

GEOPAK Road for Bridge Exercise 14-2 Superelevation Tools

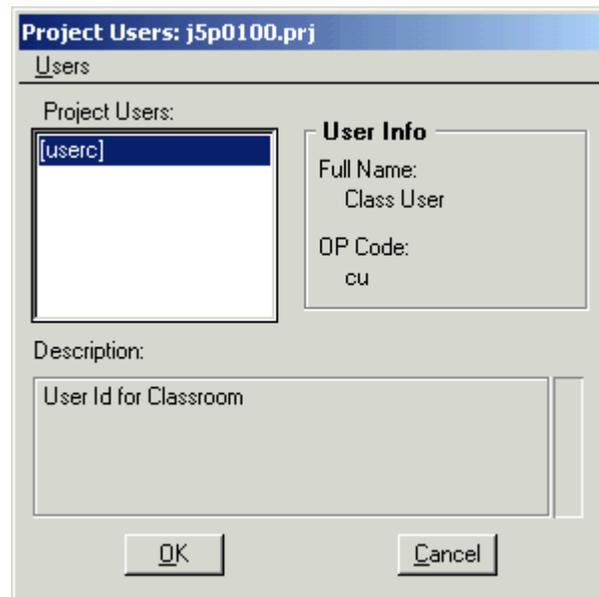
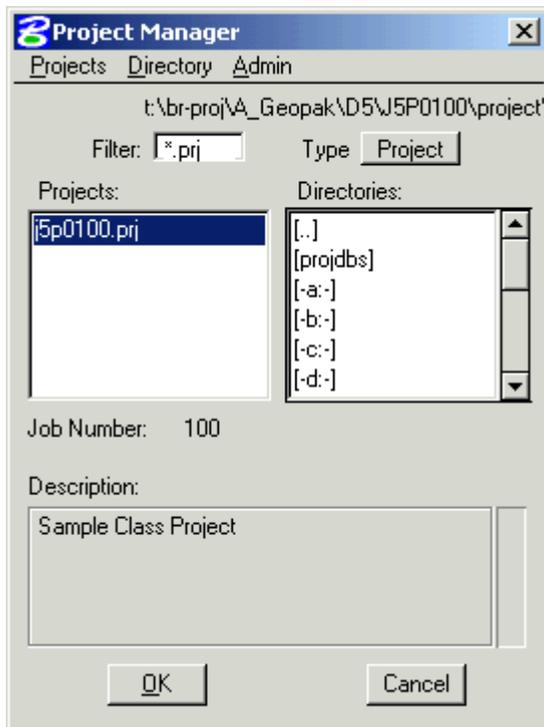
Exercise 14-2

This is a group exercise to demonstrate the use of the GEOPAK superelevation tools to help determine end locations. Specifically, the tools will be used to find elevations from two shapes to locate where they intersect.

This exercise is based on the following design information: End of wing to end of wing length is controlled by the intersection of the spill slopes with the outside edges of the bridge deck. End bent locations are controlled by the requirement to maintain a minimum clearance of 1' from the top of the end bent beam to the top of the spill slope. This clearance needs to be checked at the outside face of the exterior girders unless the crest of a vertical curve for the lower roadway is located directly beneath the bridge. The location of the checks for this exercise was obtained from the cross section of the slab from Bridge Manual page 3.56.2.5-1 shown on the following page.

1. Open the MicroStation file
t:\br-proj\A_geopak\d5\j5p0100\data\pattern_shape_j5p0100.dgn.

2. Open the project **t:\br-proj\A_geopak\d5\j5p0100\project\j5p0100.prj** as user **userc** and enter **Road**.



3. Select the **Route50** working alignment.

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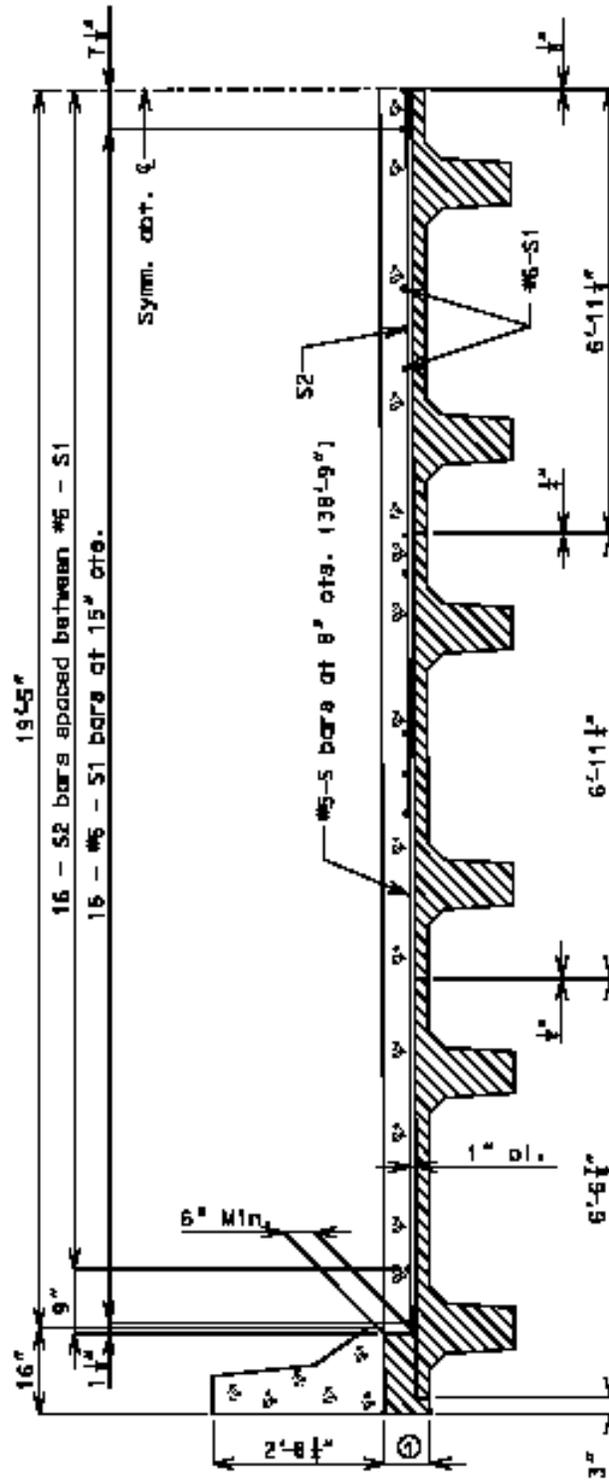
Bridge Manual

P/S Concrete Double-Tea Girders - Sec. 3.56

Page: 2.5-1

38'-10" ROADWAY (HS20 & HS MILITARY)
SLAB REINFORCEMENT

Reinforcement



HALF SECTION NEAR INT. BENT

① 2-1/2" + Theoretical slab thickness.
Note: S2 bars at Int. Bents for negative moment reinforcement.

Revised: Nov. 2000

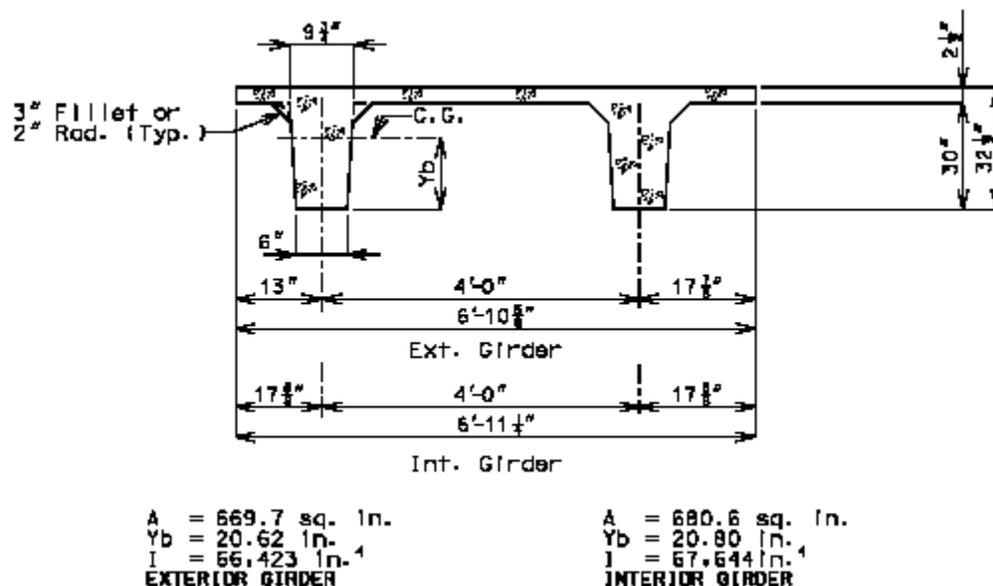
E5600

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4. **Determine Critical Offsets:** Away from the bridge, the roadbed width is 40' (6' left shoulder, + two 12' lanes + 10' right shoulder). Centering the structure on the roadbed places the centerline of structure two feet to the right of the centerline of the two driving lanes, which is 42' to the right of the highway's horizontal alignment. Consequently the centerline of structure is 44' (42' + 2') to the right of the alignment. Offsets for the bridge gutterlines are 24'-7" (44' - 19'-5") and 63'-5" (44' + 19'-5"). Adding the 16" barrier, the **offsets for the bridge deck edges are 23.25' & 64.75'**. These are the offset values that will be use to locate the intersect point of the spill slope with the bridge deck.

The figure from the Bridge Manual on the previous page show the horizontal width of the flanges on the interior double-tees as 6'-11 1/4". Because the bridge is curved, this value will be increased to 6'-11 3/8" to reduce the maximum exterior overhang on the outside edge of the curve.

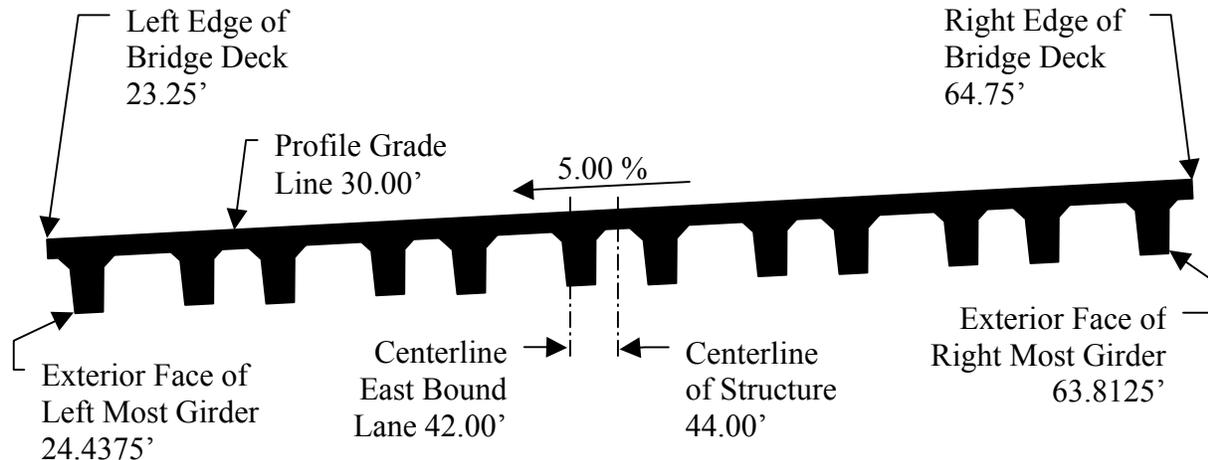
Also, because the deck is curved to the left, its edge will come in towards the girders at center span by about 1 1/2" on the left side and move away from the girder on the right side by about the same amount. To account for that, the deck will be shifted to the right by 1 1/2". The following figure from **BM page 3.56.1.6-10** shows that for a 38'-10" roadway and Type 30 girder, the normal overhang from the centerline of the exterior girder is 13". This will be increased to 14 1/2" (13" + 1 1/2") on the left and reduced to 11 1/2" (13" - 1 1/2") on the right side at the end of each span. With the 3" full depth cast in place slab overhang on the outside of the girder flange and with the 6" wide web, the exterior faces of the girders at the end bent will also be about 14 1/2" from the edge of the slab on the left and 11 1/2" from the edge of the slab on the right side of the deck at the end bents.



Because the four interior girders have been widened by 1/8", the overhangs will be reduced by 1/4" (2 girders per half section x 1/8"). Consequently, the **horizontal offsets from the alignment for the exterior girder faces are 23.25' + 14 1/4" (1.1875') = 24.4375' on the left side and 64.75' - 11 1/4" (0.9375') = 63.8125' on the right side**. These will be plotted to locate the top of the spill slopes at the ends of the bridge.

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5. The location of the critical offsets are shown on the follow cross section of the bridge away from a bent. Because the slope of the roadway under the bridge is less than that of the bridges super elevation, exterior face of the right most girder will control the location of the end bents.



The first set is to determine the change in elevation along the bridge deck from the profile grade line to the critical offset. This change in elevation is based on the 5% superelevation on the bridge plus the offset distance from the profile grade line to the critical point. Based on the above figure this change in elevation is:

$$0.05 * (63.8125' - 30') = 0.05 * (33.8125') = 1.690625.$$

The 4.25' distance from the top of deck to the top of the fill slope must be subtracted from this value. Thus the total vertical offset from the Route 50 proposed profile to profile for the top of the fill slope at the exterior face of the right most girder is:

$$1.690625 - 4.25 = -2.559375.$$

Based on this information, create the needed profile. To do this, go into Coordinate Geometry for Job **100** with Operator Code **cu**. Use the **Element > Profile > Offset** tool with the following settings:

Source Profile = Route50PR

Target Profile = EB-RT-SLP

**Begin Station = Route50PR
beginning
station**

**End Station = Route50PR
ending station**

Vertical Offset = -2.559375

Begin Station	End Station	Vertical Offset
445+30.94	494+92.90	-2.559375

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6.  Several tools from the **Superelevation Shape Manager** will be used to obtain elevation information from the shapes. The icon for the manager (shown above) is the fourth icon from the right in the **Cross Sections** toolbox, which is located in the lower left hand corner of the **Road Tools** as shown in the figure to the right. The expanded Cross Sections toolbox is shown below.



Bring up the **Superelevation Shape Manager** shown below.



The tools in this pallet are:



Automated Superelevation,



Shape Maker,



Shape Profiler,



Shape Selector, and



Autoshape Builder,



Shape Analyst,

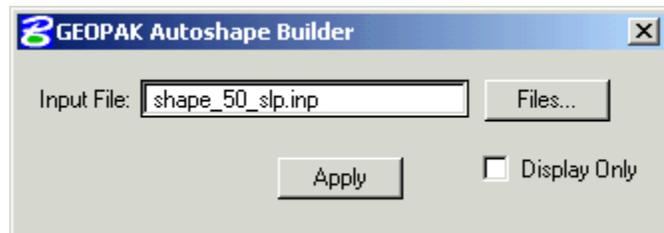


Shape Editor,



Shape Properties.

Open the **Autoshape Builder**, shown to the right. Click on the **Files...** button and select **shape_50_slp.inp**. Press the **Apply** button to run the input file.



To off level 63.

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7. In order to find the needed elevations, plot the outside face of the right exterior girder. Elevations from the shapes will be obtained at set intervals along this line.

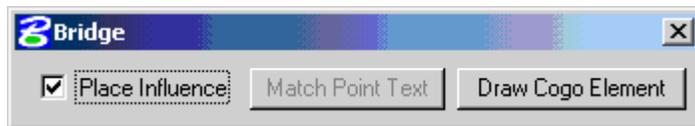
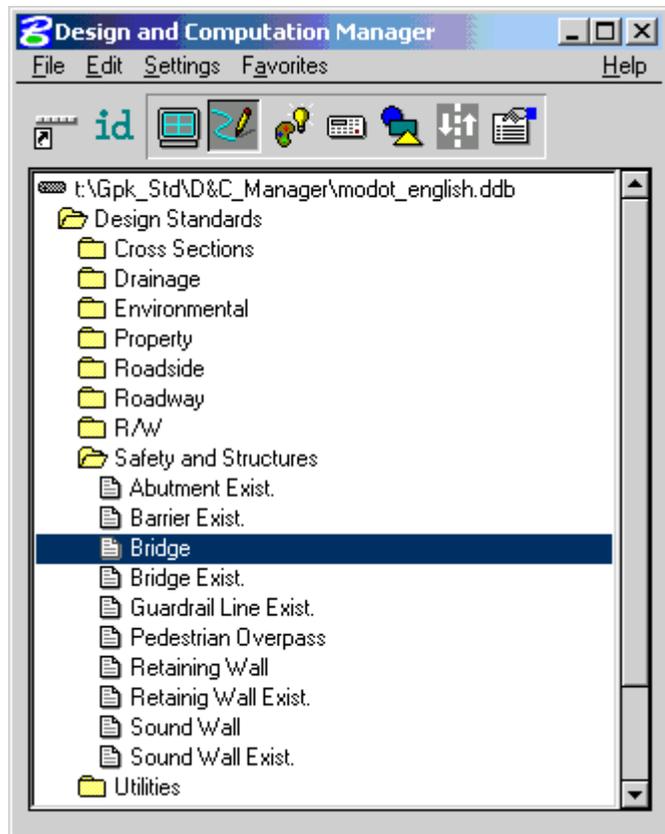
To do this, open **Design and Computation Manager**.

Expand the **Design Standards** folder.

Open **Safety and Structures** subfolder as well.

Select **Bridge** from the list of items in that folder, as shown in the figure to the right.

Since a Design Standard is being plotted, make sure **Place Influence** is checked in the Operations box as shown in the following figure.

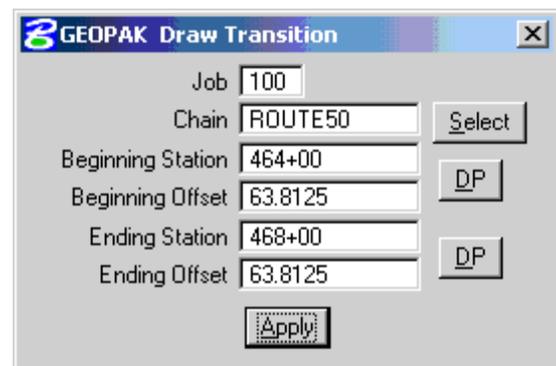


8. Use the **Draw Transition** tool (the third icon in the Plan View Design tool box) to draw the following line relative to the **Route 50** chain:

Beginning		Ending	
Station	Offset	Station	Offset
464+00	63.8125	468+00	63.8125

The values for drawing the line are shown in the figure to the right.

After drawing the drawing the line, close the D & C Manager and Draw Transition dialogs.

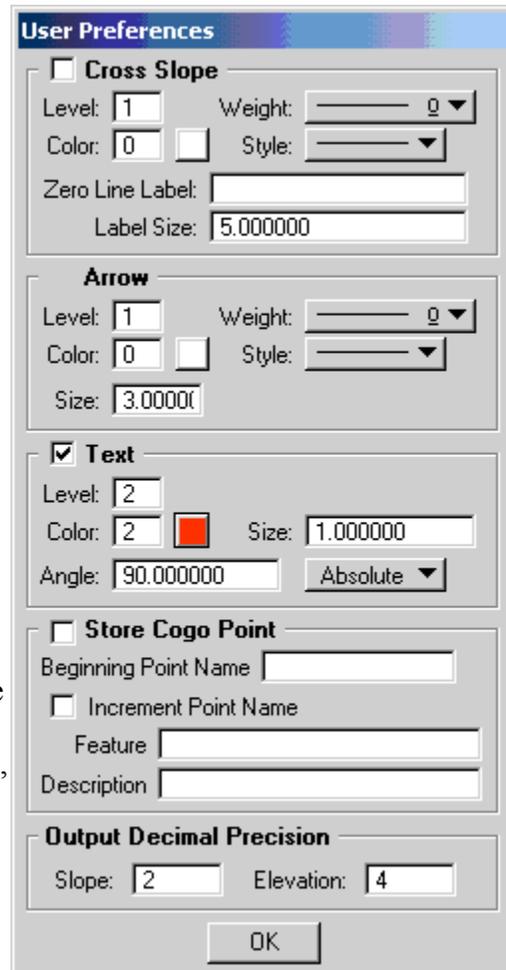
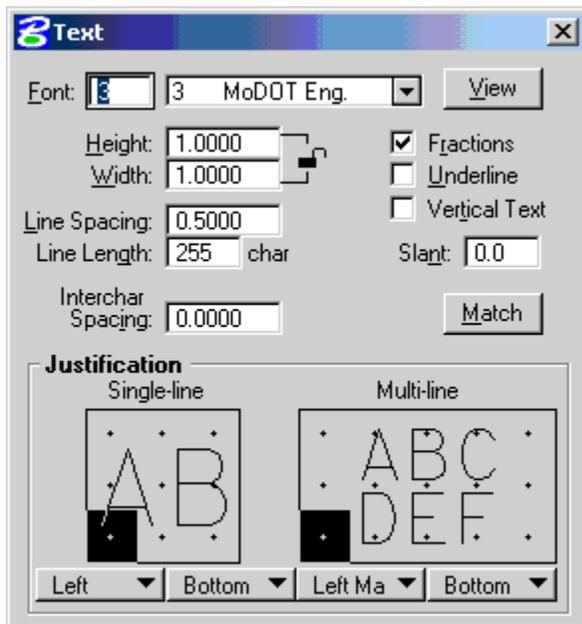
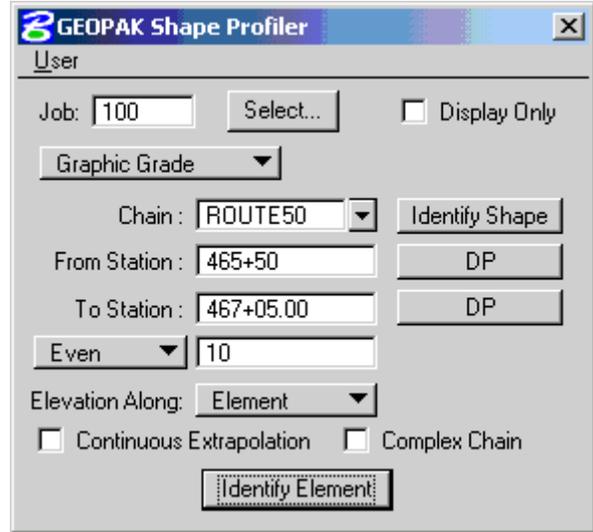


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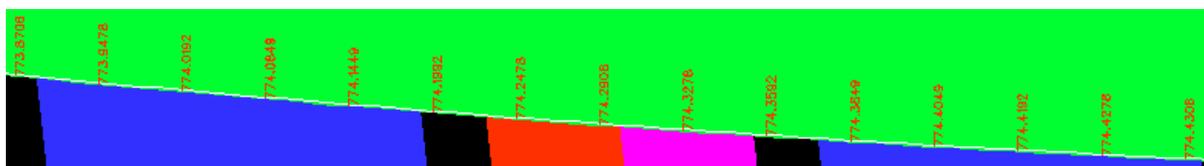
- Open the **Shape Profiler** tool. This will bring up the top dialog to the right.

Go to **User > Preferences** in Shape Profiler to customize the profiler's output as shown in the bottom figure on the right. Use the setting shown in the figure. Click **OK**.

Go to the MicroStation pull down menu **Element > Text** and set the justification to match that shown in the figure below.

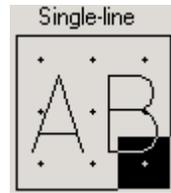


In **Shape Profiler**, click on **Identify Shape** and data point on the shape for the driving lane of eastbound Route 50 where it crosses Bighorn Dr. This will fill in the Chain and Station fields for the shape. Change the **From Station** to **465+50.00** and the **To Station** to **467+05.00**. Click on the **Identify Element** button, **data point** on the line defining the outside edge of the right exterior girder, and data point to **accept**. The end result is depicted in the figure below, which gives the elevations along the girder edge one foot below the top of the end bent beam.



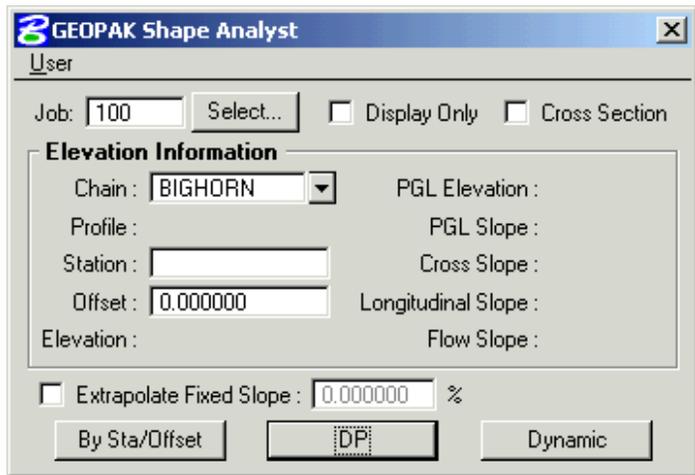
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10. To determine the elevations on the fill slopes, use **Level Manager** to turn off levels 60 so only the shapes for Big Horn Dr. are visible.

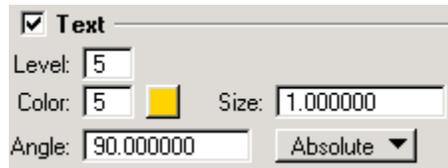


Switch the text justification to the lower right corner, as shown in the figure so the elevations for the fill slope are place opposite of the values just plotted.

Select the **Shape Analyst** tool by clicking on the following icon in the Shape Manager . This will bring up the dialog on the right. Select the **BIGHORN** chain.



Go to **User > Preferences** and change the text settings to those shown below. Click **OK** to accept the changes.

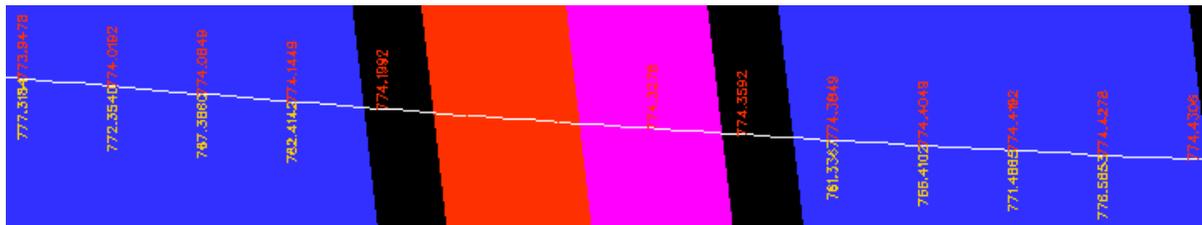


Set the tentative **snap** to **key point**.

Click on the **DP** button in **Shape Analyst**. Tentative snap on text giving the elevation at Station 465+70 (773.9478) and accept the snap, this will plot the fill slope elevation at that location. Repeat the process for the next three values plotted by the profiler. The end result is shown to the right.



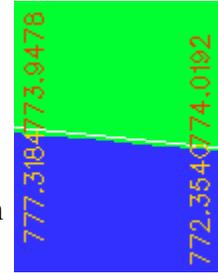
11. Move to other end of the bridge and plot the slope elevations at that end of the bridge, as shown in the following figure.



Turn on the display for level 60.

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12. Window in on the SW corner between Station 465+70 and 465+80, as was done to create the figure on the right. The plotted elevations indicate that the projection of the fill slope goes above its maximum allowable height under the bridge deck in this station range. While linear interpolation could be used to establish a crossing point, greater accuracy can be accomplished by using the shapes. To do this, elevation information will be obtained from the shapes at 1' increments.



Text

Level:

Color:  Size:

Angle: ▾

Switch to **Shape Profiler** and adjust the **User > Preferences** text settings to Level 2, Color 2, and Size 0.75 as shown to the left. The change in text size is being done to distinguish the foot from the 10' increment values.



Change the text justification to bottom left, as shown to the left.

Based on the elevations given, the crossing point is between Route 50 Sta. 465+70 and 465+80; therefore, use **Shape Profiler** to plot elevations relative to Route 50 at Sta. 465+71 - 465+78 at 1' increments. Use the following settings as shown in the figure to the right:

Chain: ROUTE50
From Station: 465+70.50
To Station: 465+78.50
Increment: Even 1

GEOPAK Shape Profiler [X]

User

Job: Display Only

Graphic Grade ▾

Chain:

From Station:

To Station:

Even ▾

Elevation Along: ▾

Continuous Extrapolation Complex Chain

Do the same thing at the other end of the bridge between Route 50 Sta. 466+80 and 466+90. Use the following settings:

Chain: ROUTE50
From Station: 466+80.50
To Station: 466+87.50
Increment: Even 1

GEOPAK Shape Profiler [X]

User

Job: Display Only

Graphic Grade ▾

Chain:

From Station:

To Station:

Even ▾

Elevation Along: ▾

Continuous Extrapolation Complex Chain

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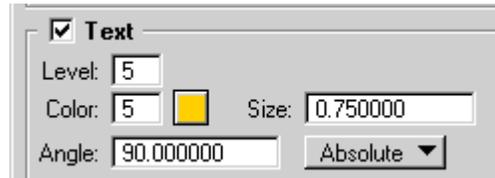
13. To obtain the elevations on the fill slopes, use **Level Manager** to turn off levels 60 so only the shapes for Big Horn Dr. are visible.



Change the text justification to bottom right.

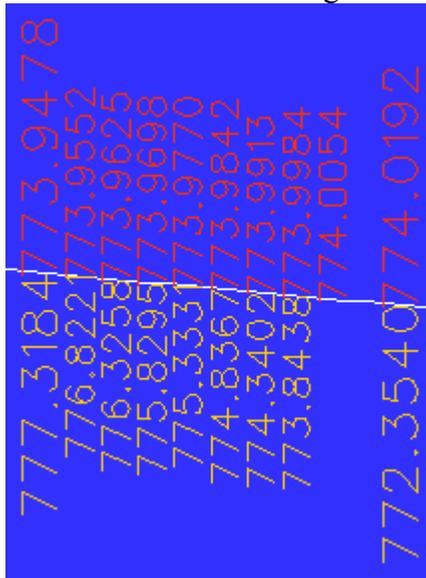
Select **Shape Analyst** by clicking on its icon in the Shape Manager . Select the **BIGHORN** chain.

Go to **User > Preferences** and change the text settings to those shown to the right. Click **OK** to accept the changes.

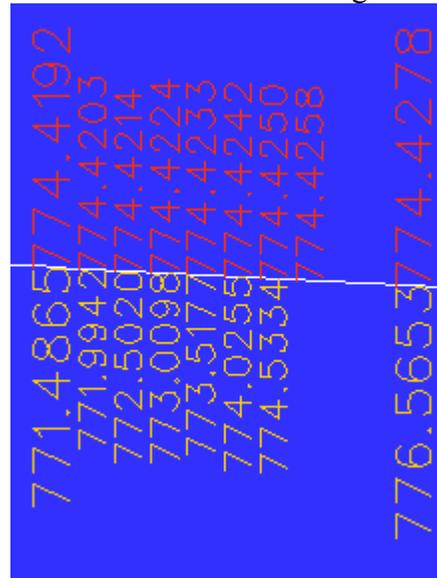


Make sure your **snap** is set to **key point**. Click on the **DP** button in **Shape Analyst**. Tentative snap on text plotted in the previous step. This will plot the fill slope elevation at that location. Screen captures from each corner of the bridge are shown below

SW Corner of Bridge



SE Corner of the Bridge



Compare your elevations to those given below.

<u>Location</u>	<u>Station</u>	<u>Deck Elev. Minus 4.25'</u>	<u>Slope Elevation</u>
SW Corner	465+76	773.9913	774.3402
SW Corner	465+77	773.9984	773.8438
SE Corner	466+85	774.4242	774.0255
SE Corner	466+86	774.4250	774.5334