Superelevation

14.1 Objectives 1
14.2 Definitions 1
14.2.1 Shapes 1
14.2.2 Shape Clusters 2
14.2.3 Shape Classes 3
14.2.4 Shape Elements 4
14.3 Accessing 4
14.4 Calculate Superelevation 4
14.4.1 Automated Superelevation 5
14.4.2 Superelevation Input File 8
14.4.3 Superelevation Log File 10
14.4.4 Autoshape Builder 11
14.5 Shape Maker 11
14.6 Additional Superelevation Tools 13
14.6.1 Shape Analyst 13
14.6.2 Shape Profiler 13
14.6.3 Shape Editor 14
14.6.4 Shape Selector 14
14.6.5 Shape Properties 14

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.

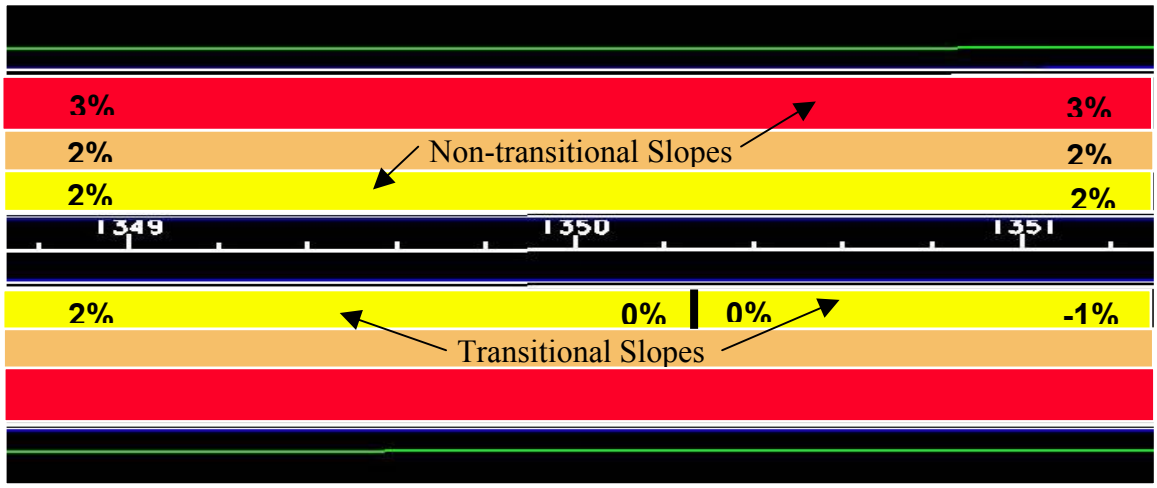
14.2 Definitions

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. In advanced design superelevation shapes are not limited to pavement, but may be used to represent any sloped surface that conforms to shape parameters—such as bridge end slopes.



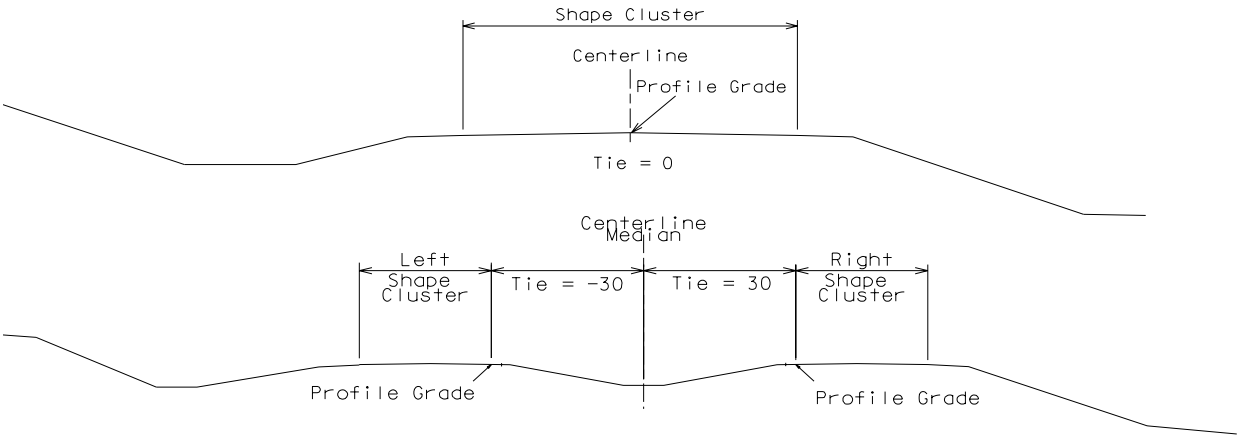
14.2.2 Shape Clusters

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

Baseline – roadway baseline

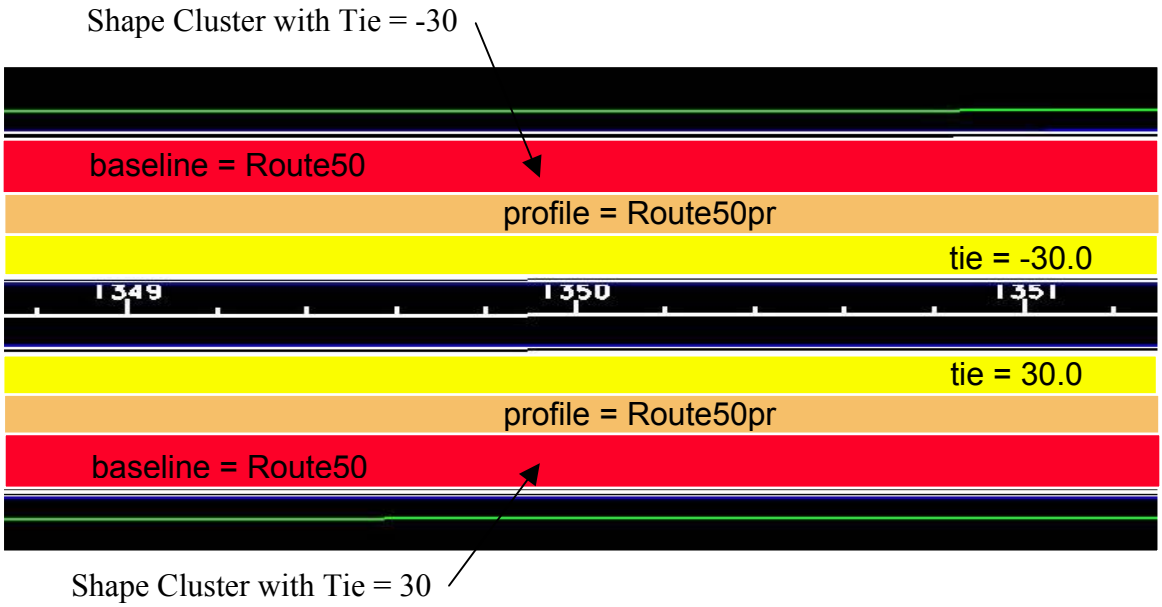
Profile – roadway profile

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.)

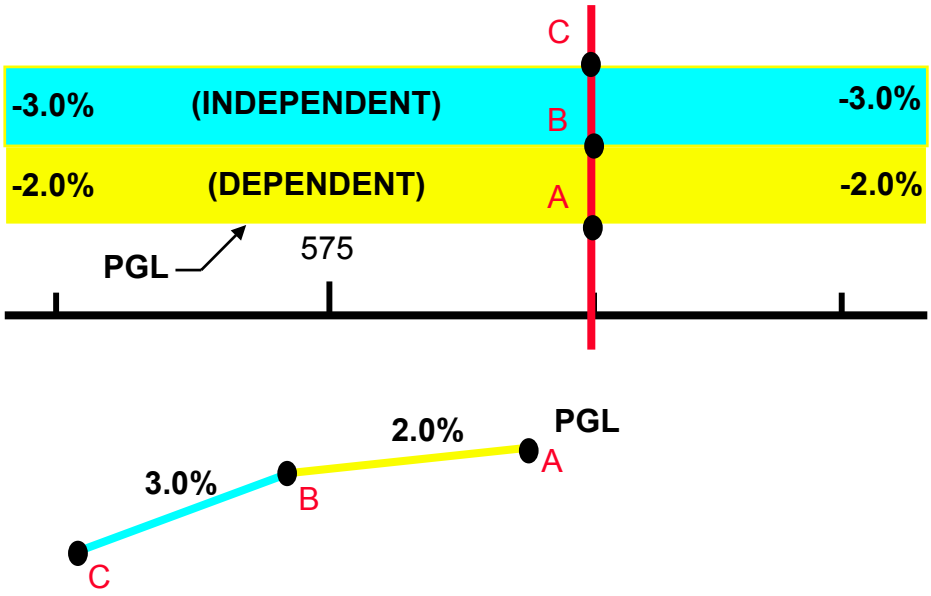
A group of shapes with the same shape attributes is called a "Shape Cluster".



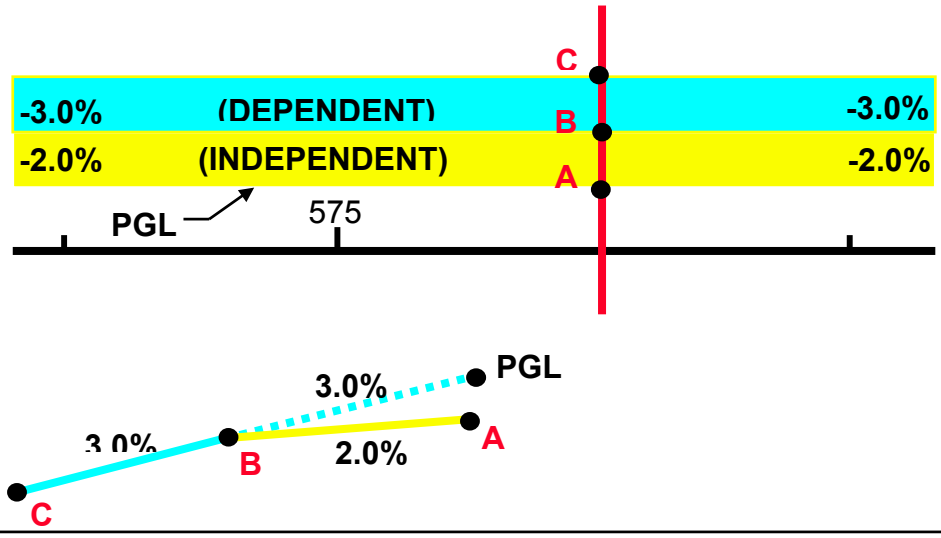
14.2.3 Shape Classes

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**.

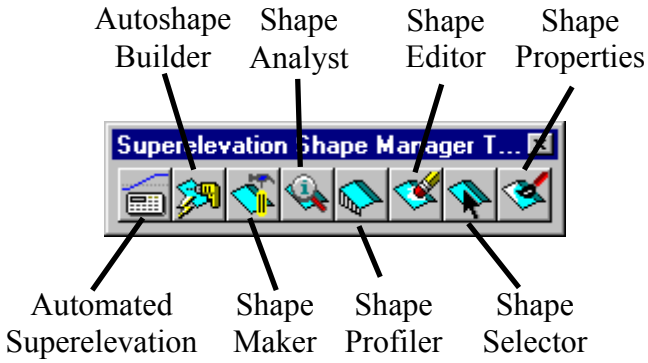
Longitudinal Edges - Typically, these consist of the roadway edges of pavement or lane lines. These lines do not represent slopes.

Filler Lines - These lines represent the beginning and ending slopes of a pavement shape. Each of these lines always represents a slope value.

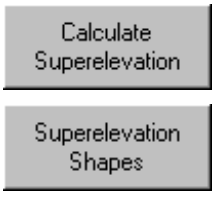
14.3 Accessing

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 superelevation toolbox is shown below.



Automated Superelevation and Shape Maker can also be accessed from the **Road Project** dialog. Pressing the **Calculate Superelevation** button opens Automated Superelevation and selecting **Superelevation Shapes** accesses Shape Maker.



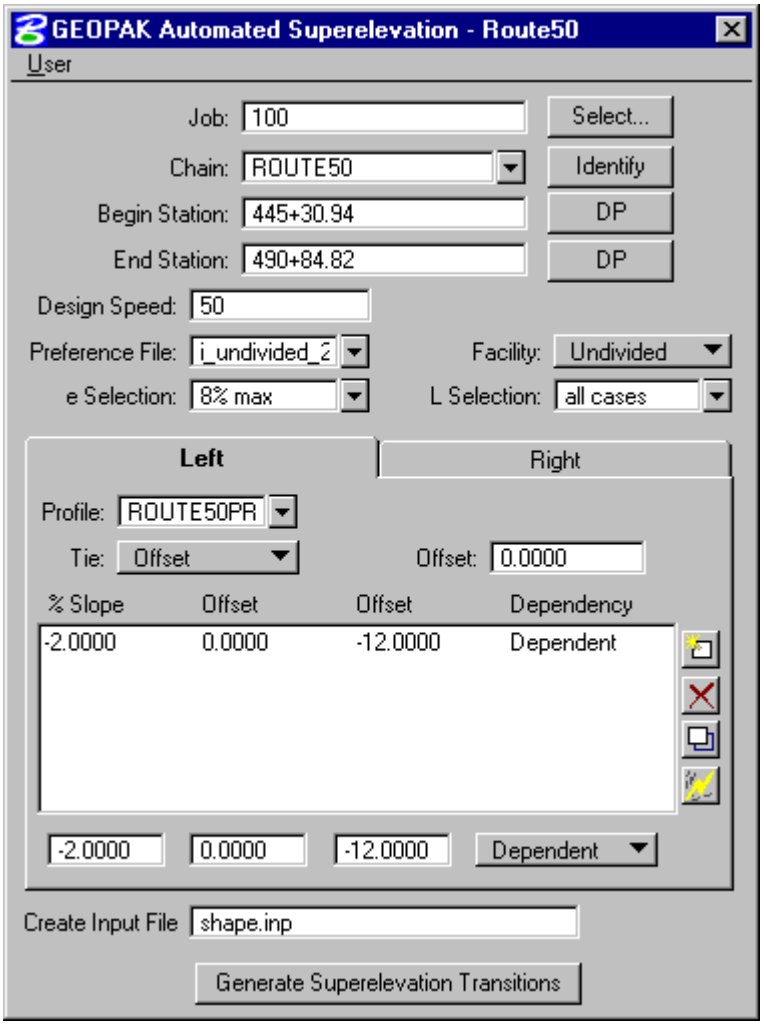
14.4 Calculate Superelevation

Calculate superelevation is a process by which pavement cross slopes are computed to conform to design standards for normal crown, full superelevation based on curve geometry, and the

transitions between normal crown and full superelevation. Once the computations are completed and checked, the cross slope information is plotted using superelevation shapes. The process has four components: automated superelevation, text editing of the superelevation input file, creation of a log file, and auto shape builder.

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.

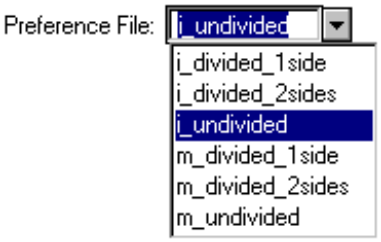
Chain – Baseline chain name for the project. This may be the centerline of roadway for an undivided roadway, the centerline of median for a divided roadway, or the edge of pavement for a ramp.

Beginning Station – station to begin the shapes.

Ending Station – station to end shapes.

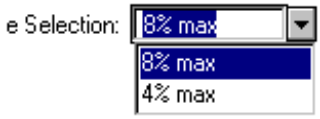
Design Speed - the design speed for the project that determines the rate of superelevation for curves.

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.



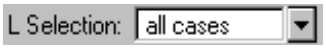
i_divided_1side – imperial, divided roadway, using standard 203.21G, when calculating only 1 side of the median
i_undivided – imperial, undivided roadway, using standard 203.20E
m_divided_1side – metric, divided roadway, using standard M203.21G, when calculating only 1 side of the median
m_undivided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

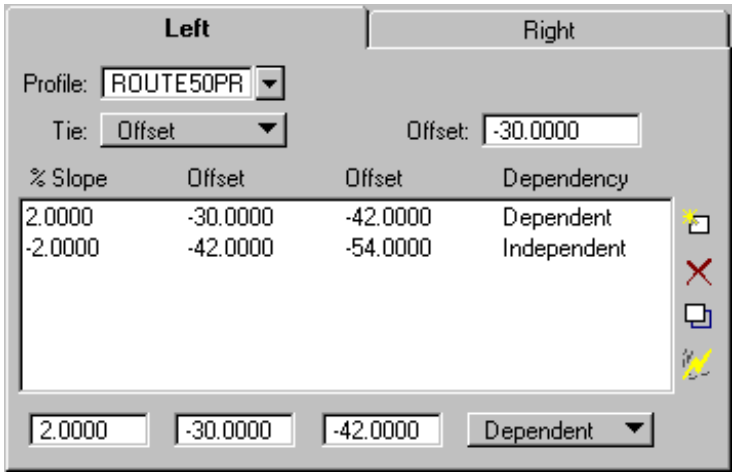
L Selection – this should be set to **All Cases** for all situations.



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.

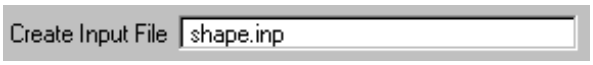


% Slope – define as the normal slope for this section of roadway.

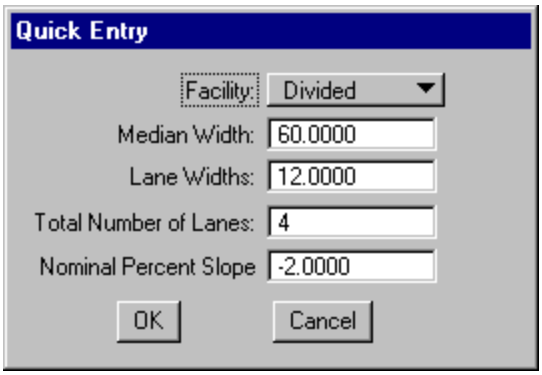
Offset – define one **Offset** as the distance between the baseline and the inside edge of the shape, and the other as the distance between the baseline and the outside edge of the shape.

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.

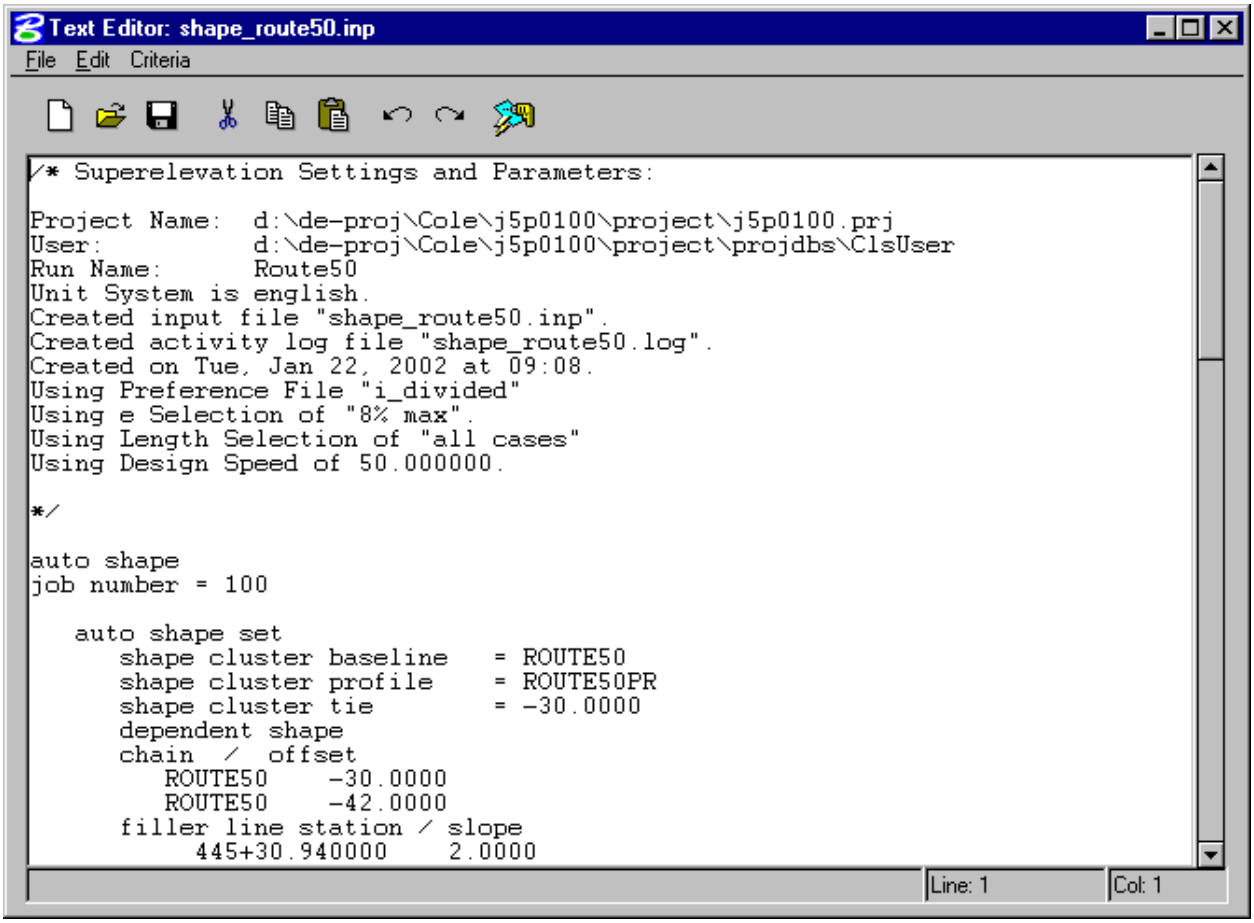
14.4.2 Superelevation Input File

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. 



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.

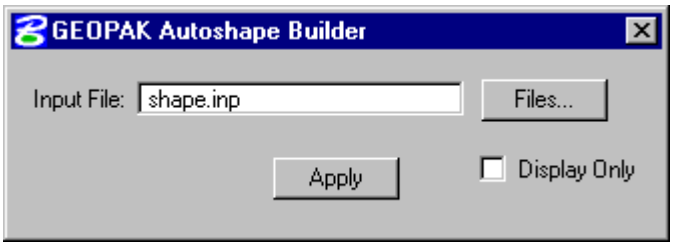
Superelevation Calculation Complete.
Output written to file "shape.inp"

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.



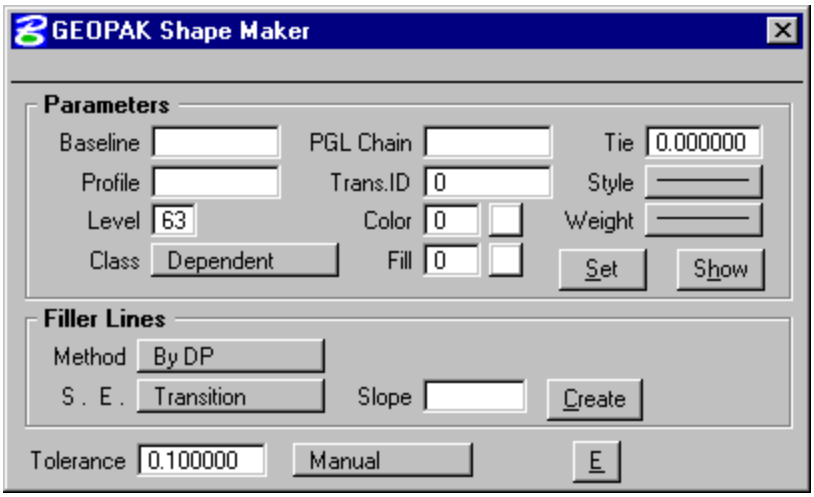
The user selects the input file to process, then presses the **Apply** button to execute the input file. The **Display Only** toggle can be turned on to temporarily plot the shapes into the MicroStation design file. When the view is updated, the temporary graphics will be deleted.

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

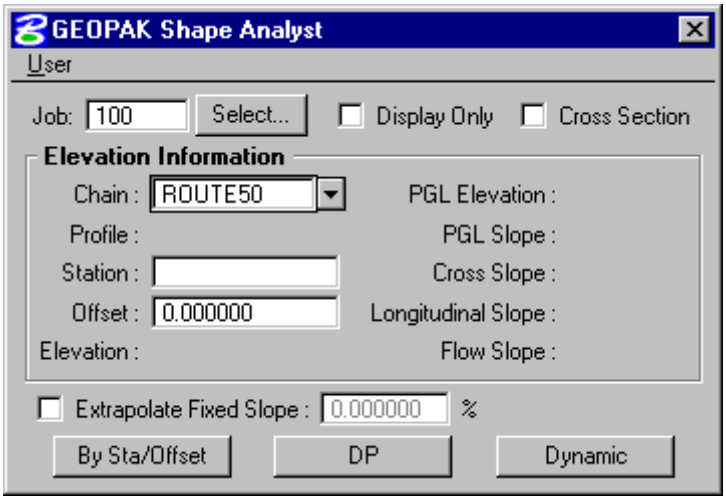
Complete Shape:

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

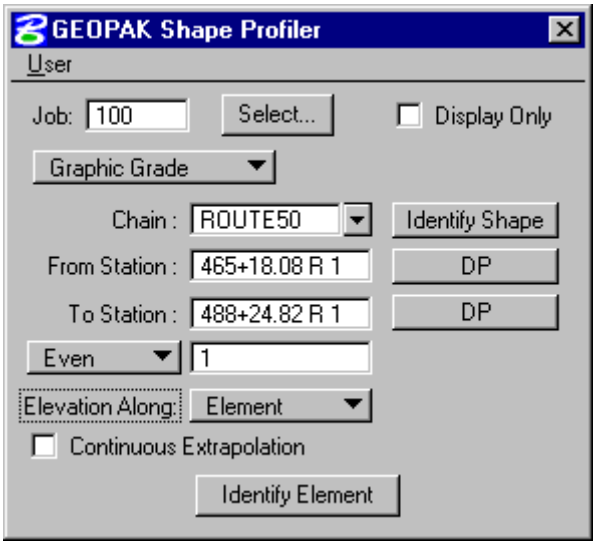
14.6.1 Shape Analyst

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.



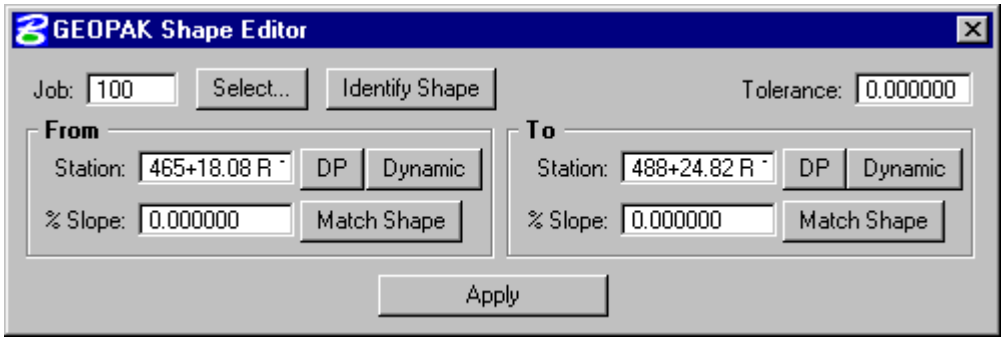
14.6.2 Shape Profiler

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.



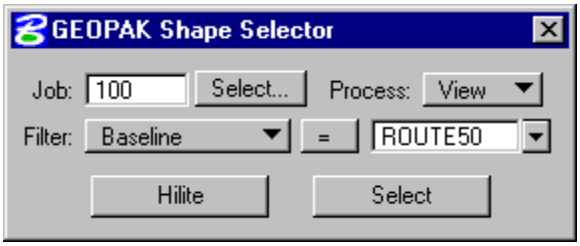
14.6.3 Shape Editor

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.

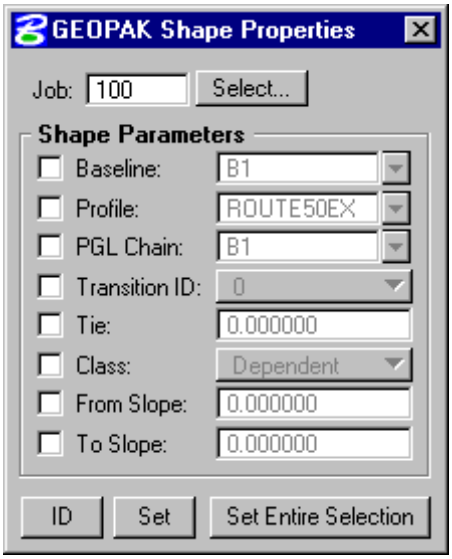


14.6.4 Shape Selector

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.