them to define side slope conditions for proposed cross-sections
- Become familiar with MoDOT's Typical Section Generator.

## 15.2 Accessing

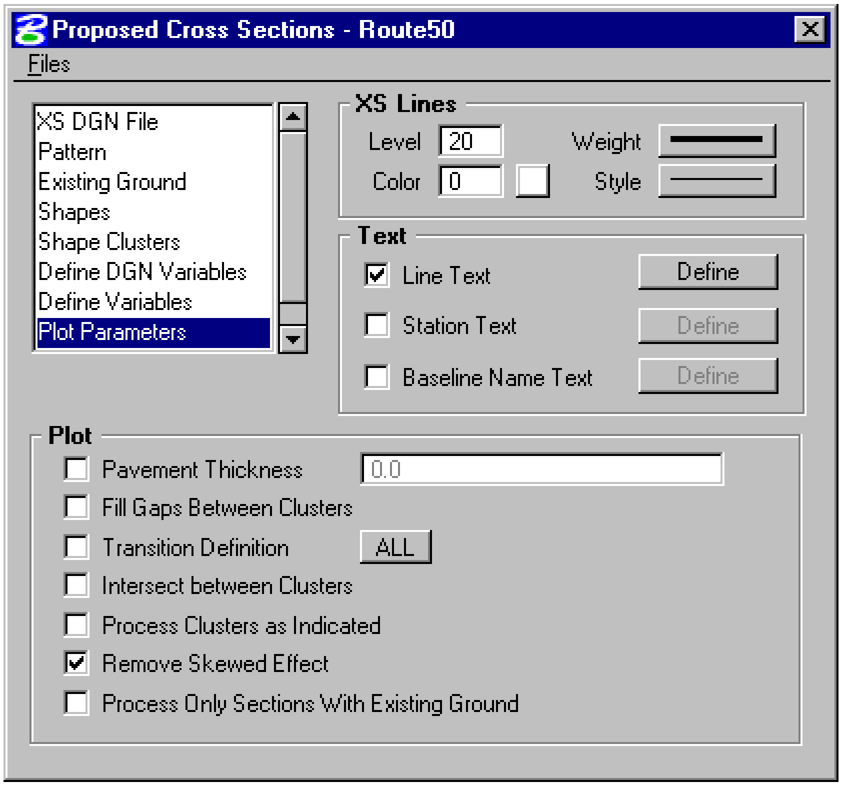
Proposed cross-sections can be accessed from **Project Manager** >> **Proposed Cross Sections**. IMPORTANT NOTE: If the default MoDOT run is older than 06/08/2004 it needs to be replaced

## 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.

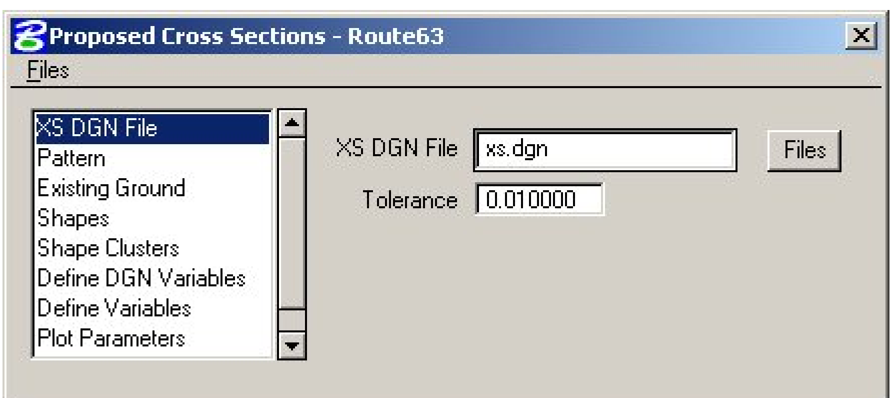



The left side of the dialog contains the list of parameters required to process proposed cross sections. When each parameter is selected, the dialog changes to reflect the requirement of each parameter. For example, when **Plot Parameters** is selected, the dialog changes to reflect the various plot parameters and text as depicted on the next page.



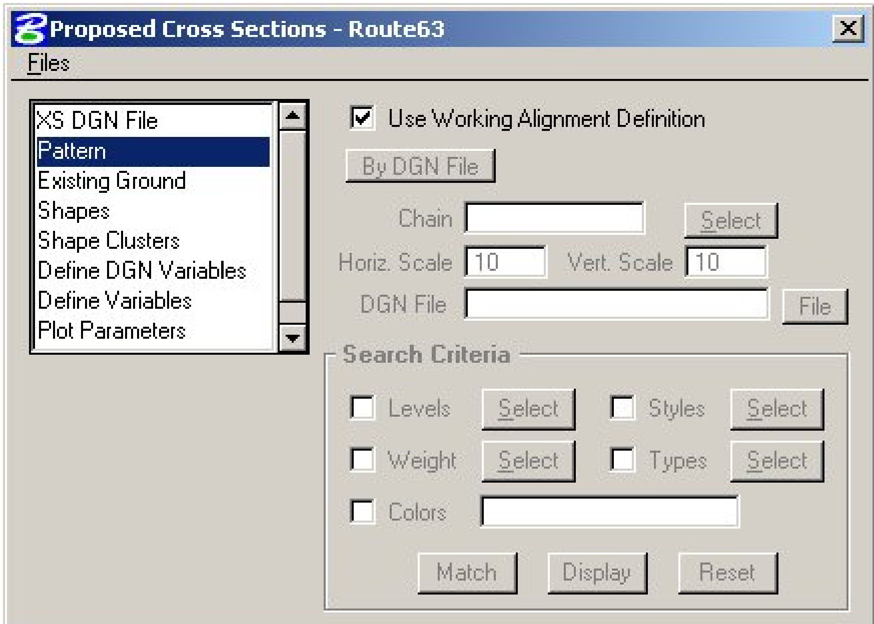

## 15.3.1 XS DGN File

**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

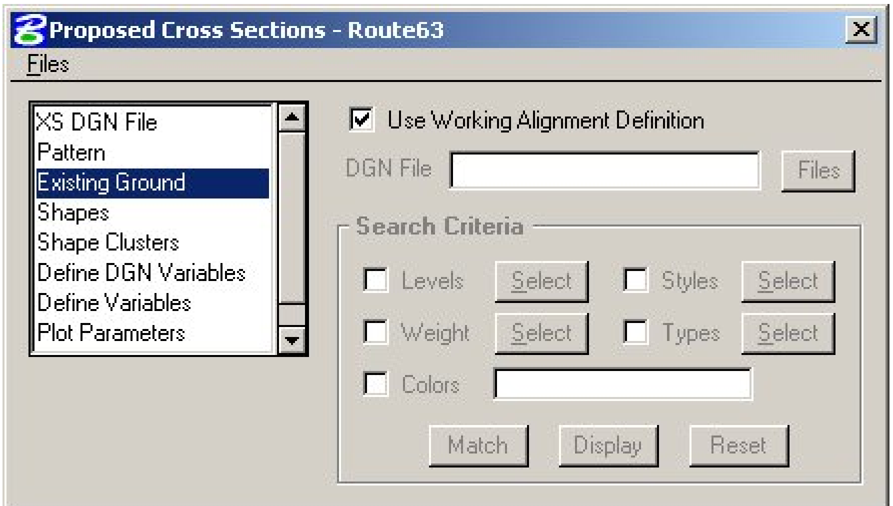
When **Pattern** is selected, the dialog changes to the illustration below. This section contains information on how to find the pattern lines used to create the original ground cross-sections.




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.

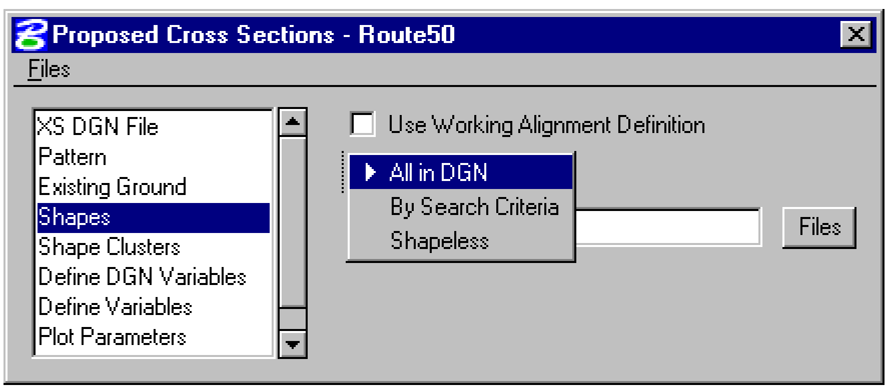
## 15.3.3 Existing Ground

**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.



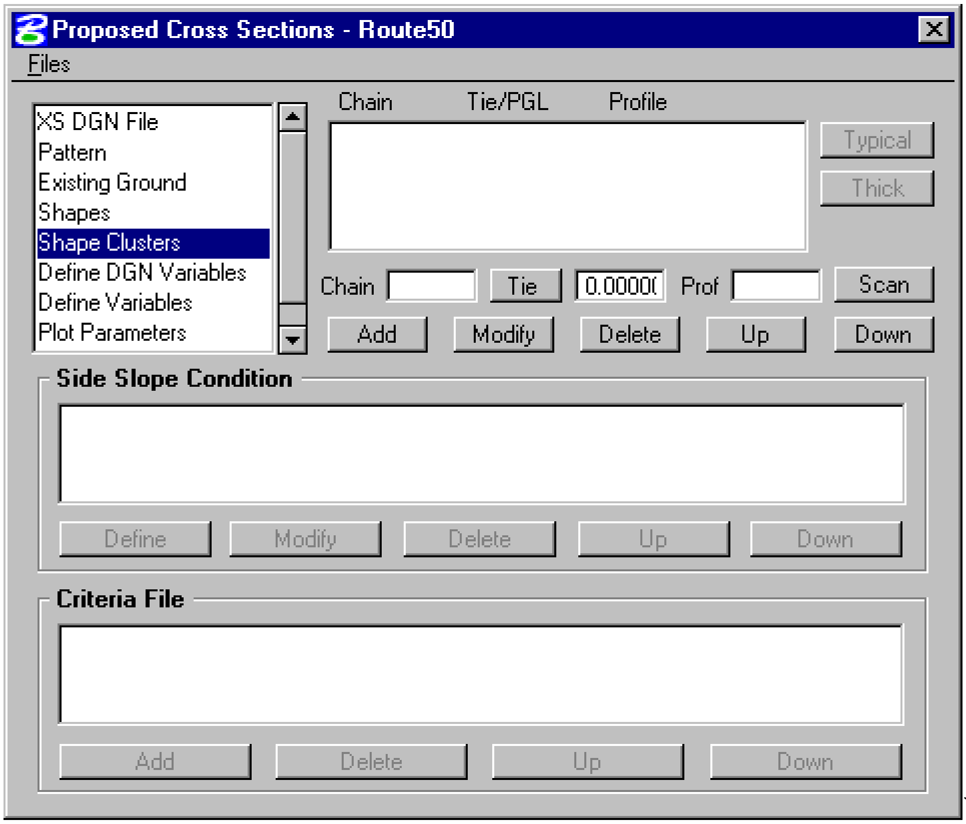

Three options are supported as depicted in the exploded view:

- **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.

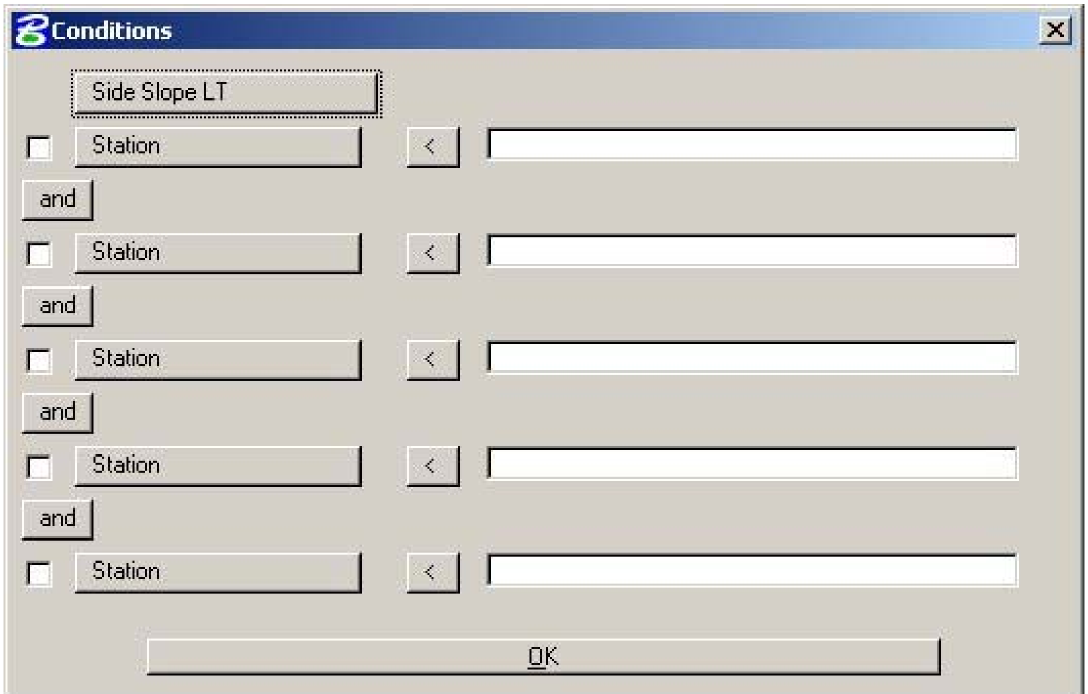
### 15.3.5.1 SIDE SLOPE CONDITIONS

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.

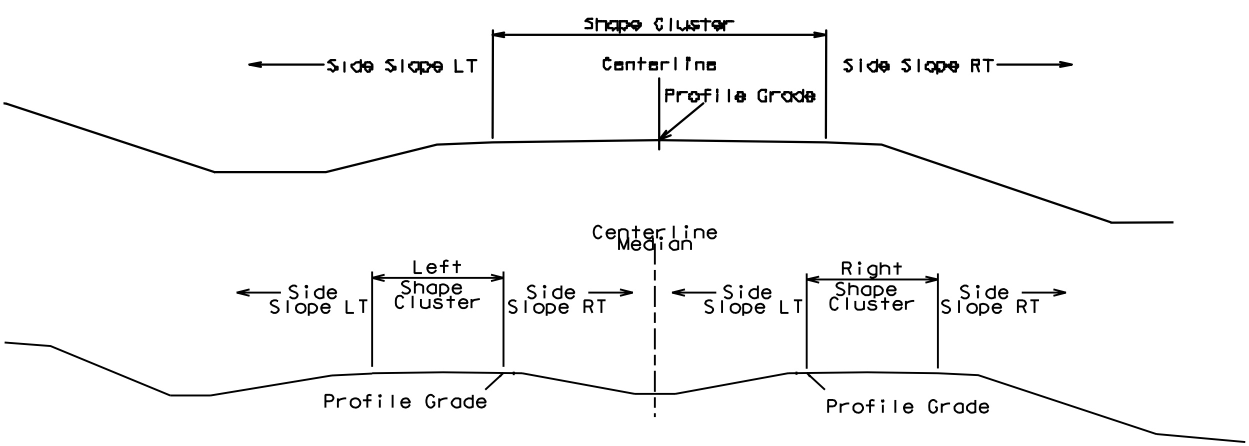
When choosing the Define button the following dialog box is displayed




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.

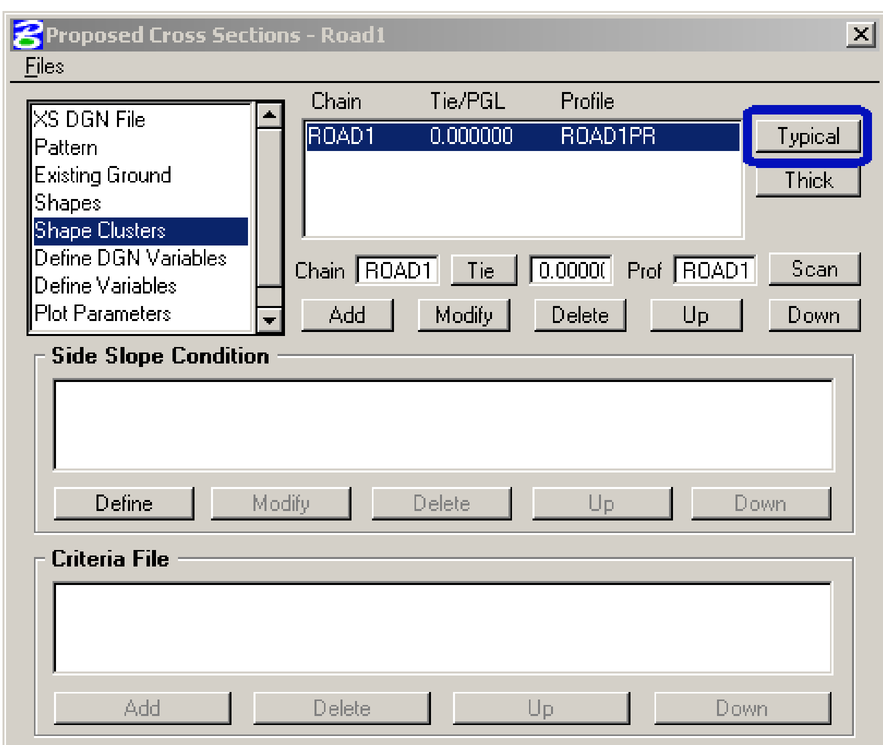
### 15.3.5.4 TYPICAL SECTION GENERATOR

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.

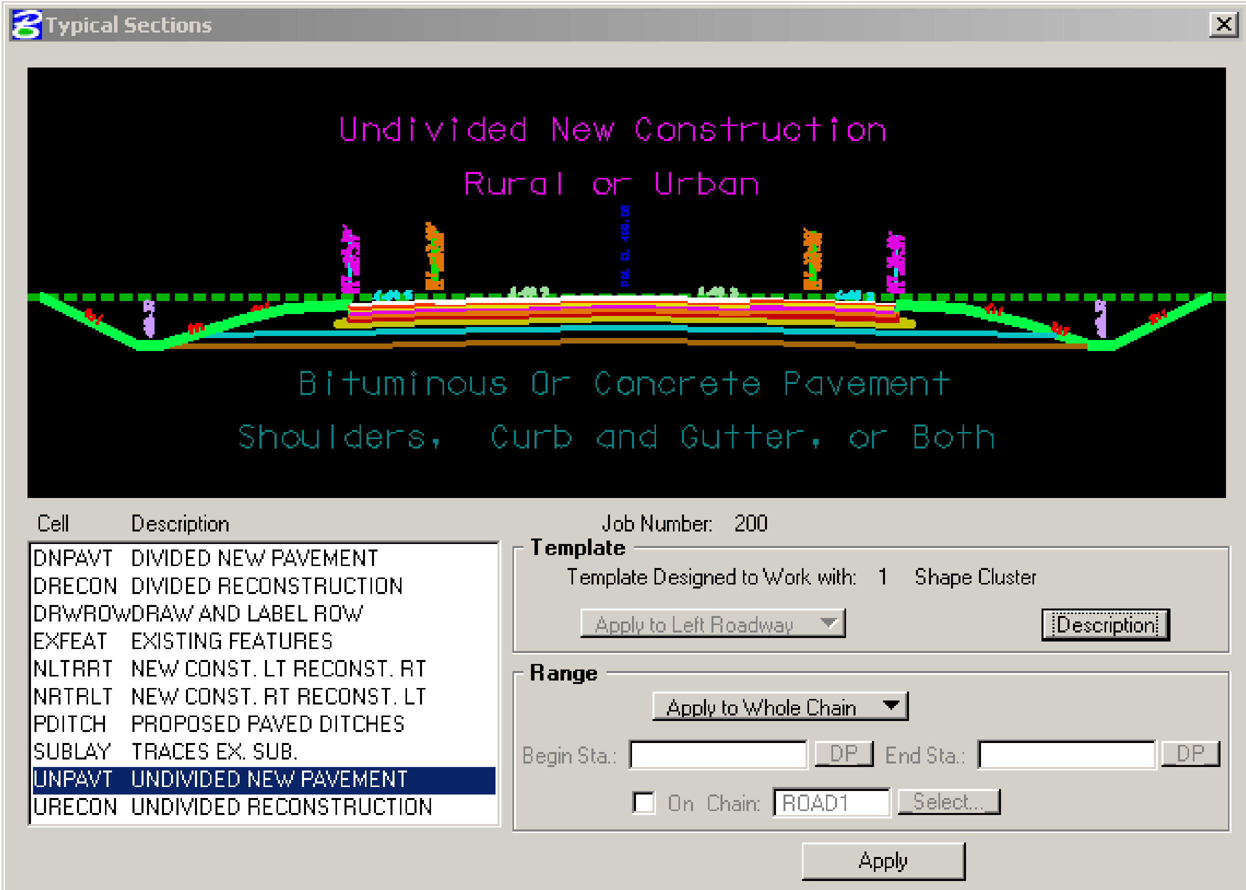
The TSG is a powerful and versatile tool. It can be used for both rural sections, urban sections or a combination of the two. Similarly, this tool can be used for both bituminous and rigid pavement as well as a combination of the two within the same project. The tool allows the user to select a particular 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

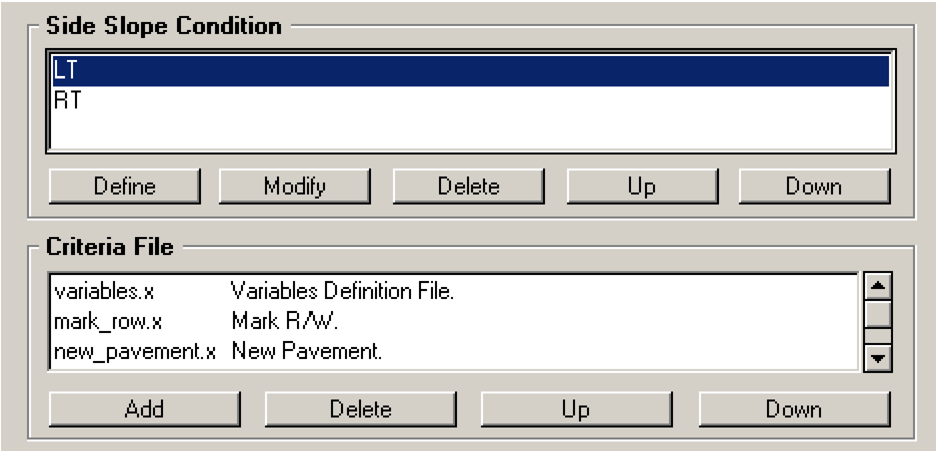



The user has a list of ten (10) different typical sections from which to choose. Each typical section has a picture and a description, which can be accessed by clicking on the **Description** button. The description shows in great detail what plan view elements are required in order for the typical section 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.

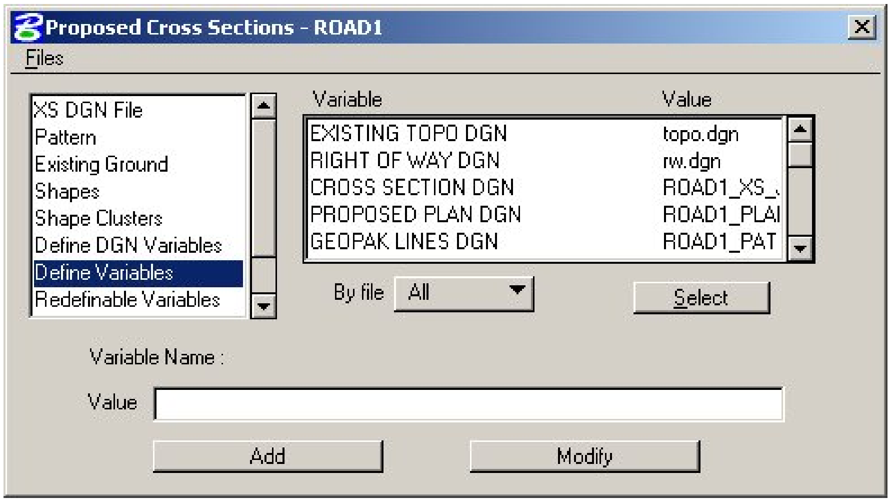



## 15.3.6 Define DGN Variables

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.

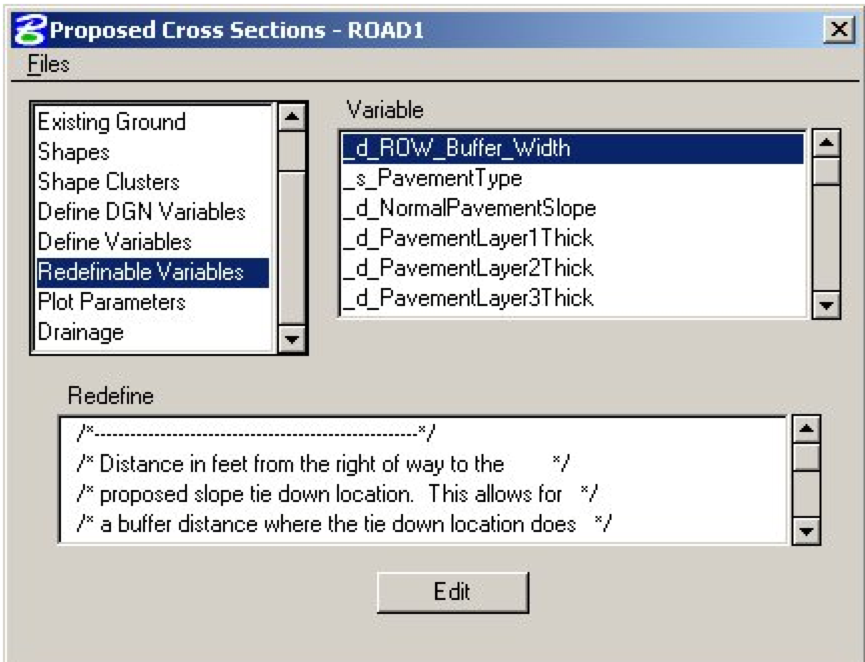
## 15.3.7 Define Variables

**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.

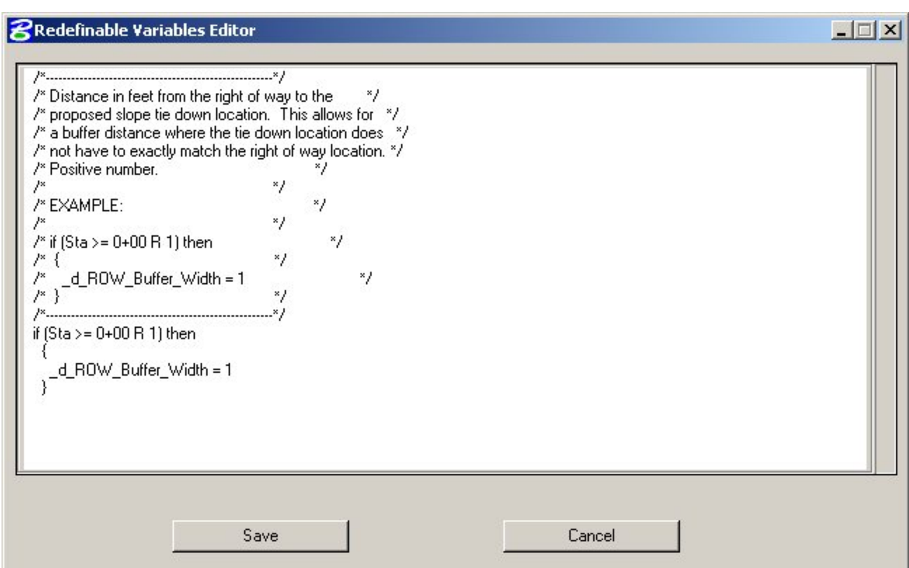


### 15.3.8 Redefinable Variables

**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.

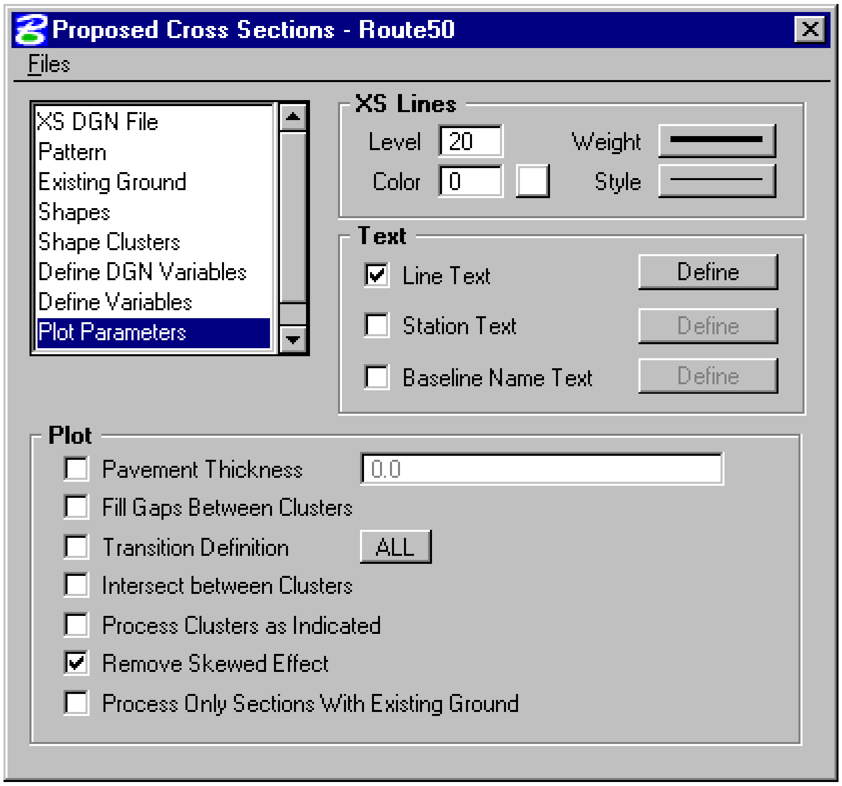



Each redefinable variable is set to a default value. The user selects the variable from the list and click on the **Edit** button to input the appropriate value for the specific project. The editor opens and the user can edit the value.



### 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 on the next page.




**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

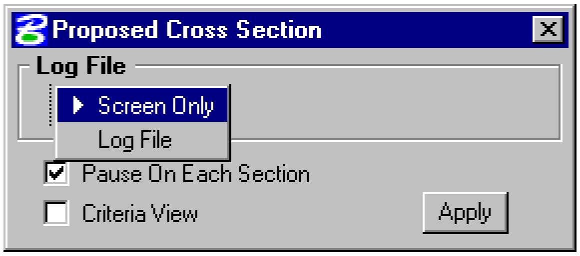
The **Drainage** section allows the user to draw the drainage components into the cross sections. The drainage .dgn file, and the drainage project database must be specified.

### 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.

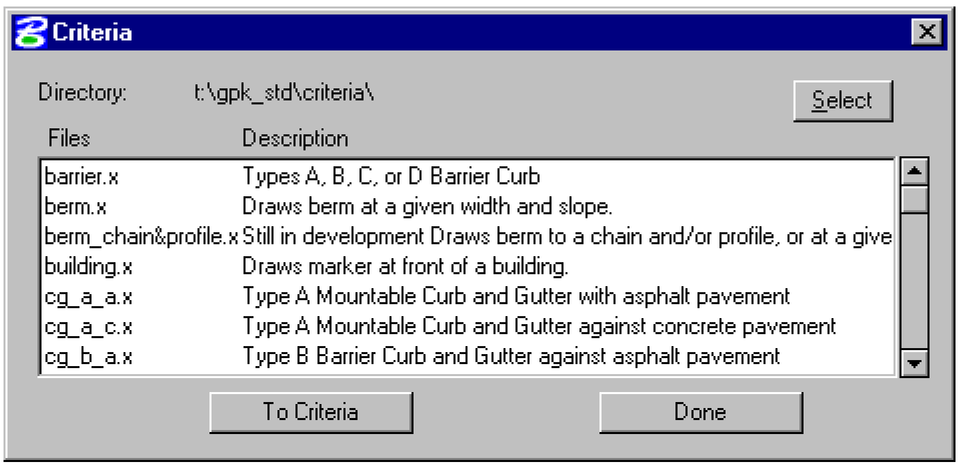
Cross-section criteria are used to draw cross-section features outside of the mosaic of superelevation shapes typically representing pavement. Operationally, the software constructs the cross-section features derived from the mosaic of shapes first. Then, the software constructs the remaining portions 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.

## 15.5 Example: Big Horn Dr.

In Proposed Cross Sections, create a new default MoDOT run by deleting the MoDOT run for user **ClsUser** and copy the MoDOT run from user AltRun, leaving the name the same. Copy the new default MoDOT run and call it **BigHorn**.

In the Shape Clusters section, add the BigHorn shape cluster information. Highlight the shape cluster and click on the **Typical** button. Select the **Undivided New Pavement** typical and click on **Apply**. This will create the side slope conditions and add the criteria files to each side slope.

Switch to the **Define Variables** section and change the following variable vales:

| | |
|---|---|
| CROSS SECTION DGN | BH_xs_j5p0100.dgn |
| PROPOSED PLAN DGN | BH_plan_j5p0100.dgn |
| GEOPAK LINES DGN | BH_pattern_shape_j5p0100.dgn |
| XS SCALE | 10 |

Based on the Typical Sections for Big Horn Drive, switch to the Redefinable Variables and change the following variables, leaving the station information the same:

| | |
|---|---|
| _d_NormalPavementSlope | -3.125 |
| _d_PavementLayer2Thick | 8.25/12 |
| _d_NormalOutsideShoulderSlope | -3.125 |
| _d_ShoulderLayer1Thick | 1.75/12 |
| _d_ShoulderLayer2Thick | 4/12 |
| _d_ShoulderLayer3Thick | 4/12 |
| _d_CurbSearchDistance | 4 |
| _d_BermSlope_Left | 3 |
| _d_BermSlope_Right | 3 |
| _d_DitchForeSlope2_Left | 4:-1 |
| _d_DitchForeSlope2_Right | 4:-1 |
| _d_DitchBackSlope_Left | 2:1 |
| _d_DitchBackSlope_Right | 2:1 |
| _d_FillSlope1_Left | 4:-1 |
| _d_FillSlope1_Right | 4:-1 |

Change the following Redefinable Variables to include the indicated station ranges.

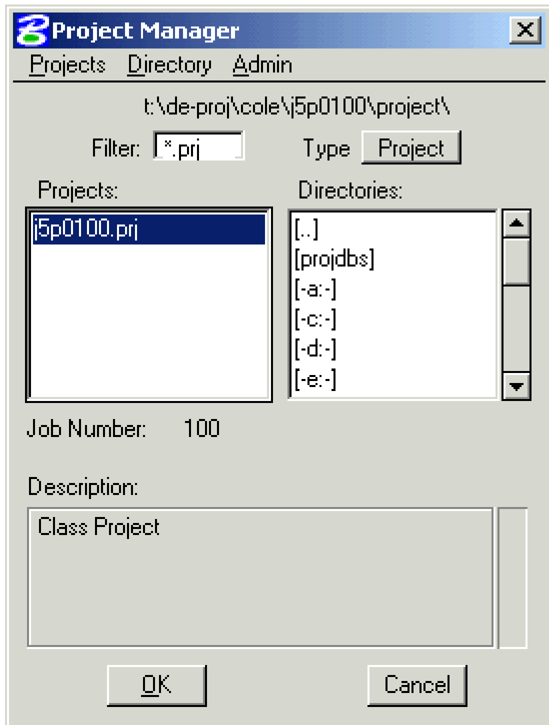
| | Sta >= 0+00 R 1 | Sta >= 17+31.61 R 1 |
|---|---|---|
| _d_StandardDitchDepth_Left | 0 | 2 |
| _d_StandardDitchDepth_Right | 0 | 2 |
| _d_DitchWidth_Left | 0 | 8 |
| _d_DitchWidth_Right | 0 | 8 |
| _d_FillSlope1Width_Left | 0 | 8 |
| _d_FillSlope1Width_Right | 0 | 8 |
| _d_FillSlope2_Left | 2:-1 | 4:-1 |
| _d_FillSlope2_Right | 2:-1 | 4:-1 |

Run the proposed cross sections, pausing on each section.

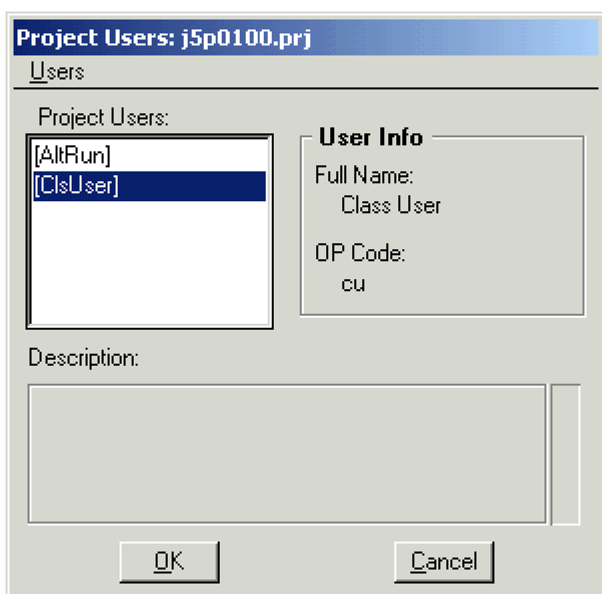
# Exercise 15-1

1. Open the Microstation file **t:\de-proj\cole\5p0100\data\rte50_xs_j5p0100.dgn**.

2. Open the project **t:\de-proj\cole\5p0100\project\j5p0100.prj**.




3. Select the user **ClsUser**.

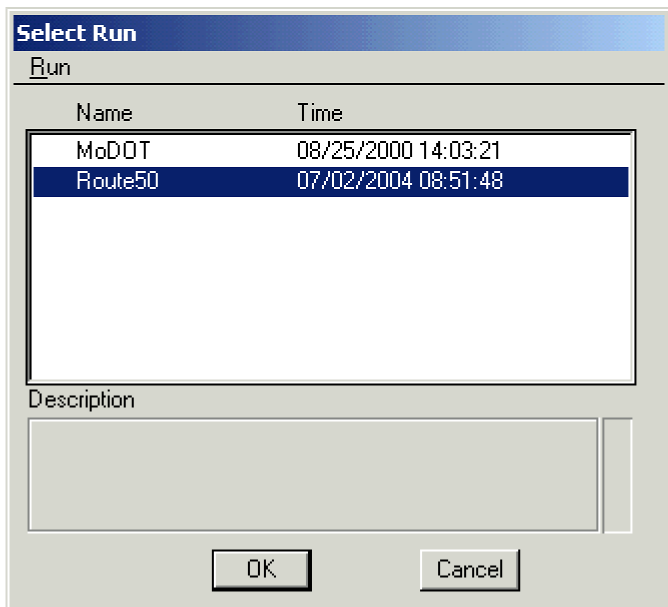


4. Enter **Road**.

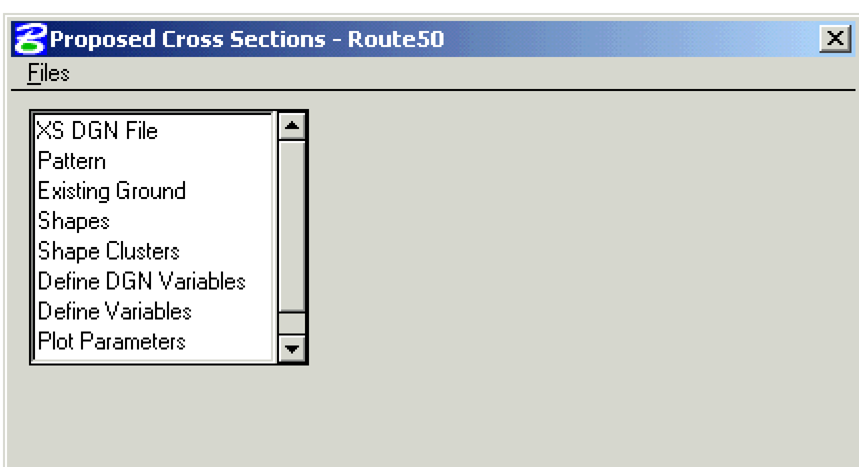

5. Select the **Route50** working alignment.

6. Choose **Proposed Cross Sections** from the **Road Project** dialog.


Copy the **MoDOT** run to **Route50**, and open the **Route50** run.




This will bring up the following dialog:

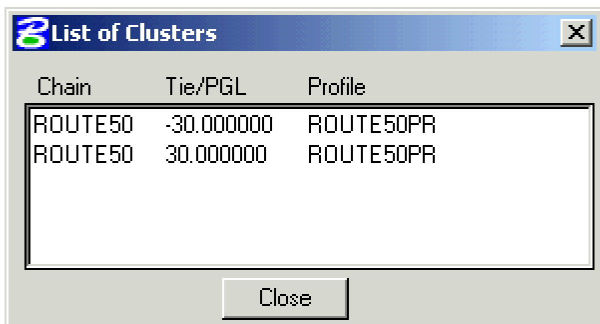


7. Be sure the following items are set in the given sections of the dialog:

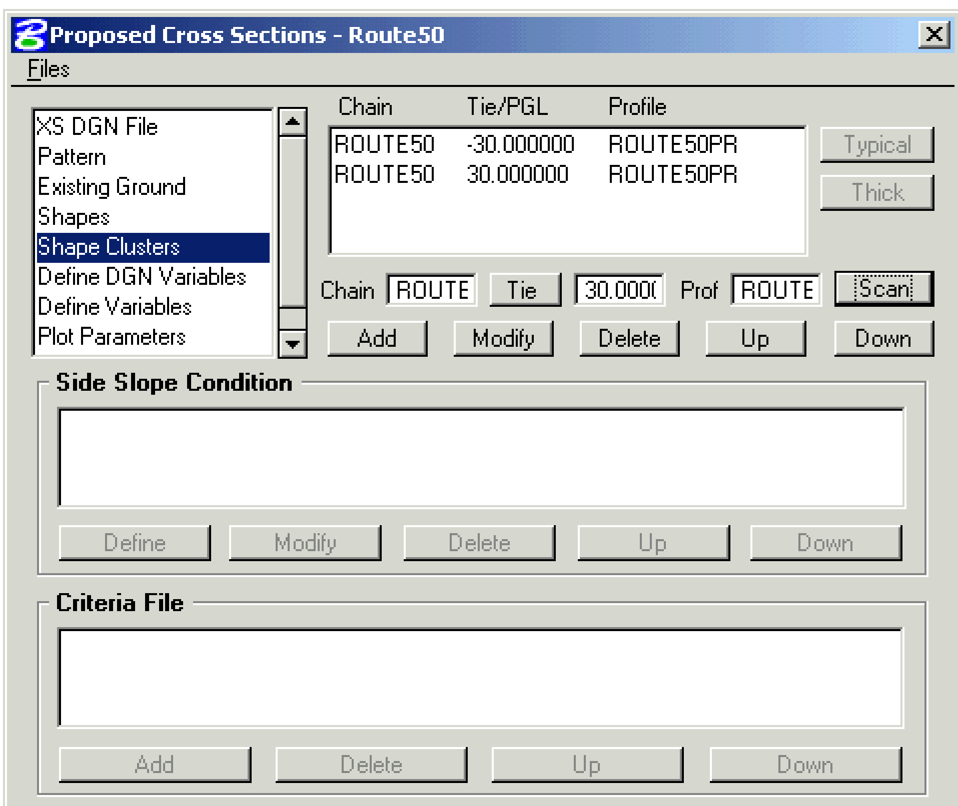
| | |
|---|---|
| XS DGN File: | **rte50_xs_j5p0100.dgn** |
| Pattern: | **Use Working Alignment Definition** |
| Existing Ground: | **Use Working Alignment Definition** |
| Shapes: | **Use Working Alignment Definition** |

8. In the **Shape Clusters** section of the dialog, choose the **Scan** button. Add the two shape clusters in the following order:

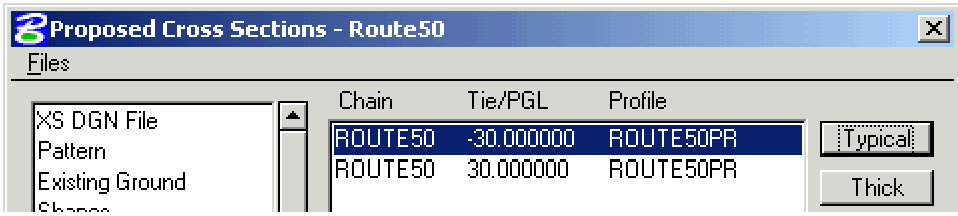
| Chain | Tie | Profile |
|---|---|---|
| **ROUTE50** | **-30** | **ROUTE50PR** |
| **ROUTE50** | **30** | **ROUTE50PR** |




Once the shape cluster have been added, the dialog should look like the following figure

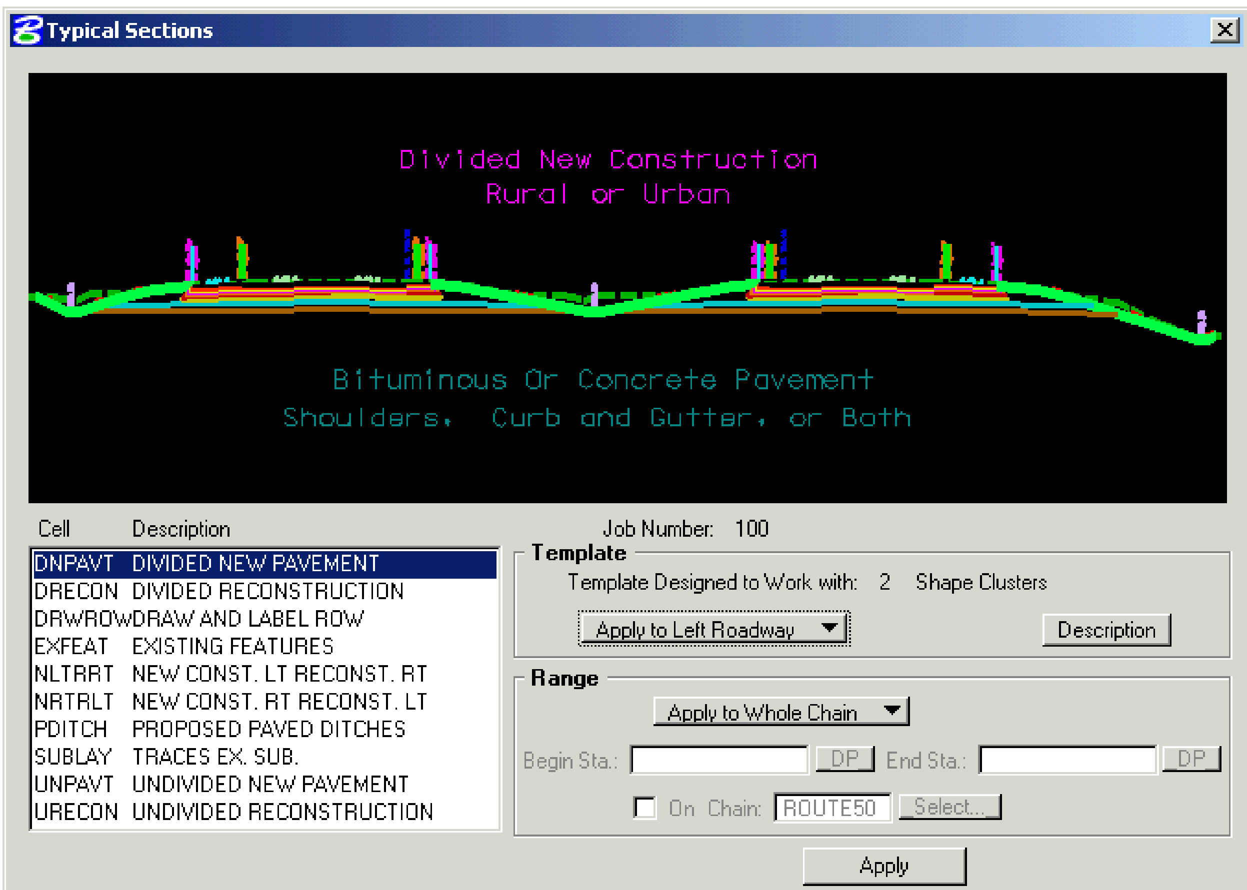


9. **Highlight** the left cluster and click on the **Typical** button.



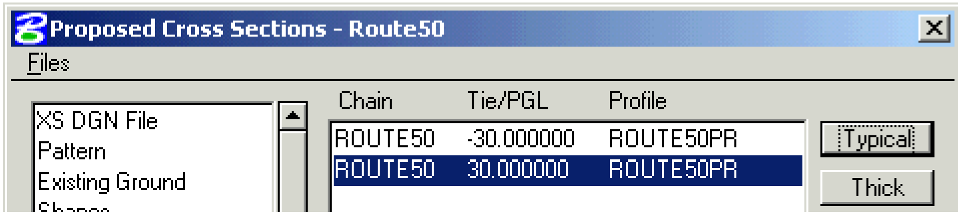

This displays the **Typical Sections** dialog shown below. Select the **Divided New Pavement** template, which is highlighted in the list box in the lower left hand corner, as shown in the figure. In the **Template** section of the dialog, select: **Apply to the Left Roadway**. Clicking on the Description 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.

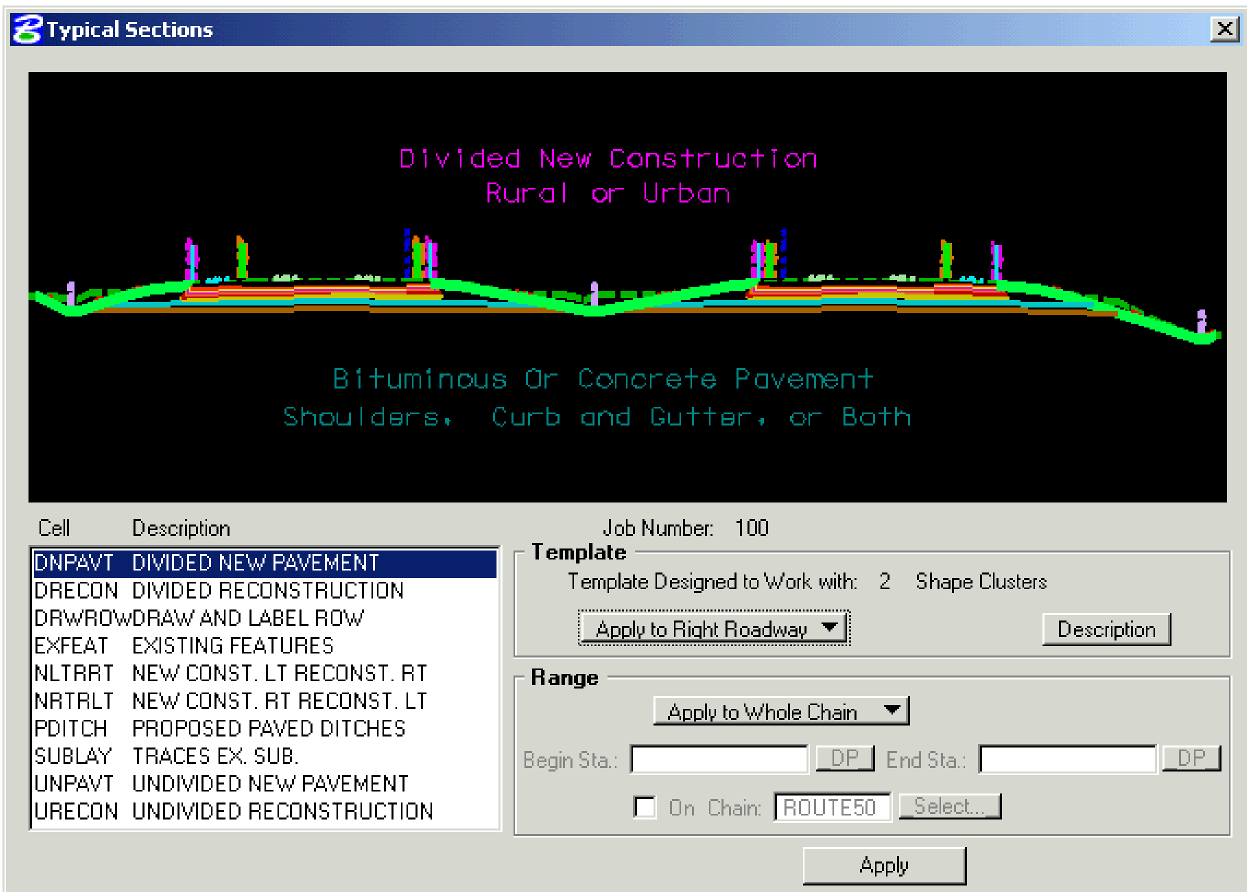



Select **Yes To All** if you are asked if you wish to overwrite any of the criteria files

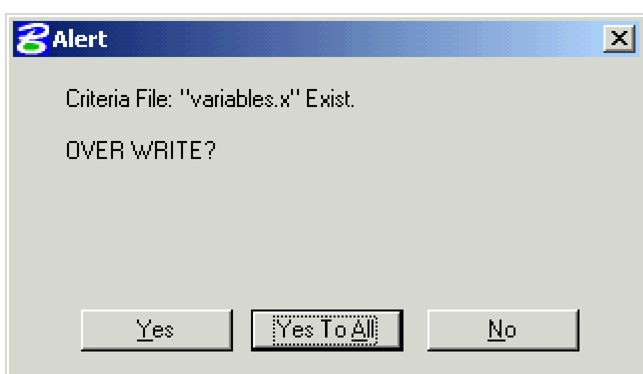
10. **Highlight** the right cluster and click on the **Typical** button.




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.



11. Switch to the **Define Variables** section and change the following variable vales:

| | |
|---|---|
| CROSS SECTION DGN | **rte50_xs_j5p0100.dgn** |
| PROPOSED PLAN DGN | **rte50_plan_j5p0100.dgn** |
| GEOPAK LINES DGN | **rte50_pattern_shape_j5p0100.dgn** |
| XS SCALE | **10** |

Leave the remaining variable set to the defaults

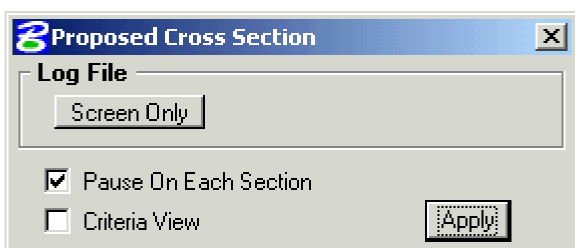
12. In the **Redefinable Variables** set the following values for the given variables.

| | | |
|---|---|---|
| _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 |
| _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.

13. **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.

## Chapter 16

# Port Viewer

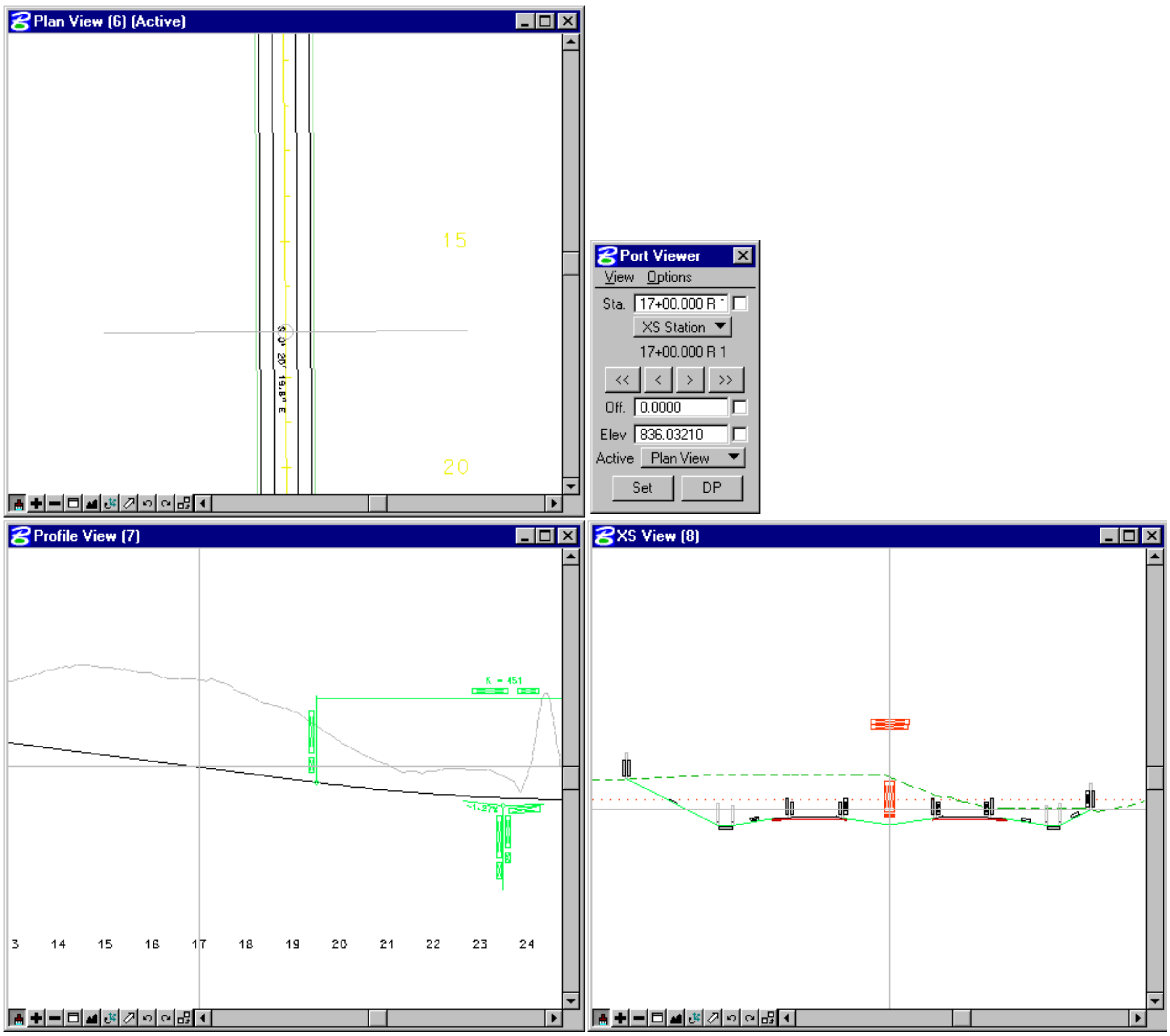
## 16.1 Objectives

- 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

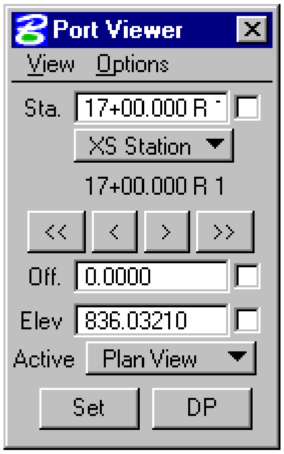


## 16.3 Accessing

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 **Project Manager** dialog.

## 16.4 Dialog




The **Port Viewer** dialog box allows the user to manipulate the views several different ways.

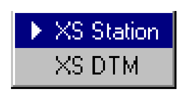
The user is able to key-in the **Station** they want to view. The cross hairs in the plan and profile views will move to the keyed-in station, and the section view will display the cross-section nearest that station.

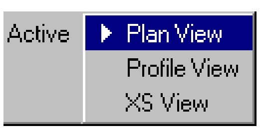
The navigation buttons allow the user to navigate station by station (< or >), or to the beginning (<<) or ending (>>) station.

The **Offset** option will control the location of the circle in the plan view and the vertical cross hair in the cross-section view.

The **Elevation** option will control 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 will cut a section at the location of the cross hairs in the plan view.



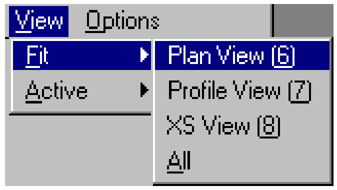



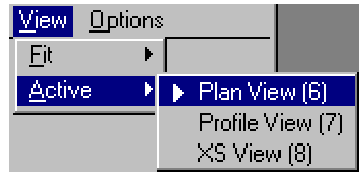

The **Active View** chooses the view to change the current file. Any Microstation drawing commands will be executed in the **Active View**. If the user wants to draw something in the cross sections, they should switch the **Active View** to XS View.

Selecting the **Set** button allows the user to move the cursor to a view and move the cross hairs. As the user moves the cursor along the view, the other two views will be updated according to the placement of the cursor in the current view.

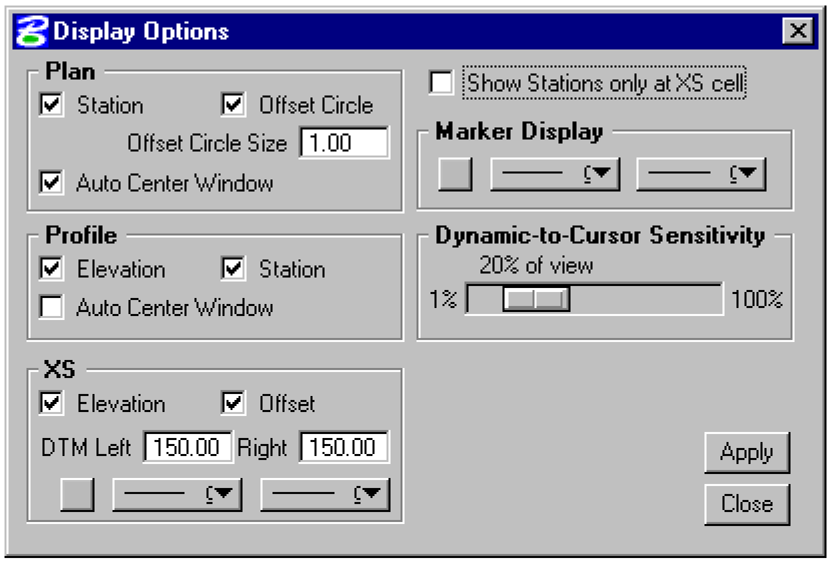
The **DP** button allows the user to issue a data point for a Microstation command. For example, if the user wanted to draw a line at the given station and offset listed in the **Port Viewer** dialog, they would select the line tool, and press the **DP** button. This would begin drawing a line at the given station and offset.

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 controls which cross hairs to display, as well as the symbology of the DTM section view.



## Chapter 17

# Earthwork

## 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.

Definitions

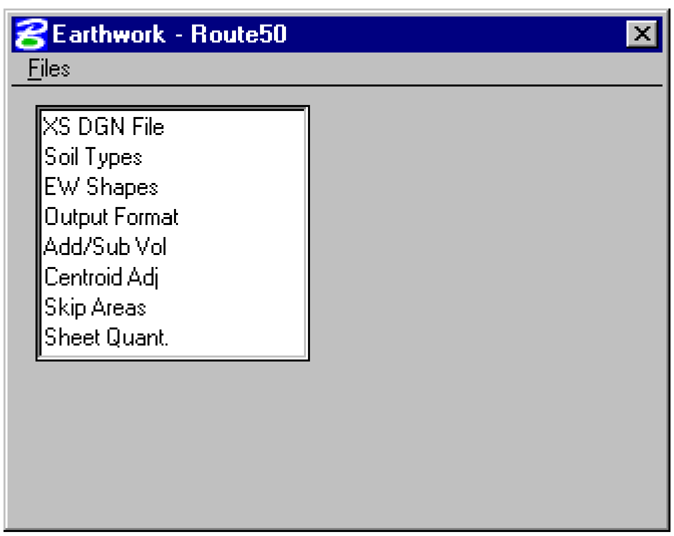
GEOPAK forms **earthwork shapes** in a design cross section .dgn file to represent the end areas used to calculate volumes. These shapes are created when the designer processes an earthwork run in which the existing ground, finished grade, base, etc. are identified by level, color, weight and type. For complete information, see the *GEOPAK Manual* or online help.

## 17.2 Accessing

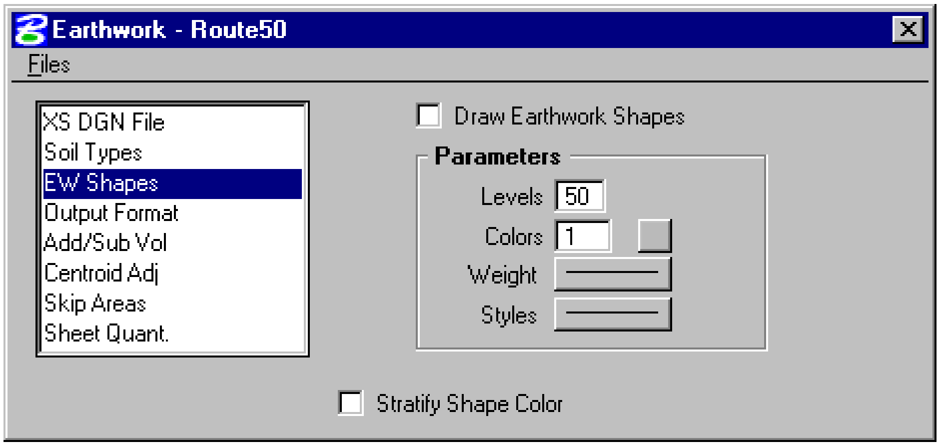
To access the necessary dialogs needed to create and process an earthwork run, select **Project Manager >> Earthwork**.

## 17.3 Dialog

Once the Earthwork run is chosen, the following dialog box appears.

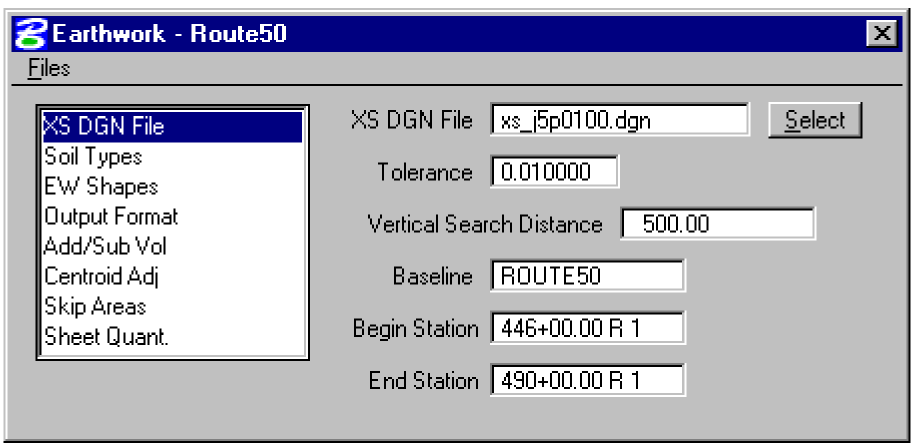



The left side of the dialog contains the list of parameters required to compute earthwork. When each parameter is selected, the dialog changes the keyin fields to reflect the selection. For example, when **EW Shapes** is selected, the dialog changes as illustrated below.




### 17.3.1 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.

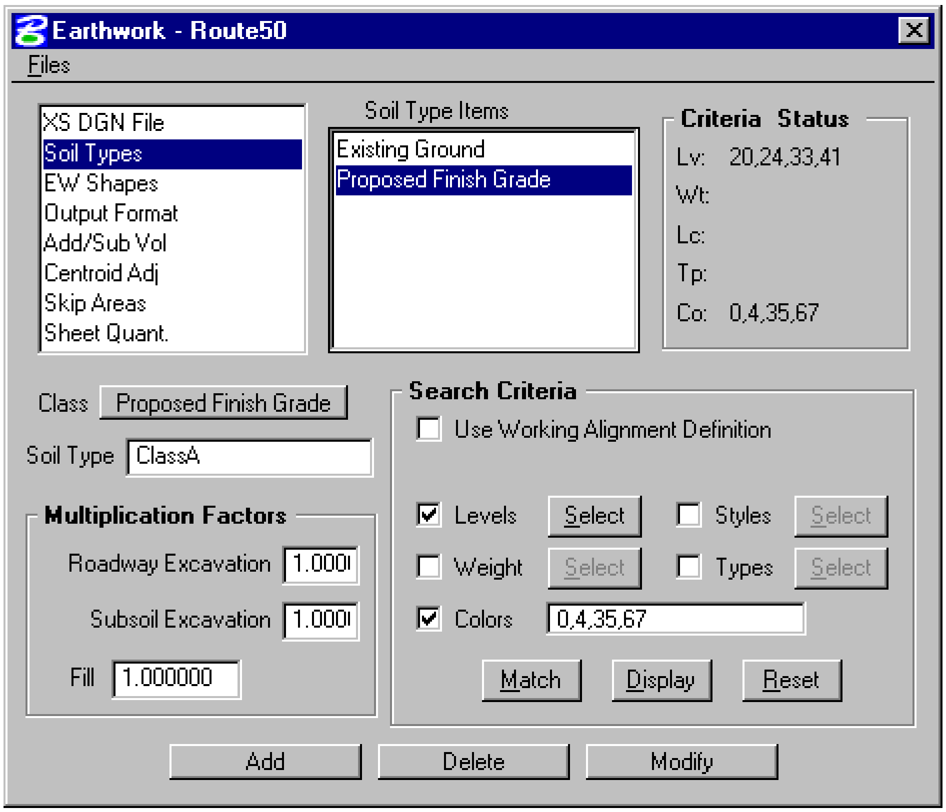
**Vertical Search Distance** specifies the distance above and below the cross-section to look for elements pertaining to that cross-section. **(DO NOT CHANGE!)**

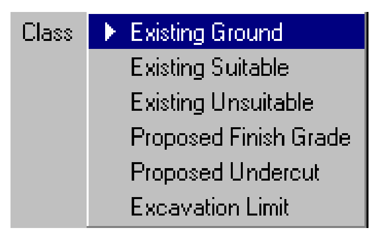
**Baseline** specifies the Geopak COGO chain the cross-sections are based from.

**Begin/End Station** specifies the beginning and ending stations to perform the earthwork calculations.

## 17.3.2 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. 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 |

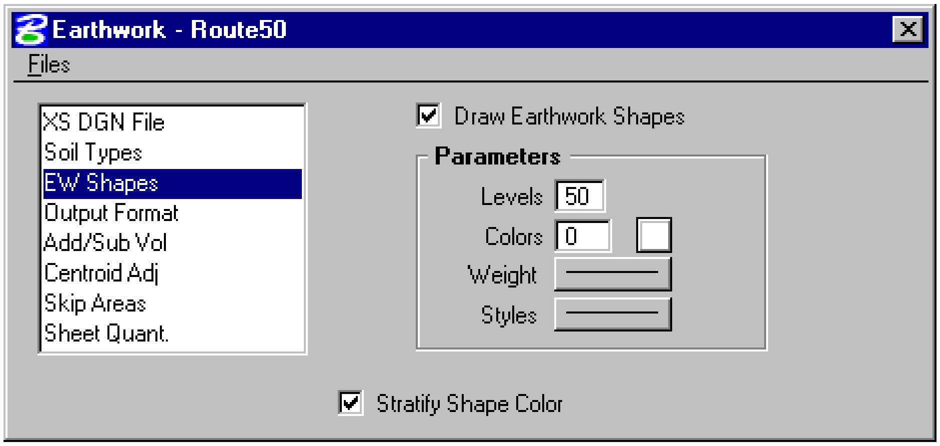
As can be seen from the above examples, when the soil types for the Existing Ground and Proposed Finish Grade classifications were named differently, both soil types appeared in the output. When the soil types for the Existing Ground and Proposed Finish Grade classifications were named the same, the 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.

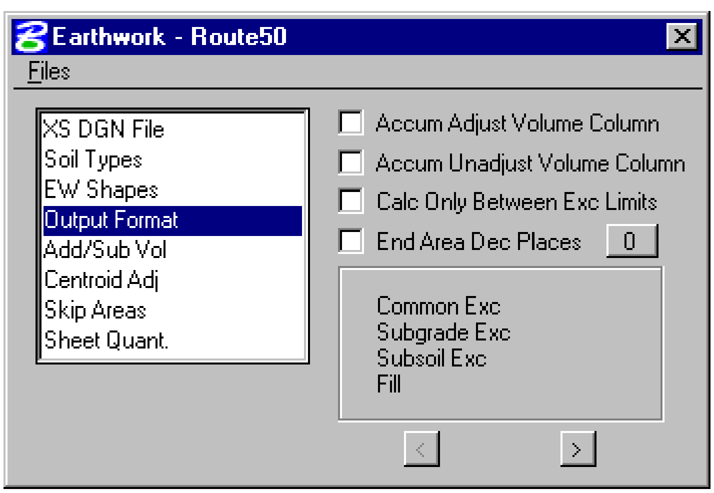
### 17.3.3 EW Shapes

**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.




### 17.3.4 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.

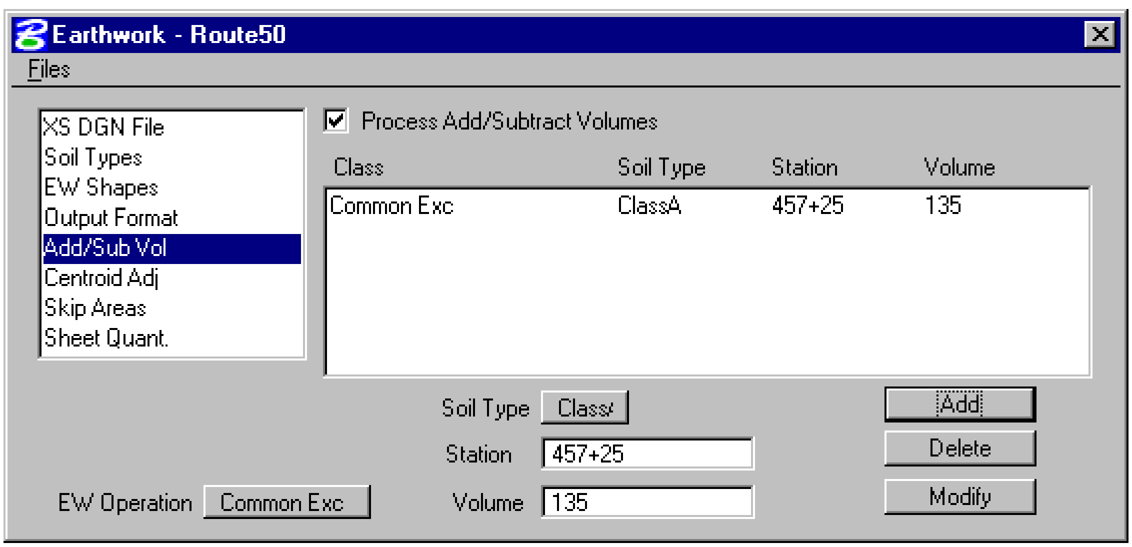
**Accum Unadjust Volume Column** will add a column to the earthwork quantities report to show the accumulated unadjusted volume. This provides a running total for the unadjusted volumes.

**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.

### 17.3.5 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.

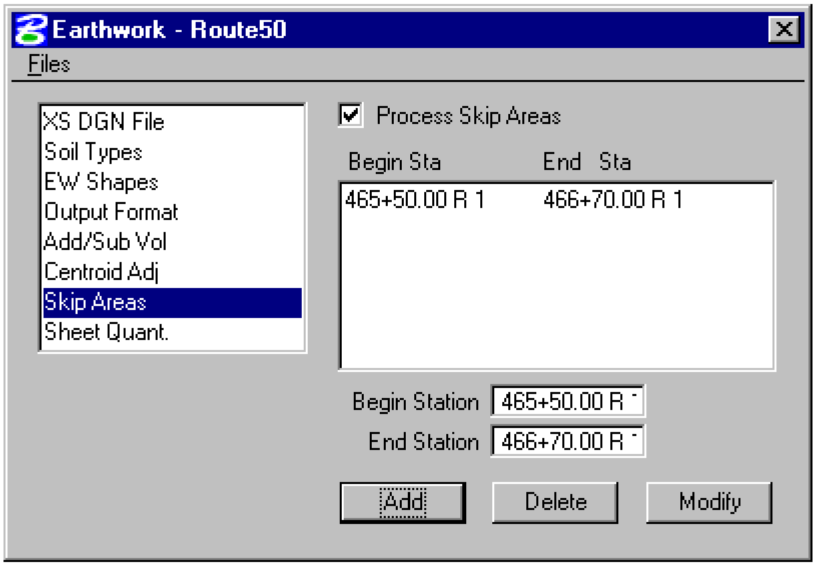



### 17.3.6 Centroid Adj

**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.

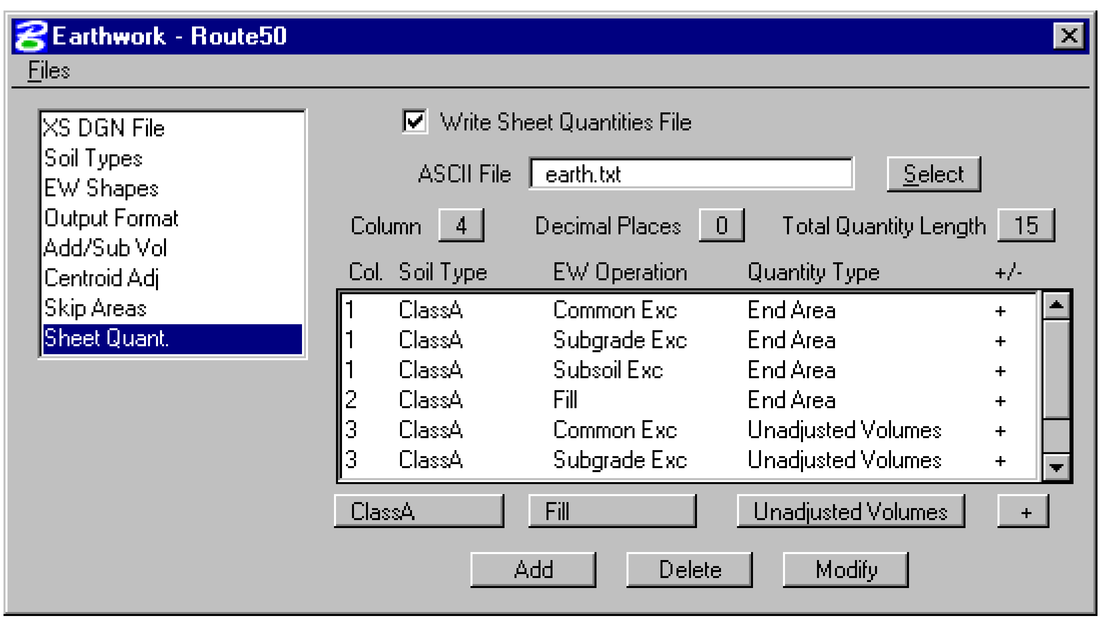
### 17.3.7 Skip Areas

**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**.




### 17.3.8 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 | + |

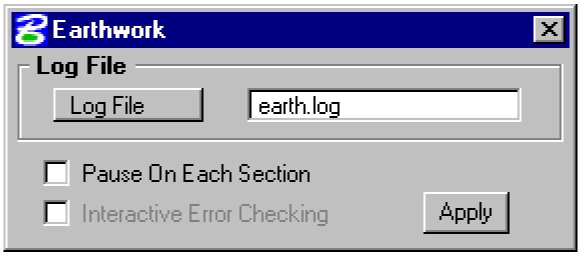
This information is written to the ASCII file, and can be used to plot the quantities on the cross-section sheets. The process of plotting this data on the cross section sheets is covered in more detail in Chapter 14.

### 17.3.9 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.

### 17.3.10 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.

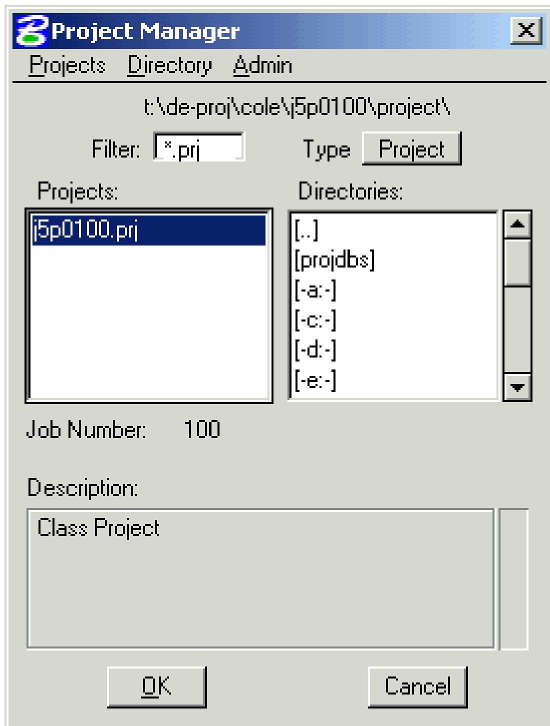



When processing the earthwork quantities, a .log file should be created. This ASCII file will contain the earthwork quantities that the user will use to evaluate the earthwork.

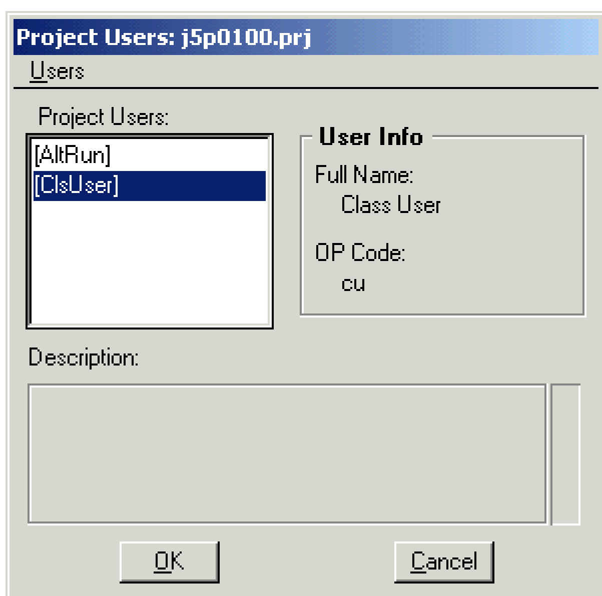
## 17.4 Example 17-1

1. Open the Microstation file **t:\de-proj\cole\5p0100\data\rte50_xs_j5p0100.dgn**.

2. Open the project **t:\de-proj\cole\5p0100\project\j5p0100.prj**.




3. Select the user **ClsUser**.

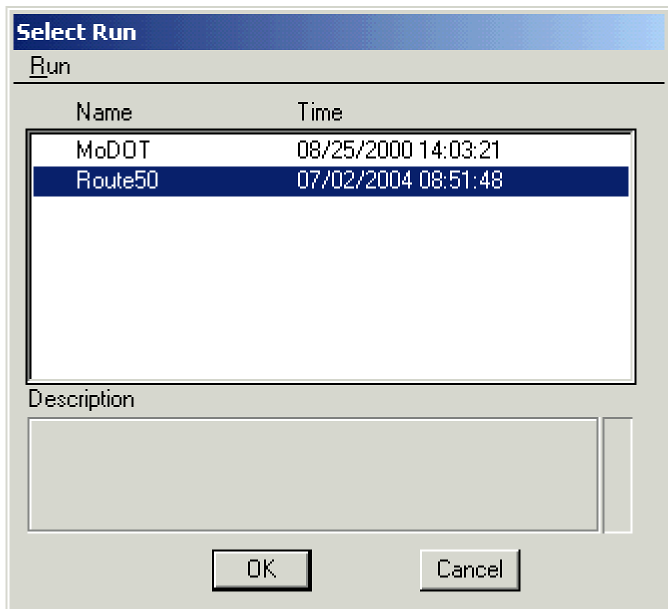


4. Enter **Road**.


5. Select the **Route50** working alignment.

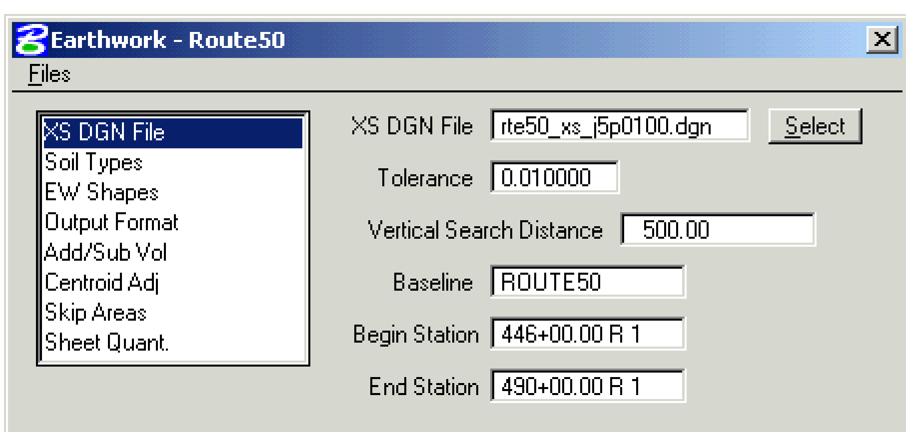
6. Choose **Earthwork** from the **Road Project** dialog.


Copy the **MoDOT** run to **Route50**, and open the **Route50** run.

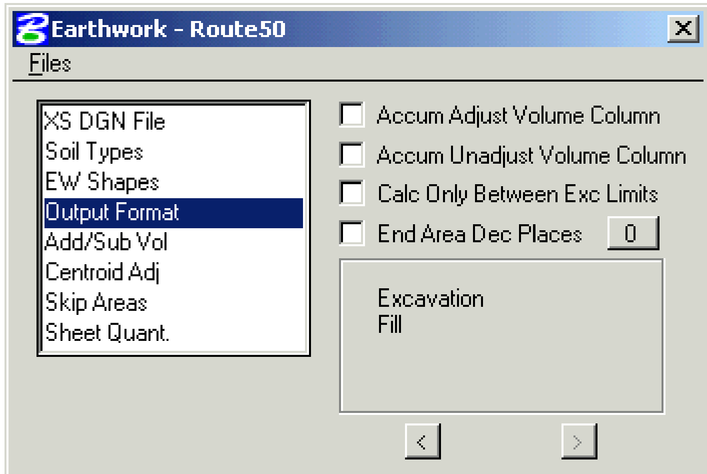



7. Be sure the following items are set in the **XS DGN File** sections of the dialog:

XS DGN File: **rte50_xs_j2p0200.dgn**
Baseline: **ROUTE50**

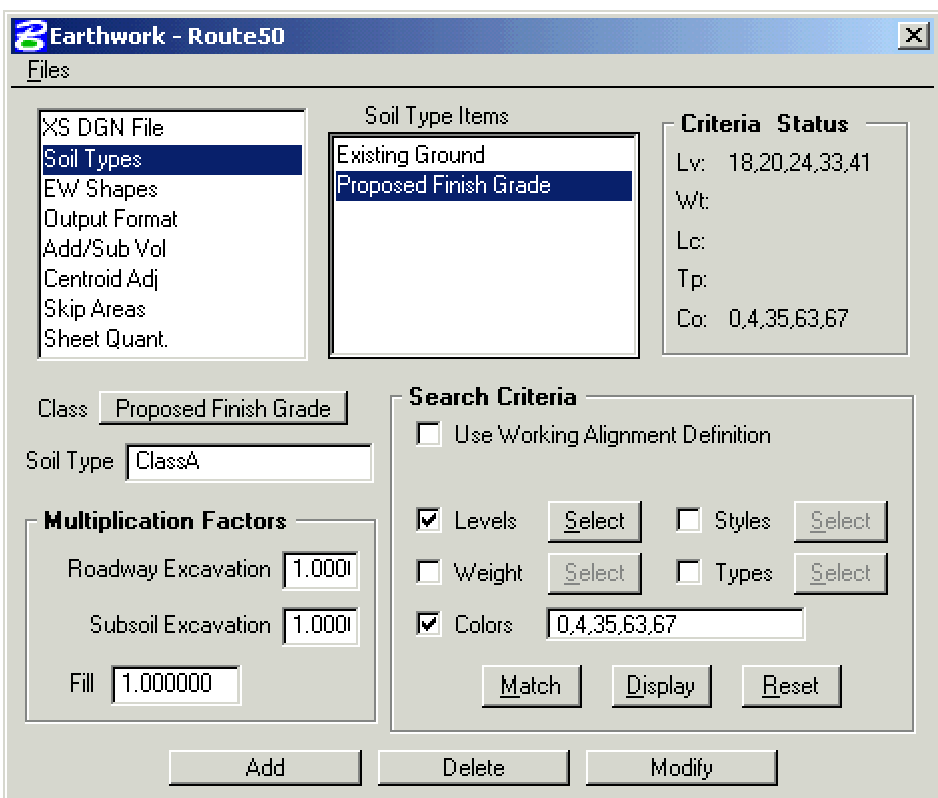


8. In the **Output Format** section of the dialog, set the format to **Excavation** and **Fill**:



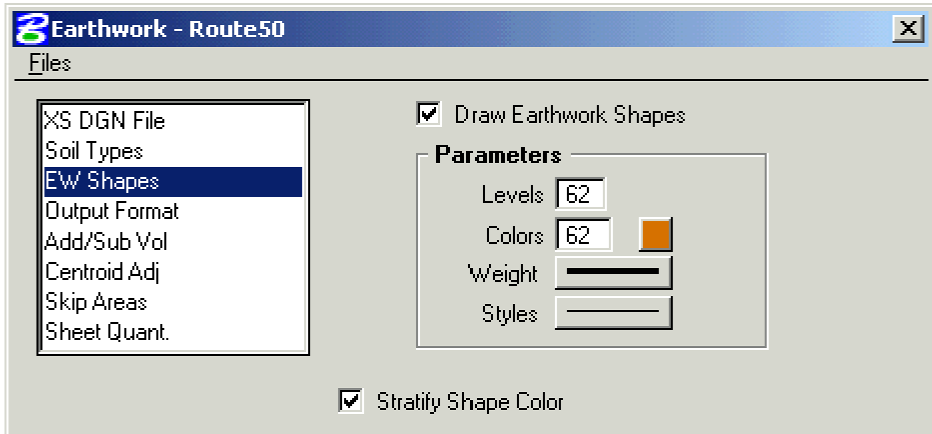

9. In the **Soil Types** section create the following **Soil Type Items**.

| Class | Soil Type | Search Criteria |
|---|---|---|
| Existing Ground | ClassA | Level = 57<br>Color = 90 |
| Proposed Finish Grade | ClassA | Level = 18,20,24,33,41<br>Color =0,4,35,63,67 |



10. Toggle on **Draw Earthwork Shapes** and **Stratify Shape Color** in the **EW Shapes** section. Set the following **EW Shapes** parameters as shown:

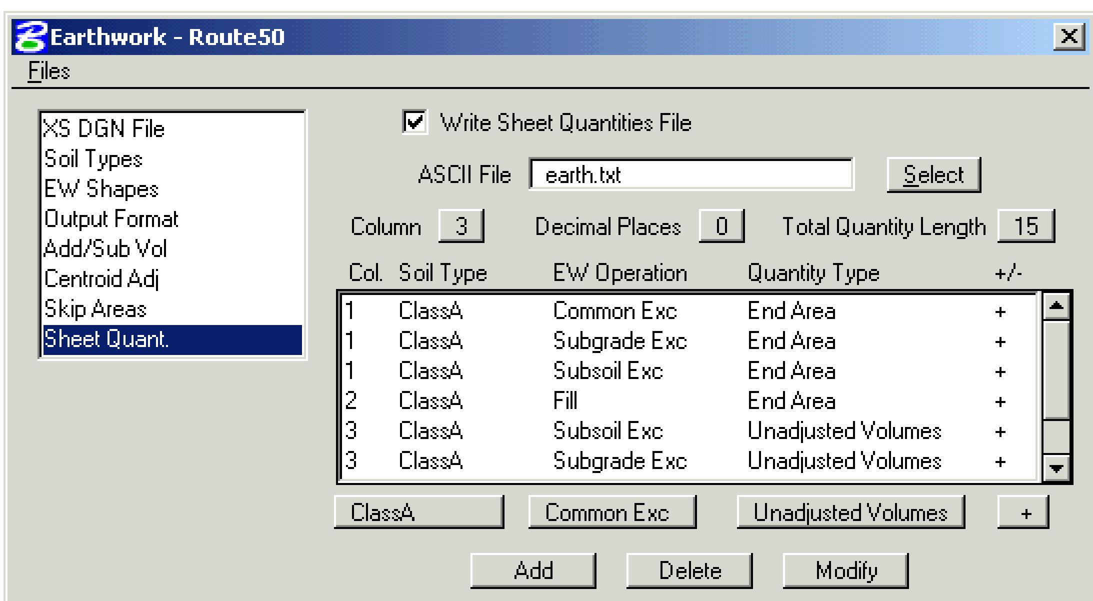
| | |
|---|---|
| Levels | 62 |
| Colors | 62 |
| Weight | 4 |
| Styles | 0 (Solid Line) |




11. In the **Sheet Quant.** Section, toggle on the **Write Sheet Quantities File**.

ASCII file: **earth.txt**
Decimal Places: **0**
Total Quantity Length: **15**

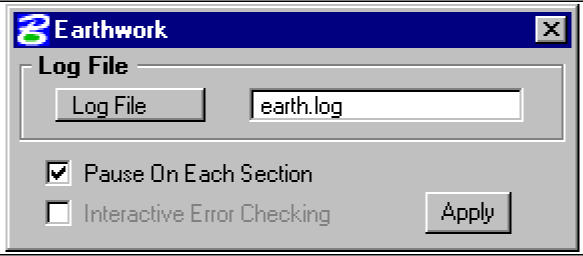
| Col. | Soil Type | EW Operation | Quantity Type | +/- |
|---|---|---|---|---|
| 1 | ClassA | Common Exec | Endarea | + |
| 1 | ClassA | Subgrade Exec | Endarea | + |
| 1 | ClassA | Subsoil Exec | Endarea | + |
| 2 | ClassA | Fill | Endarea | + |
| 3 | ClassA | Common Exec | Unadjusted Volumes | + |
| 3 | ClassA | Subgrade Exec | Unadjusted Volumes | + |
| 3 | ClassA | Subsoil Exec | Unadjusted Volumes | + |
| 4 | ClassA | Fill | Unadjusted Volumes | + |




12. Save the settings for the dialog.

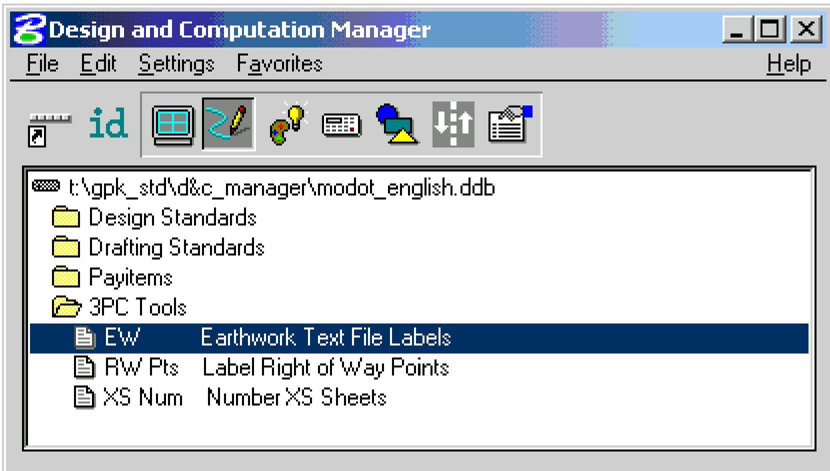
13. Run the proposed cross-sections.

    Set the **Log File** option to **Log File**, and name the log file **earth.log**.

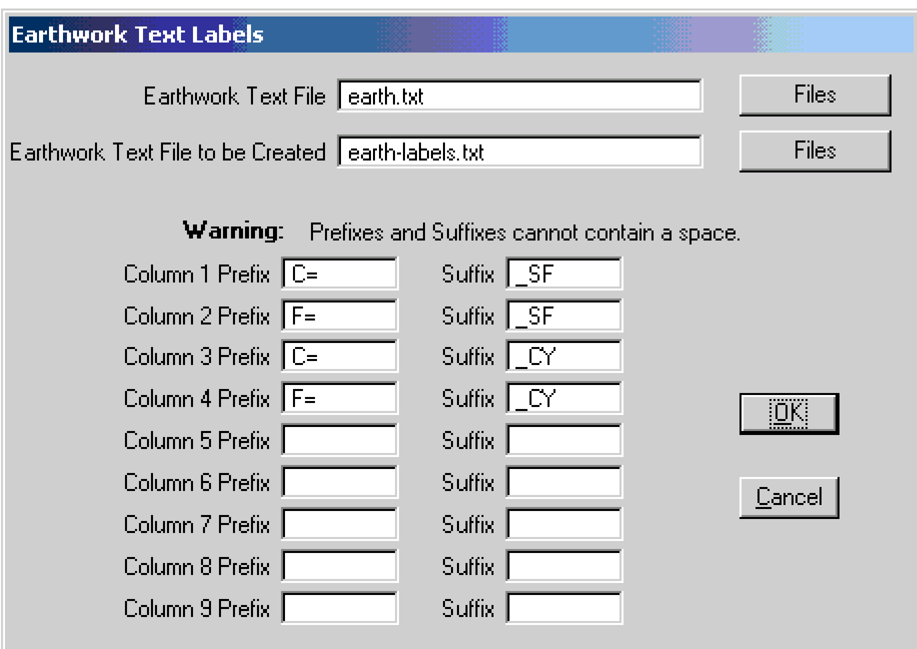



14. Review the **earth.log**, and the **earth.txt** files.

15. To add the labels to the earth.txt file, open **Design and Computation Manager**. Navigate to **3PC Tools** and double click on **EW Earthwork Text File Labels** as shown in the following figure.




This will open the following dialog. Fill it out as shown and press OK.



16. Review the **earth-labels.txt** file.

17. Save the changes to the MicroStation DGN.

    Exit D&C Manager.

    Exit the run and exit the Earthwork dialog.

## Chapter 18

# Cross Section Sheets

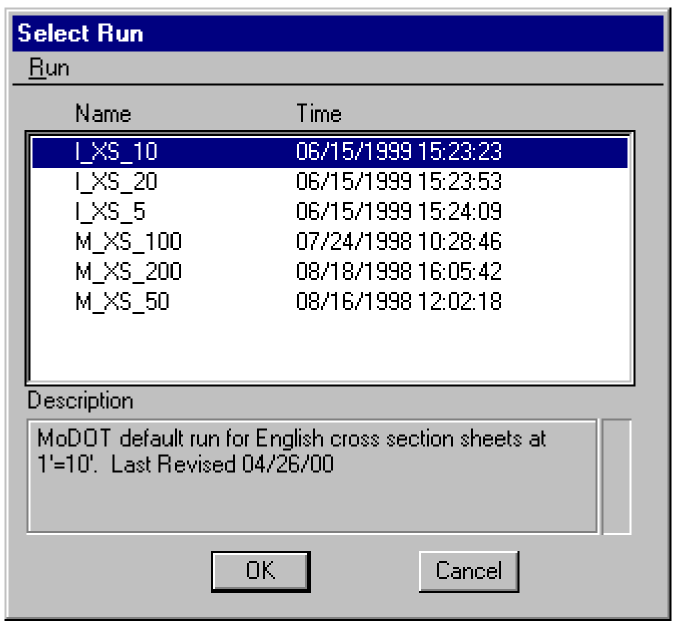
## 18.1 Objectives

- Learn the procedures for laying out cross-section sheets.

## 18.2 Accessing

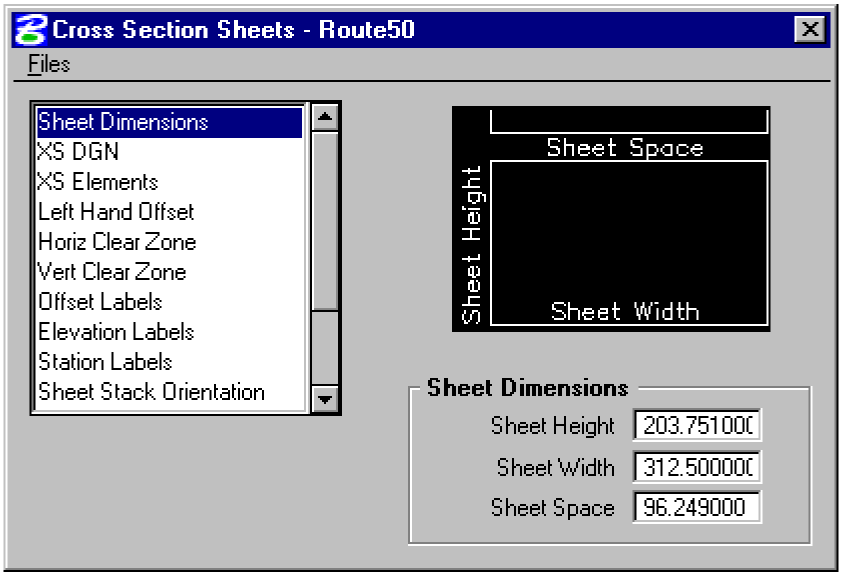
Prior to beginning the cross-section sheet layout process, the user will need to create a cross-section sheet file. There are six seed files the user can choose from when setting up the cross-section sheet file: i_xs_shts_5.dgn, i_xs_shts_10.dgn, i_xs_shts_20.dgn, m_xs_shts_100.dgn, m_xs_shts_200.dgn, 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**. The run should be chosen according to the scale that the cross-sections will be plotted at.




Once the run is chosen, the dialog box shown below appears.

## 18.3 Dialog

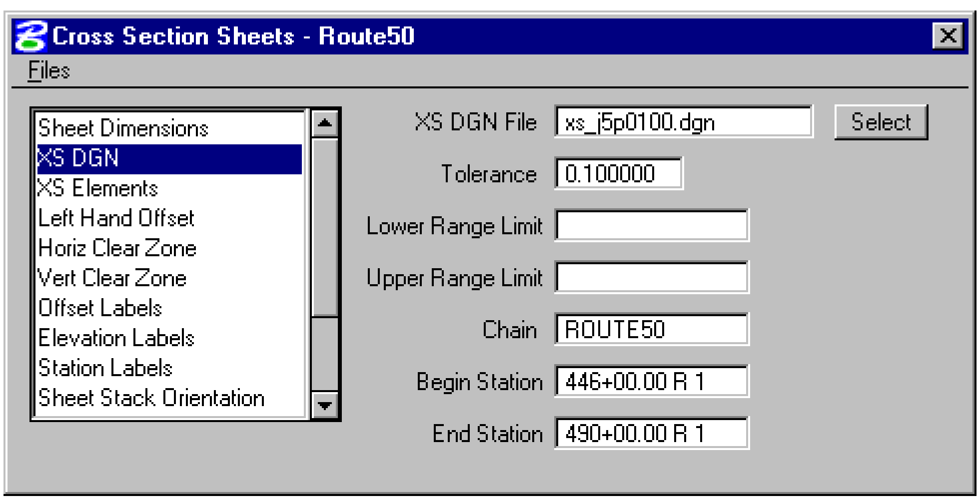



The left side of the dialog contains the list of parameters required to draw the cross section sheets. When each parameter is selected, the dialog changes the key-in fields to reflect the selection.

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.

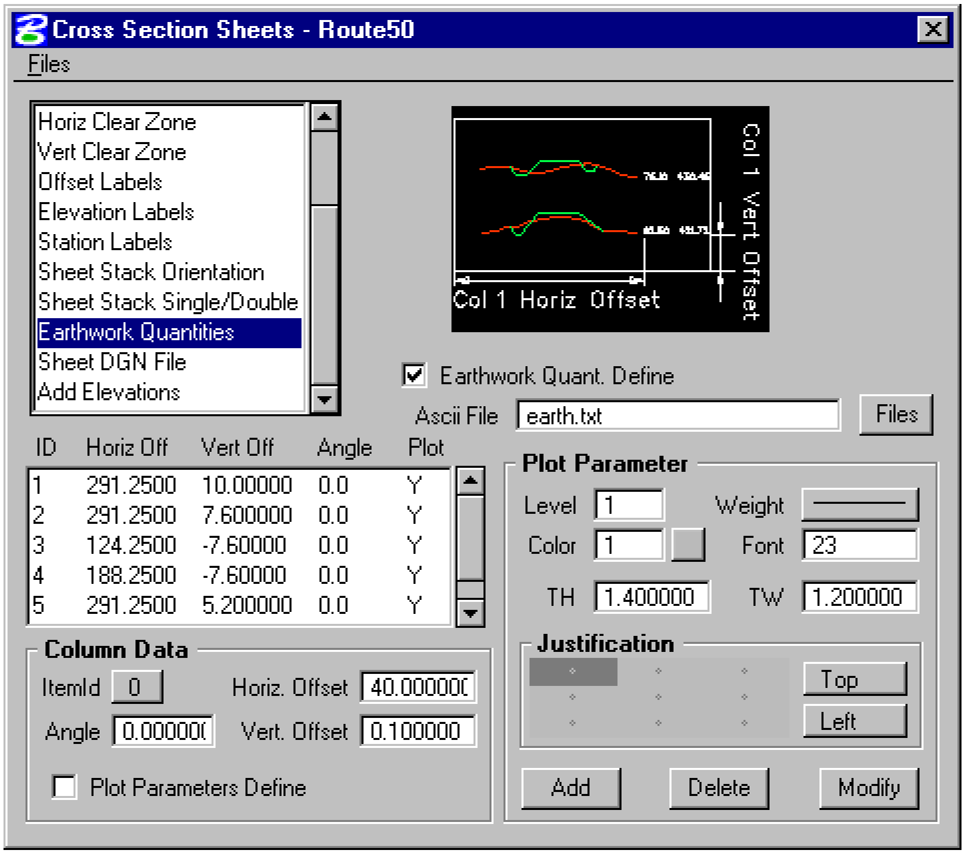
### 18.3.1 XS DGN

**XS DGN** defines the file in which the cross-sections are located, the baseline chain, and the station limits.



## 18.3.2 Earthwork Quantities

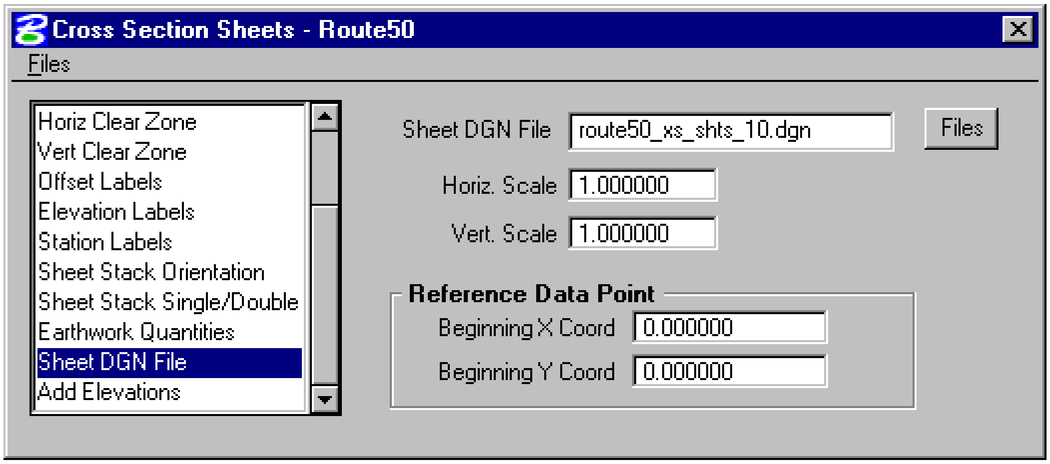
**Earthwork Quantities** allows the user define the ASCII file that contains the earthwork quantity information, as well as toggle on/off the plotting of the earthwork quantities. If the **Sheet Quantities** portion of the earthwork run was not changed, the user should not change anything else in this dialog.



### 18.3.3 Sheet DGN File

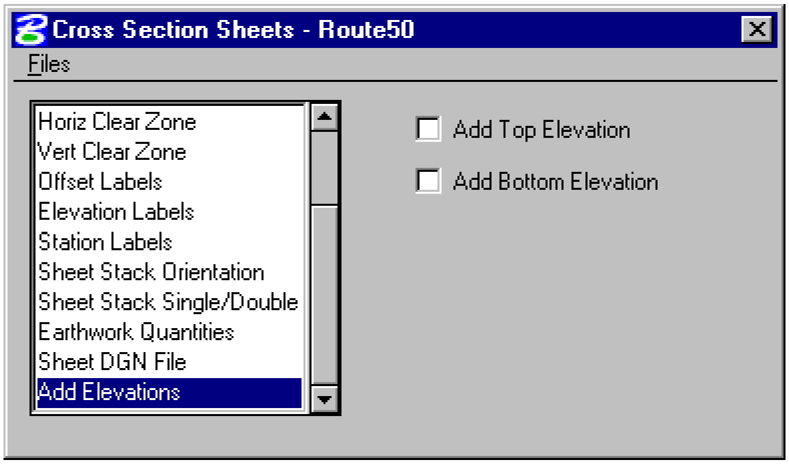
The **Sheet DGN File** specifies which file the cross-section sheets will be placed in. (Currently, the path to the Sheet DGN File including the file name is limited to 40 characters. By using the working directory, the user can specify only the file name in the Sheet DGN File field to increase the length 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.**




### 18.3.4 Add Elevations

Using the toggles **Add Top Elevation** and **Add Bottom Elevation** located in the **Add Elevations** section, the user can plot the elevation above and/or below the cross section elements.

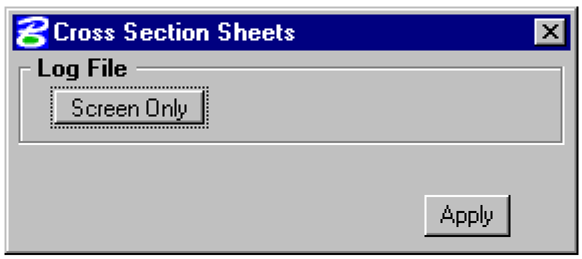


## 18.3.5 Files Menu


From the **Files** menu, the **Run** option will process all parameters that have been set in the **Cross Section Sheets** dialog box. The **Save Settings** option will save all information in the **Cross Sections Sheets** dialog box. The **Export** option will allow the user to save the parameters in the **Cross Section Sheets** dialog box as an ASCII input file. The **Exit** option will exit the **Cross Sections Sheets** dialog box.

## 18.3.6 Process Cross Sections

Once the dialog box is complete, the user can select **File** >> **Run** and the following dialog box will appear.

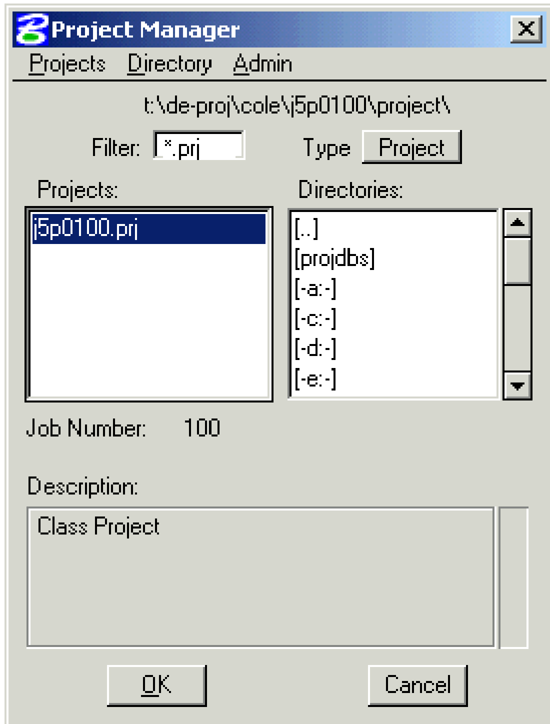



The user can display the results to the screen only, or write them to a log file. Once the **Apply** button is selected, the cross-sections will be plotted in sheet format.

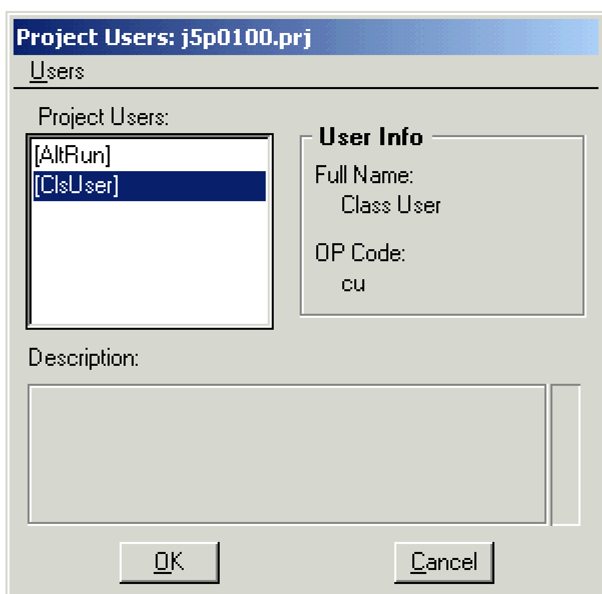
## 18.4 Example 18-1

1. Open the MicroStation file **t:\de-proj\cole\5p0100\data\rte50_xs_j5p0100.dgn**.

2. Open the project **t:\de-proj\cole\5p0100\project\j5p0100.prj**.




3. Select the user **ClsUser**.

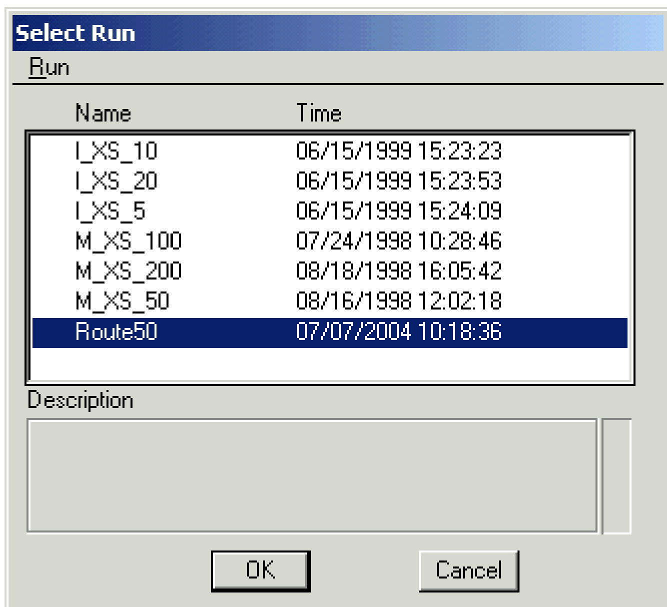


4. Enter **Road**.


5. Select the **Route50** working alignment.

6. Choose **Cross Section Sheets** from the **Road Project** dialog.


Copy the **I_XS_10** run to **Route63** and open the **Route50** run.




7. Create a new MicroStation file in **t:\de-proj\cole\5p0100\data** using the seed file:

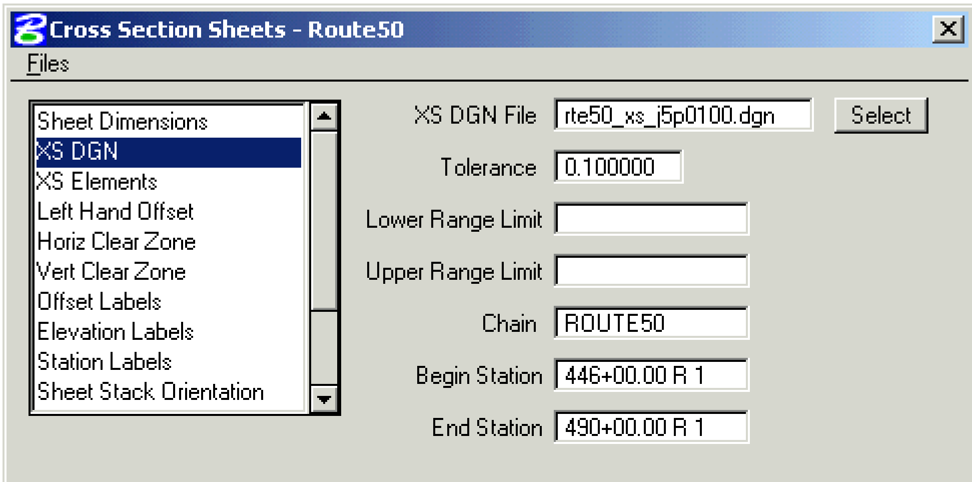
**t:\standard\wsmod\design\seed-i\i_10_xs_100_sheets.dgn**

Name the file **rte50_xs_sheets.dgn**.

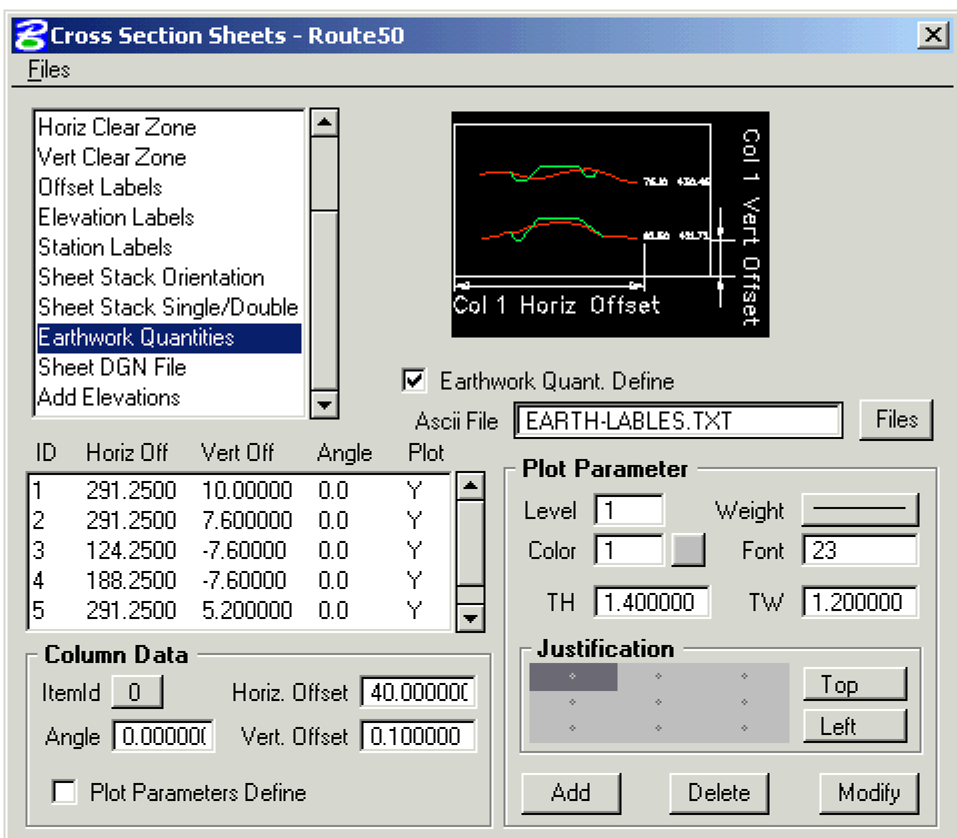
8. Be sure the following items are set in the **XS DGN File** sections of the dialog:

   XS DGN File: **rte50_xs_j2p0200.dgn**

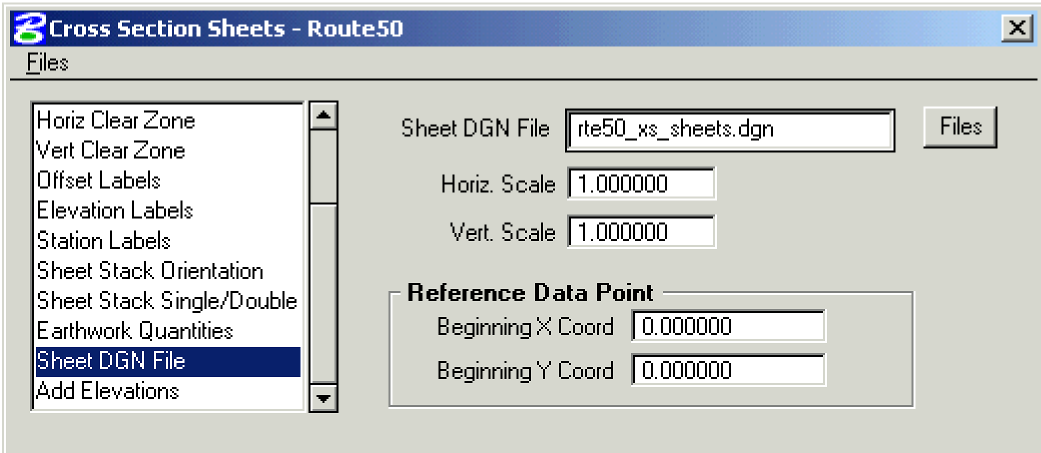
   Baseline: **ROUTE50**




9. In the **Earthwork Quantities** section, turn on the **Earthwork Quant. Define** option, and choose the ASCII file of **EARTH-LABELS.TXT**.



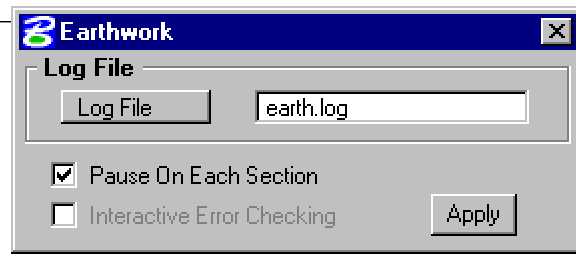
10. Select the **Sheet DGN File** to be the file **rte50_xs_sheets.dgn** created in step 7.



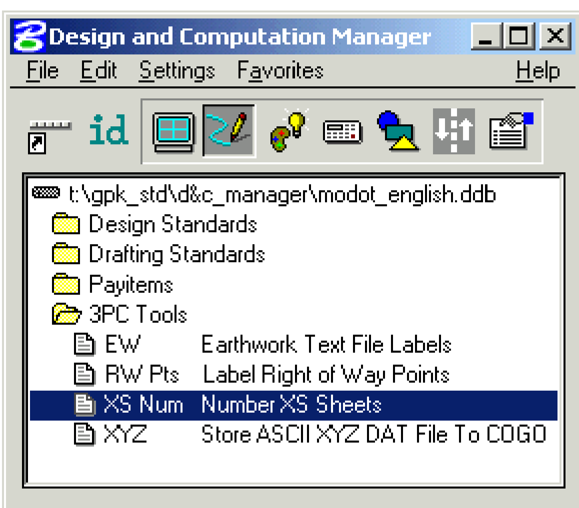

11. Save the settings for the dialog.

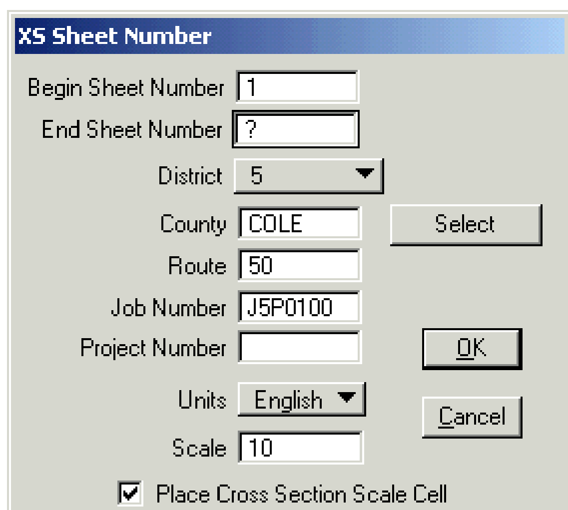
Run the proposed cross-sections.

Set the **Log File** to **Screen Only**.




12. To add the title block information, open **Design and Computation Manager** and navigate to the **3PC Tools**. Double click on XS Num Number XS Sheets and fill out the dialog as shown except enter the appropriate value in the **End Sheet Number**.




Click **OK** and data point inside the border for the first sheet as indicated in the **Prompt** dialog shown below:

# Chapter 19

# XS Reports & Limits of Construction

## 19.1 Objectives

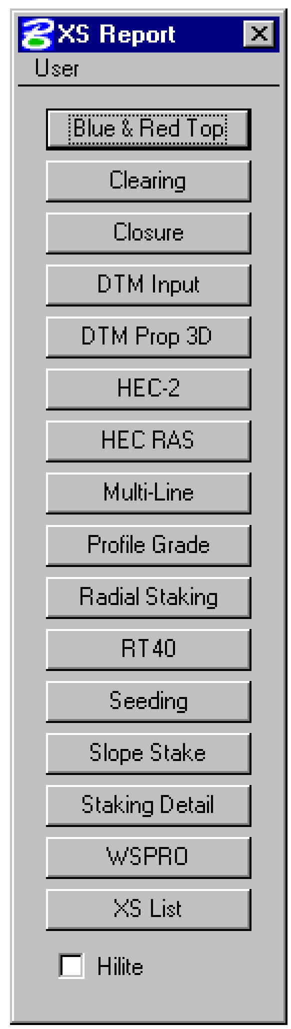
- Create various cross section reports:
  - for plan use (design elements and quantities)
  - as input for other programs and/or applications of GEOPAK
  - for construction layouts
- Create and plot construction limits in the plan view.

## 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.

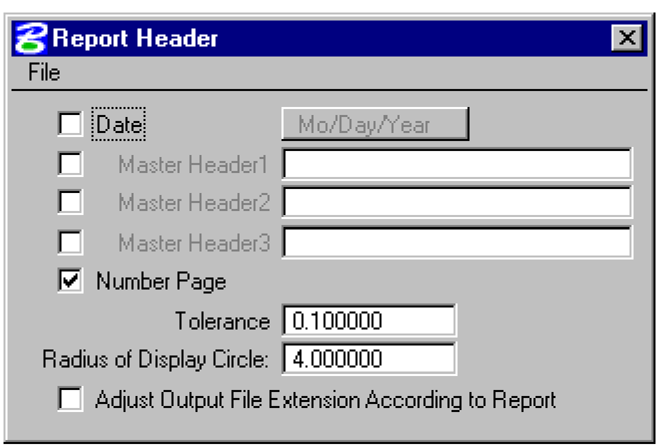
## 19.3 XS Reports Accessing

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.

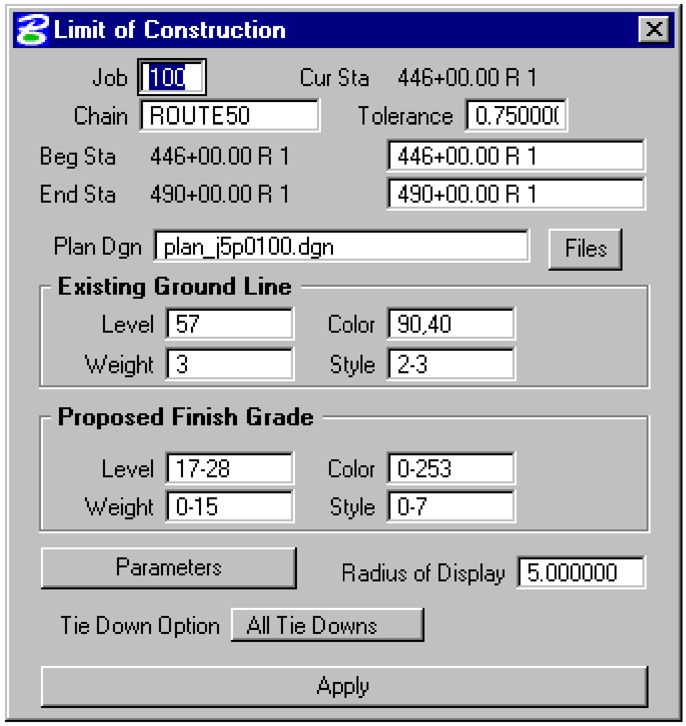
### 19.5.16 XS List

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 manual or the 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.

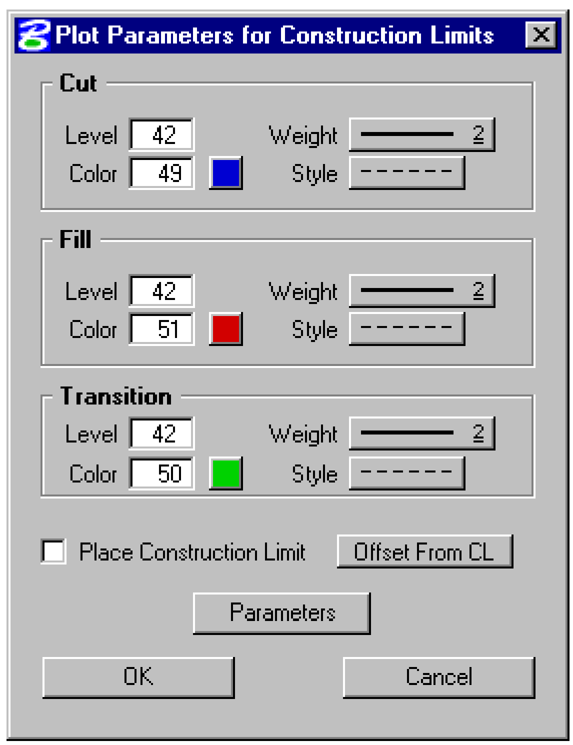



## 19.7 Processing Limits of Construction

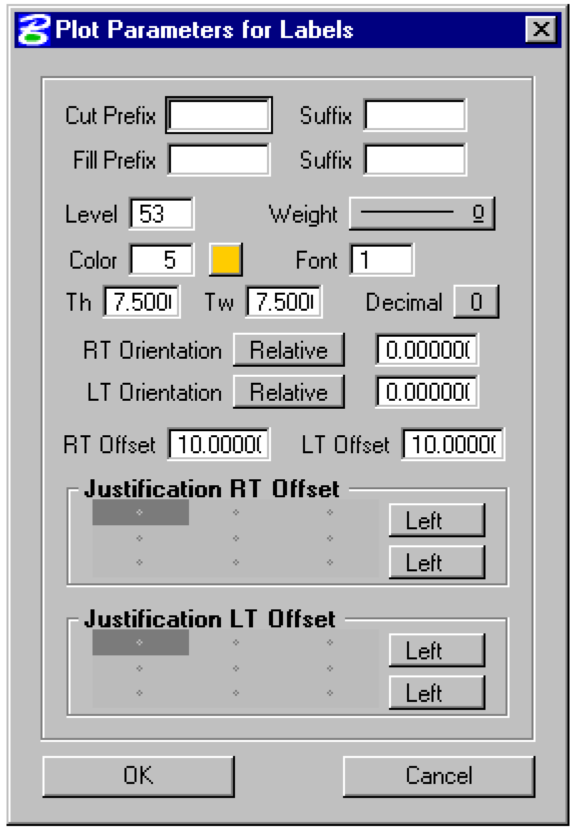
The user can specify the .gpk job number, the centerline, and the file containing the plan view information. The **Working Alignment** should fill the **Existing Ground** and the **Proposed Finish Grade** sections.

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.

## Chapter 20

# 3D Modeling

## 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.

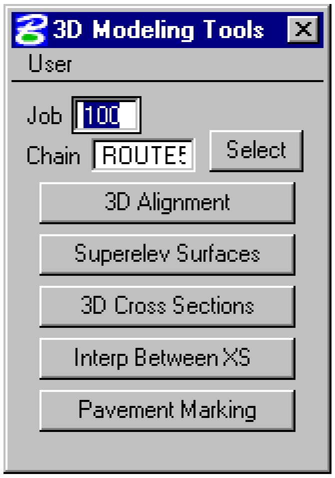
### Plan View Graphics

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, 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 **Project Manager >> 3D Models** or by selecting the **3D Models** icon. The dialog box will appear requiring a job number and chain name. This chapter will primarily focus on the **3D Cross Sections, Interp Between XS** and **Pavement Markings** tools. Descriptions of the available 3D modeling tools follow:

**3D Alignment -** will draw elements into a 3D file, at correct coordinates, using the specified alignment and profile.

**Superelevation Surfaces -** is used to draw Geopak generated 2D shapes into B-spline surfaces, within a 3D model, following user defined plotting parameters.

**3D Cross Sections -** will reference your 2D cross section file and create a 3D complex chain to represent the 3D cross sections.

**Interp Between XS -** interpolates between the 3D cross sections to create B-spline surfaces.

**Pavement Markings -** will add pavement markings to a 3D model. The pavement-marking tool will scan pavement markings in a 2D file and draw the markings in the 3D file based on user defined parameters.

## 20.5 3D Modeling Process

1. Plot the 3D alignment, and attach the plan view as a reference file.

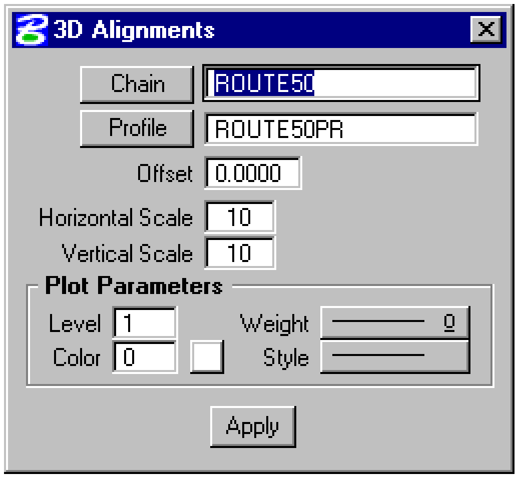
2. Geopak will open the 2D cross section file, scan the cross sections and create a complex line-string based on the cross sections.

2. Geopak then returns to the 3D-design file to draw the 3D cross sections.

3. B-spline surfaces must be created using **Interp Between XS**.

### 20.5.1 3D Alignment

A 3D alignment must be plotted. This 3D alignment is a representation of the combined chain and profile. An offset from the chain can be specified as well as the horizontal and vertical scales, and the symbology of the 2D alignment.




### 20.5.2 3D Cross Sections

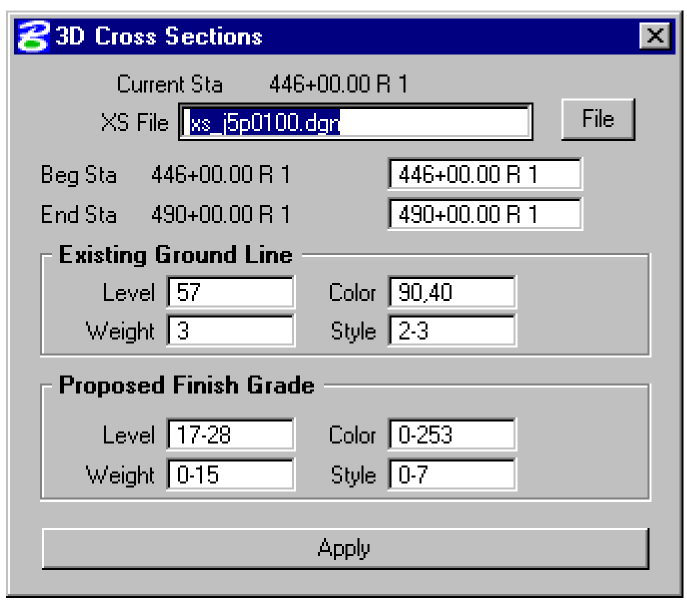
Generate 3D Cross Sections:

- 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.

- Select **Apply**

Geopak opens the 2D cross-section file and begins creating 3D complex line-strings from each cross-section. Each 2D cross-section will highlight 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 XS

Two **Methods** exist for interpolating cross-sections:

**Longitudinal -** is used when a 2D-plan view is referenced to the 3D cross-section file. This is the most common method.

**Surfaces -** should be selected when your plan view reference file is a 3D file.

**Beginning Station and Ending Station -** values will automatically be displayed when each of their offsets are defined. Offset information must be entered in order and is controlled by successive activation of the **DP** buttons. The user must define the Beginning Station offsets by first issuing a **DP** for the left and right offset locations. The same process is repeated for the End Station box.

**Highlight Applied Breaklines -** will highlight the breaklines used in interpolation when toggled on.

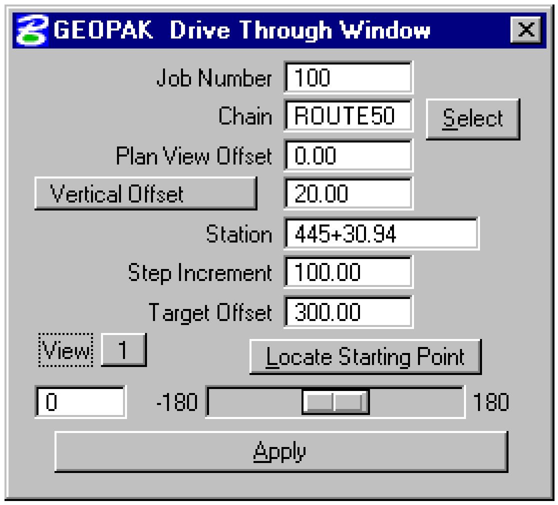
Select the **Draw Surfaces** bar at the bottom of the dialog box to begin the interpolation process. The user is encouraged to process a small range of cross sections until the entire project has been done. When Geopak interpolates 3D cross sections, it projects *like color* to *like color* between cross-sections. All Microstation elements should maintain a consistent color scheme throughout the project. For example, within a 2D file, all ditch slopes should be drawn the same color and roadway lines should also be drawn using one color. 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.

## 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.




The user must enter the **Job Number** and a **Chain** name. The drive through will follow this chain or may be offset from the chain by entering a value in the **Plan View Offset** box.

Two options are available to define the distance the driver is from the roadway vertically:

- **Constant Elevation** will place 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 will automatically display the beginning station of the selected chain, but 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 will find 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 activate the first camera view. 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 again.

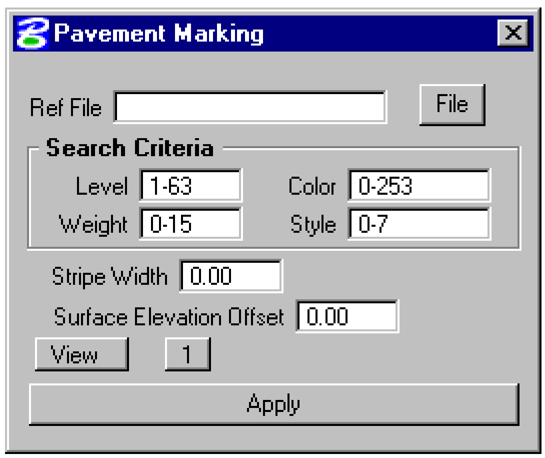
After viewing the model:

- 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).

## 20.7 Pavement Markings

This tool places pavement markings in a 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.)




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.

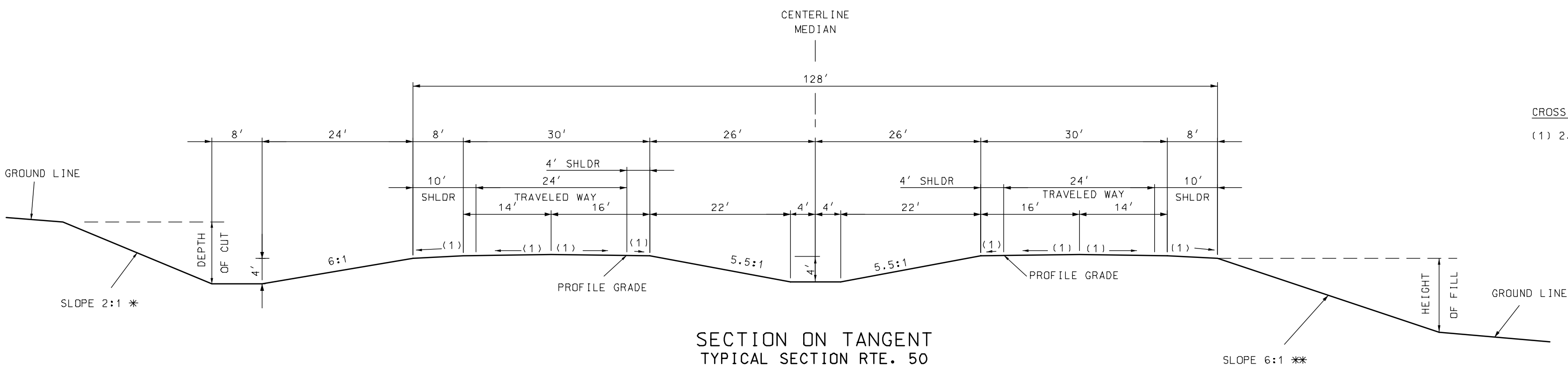
Pavement Markings may be applied to an entire view or a fenced area by selecting the appropriate option. If view is chosen, be sure to *fit the view* before processing.

| ROUTE | STATE | DISTRICT | SHEET NO. |
|---|---|---|---|
| 50 | MO | 5 | |
| JOB NO. J5P0100 | | | |
| CONTRACT ID | | | |
| PROJECT NO. | | | |
| COUNTY COLE | | | |

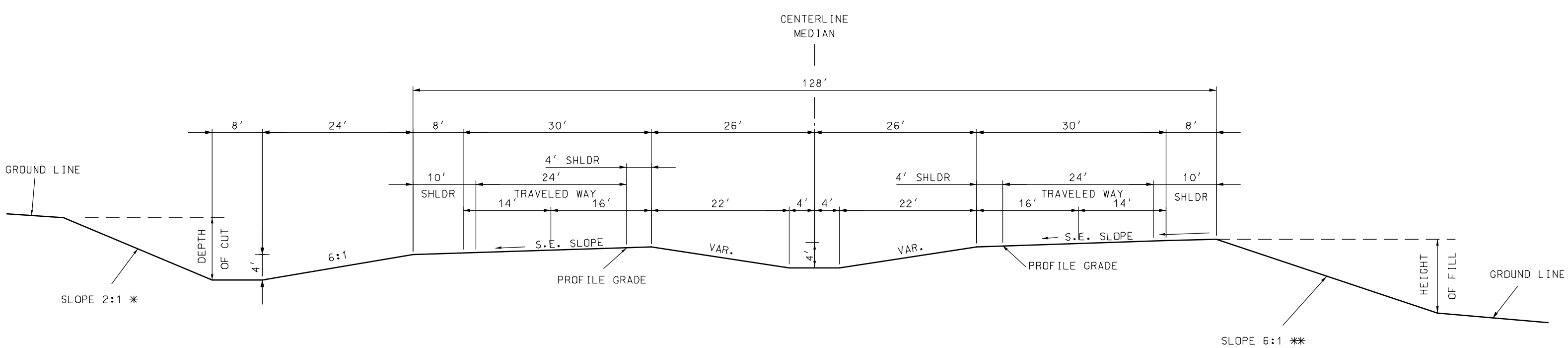
DATE____________

CROSS SLOPE

(1) 2.0%




SECTION ON TANGENT
TYPICAL SECTION RTE. 50




SECTION ON SUPERELEVATED CURVE
TYPICAL SECTION RTE. 50

* BACKSLOPE DETERMINED BY SOIL SURVEY.

** THE FILL SLOPE SHALL BE 6:1 OR FLATTER WHEN THE FILL HEIGHT IS EQUAL TO OR LESS THAN 4 FEET (I.E., THE OFFSET FROM THE TOE OF FILL TO THE SHOULDER POINT IS A MINIMUM OF 24 FEET). THE SLOPE MAY VARY TO MEET THIS REQUIREMENT. FOR FILL HEIGHTS GREATER THAN 4 FEET, THE SLOPE SHALL NOT EXCEED THE MAXIMUM SLOPE DETERMINED BY THE SOIL SURVEY.

TYPICAL SECTONS
ROUTE 50

| ROUTE | STATE | DISTRICT | SHEET NO. |
|---|---|---|---|
| 50 | MO | 5 | |

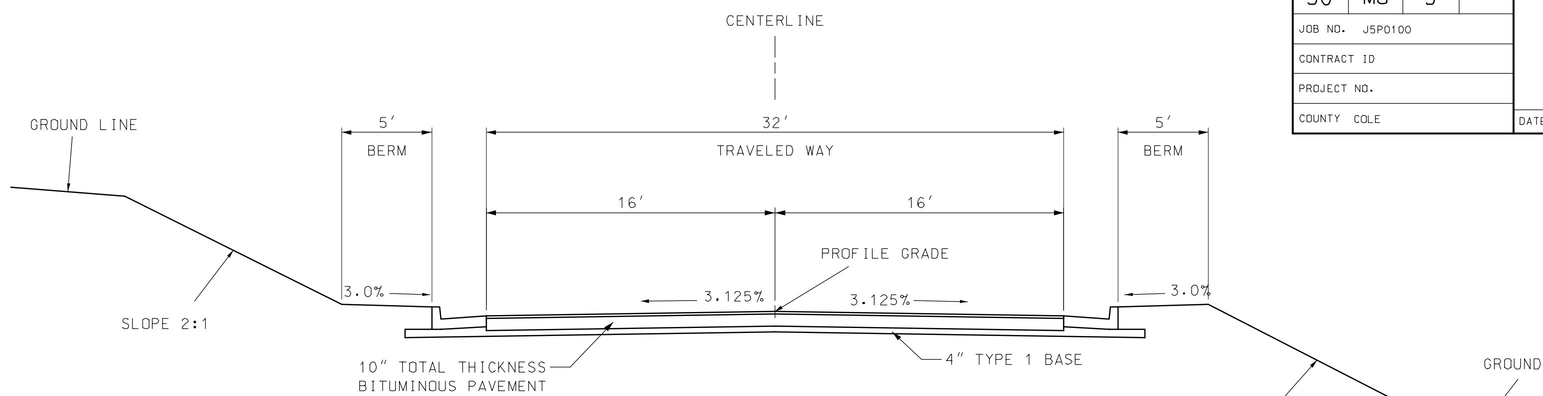
JOB NO. J5P0100

CONTRACT ID

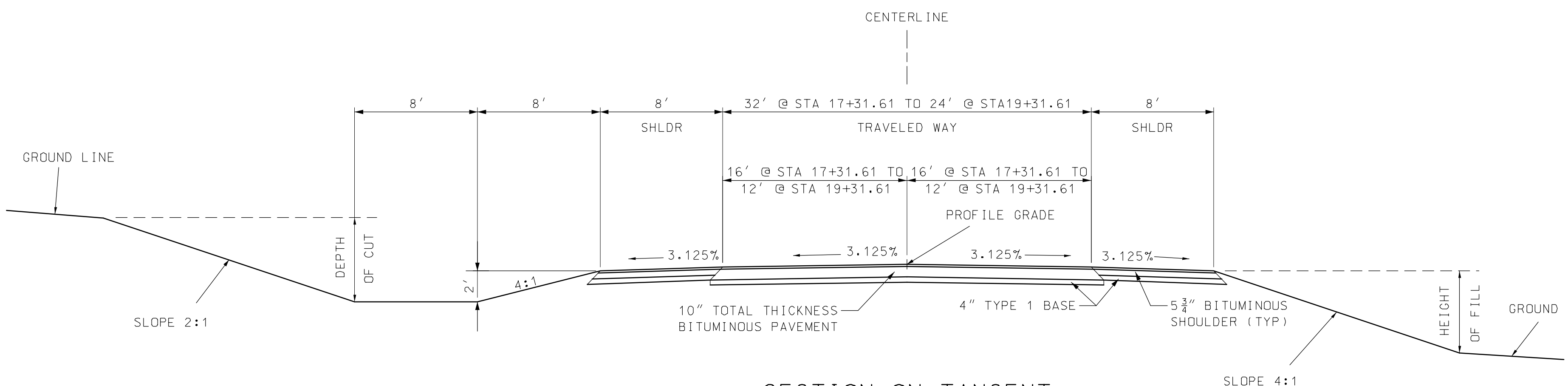
PROJECT NO.

COUNTY COLE

DATE




## SECTION ON TANGENT
TYPICAL SECTION BIG HORN DR.
STA. 0+97.77 TO STA. 17+31.61




## SECTION ON TANGENT
TYPICAL SECTION BIG HORN DR.
STA. 17+31.61 TO STA. 21+52.70

# TYPICAL SECTIONS
# BIG HORN DRIVE

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