Earthwork Exercise

1. Open the Microstation file t:\de-proj\cole\J5U0441G\data**XS_EARTHWORK_Run#1.dgn**

2. In the project J5P0441G.prj, select the working alignment **Run#1**.

3. Select the Proposed Cross Sections button from the Project Manager dialog. Copy the **MoDOT** run to **Run#1**, and enter the run.

4. Setup the Shape Clusters as follows.

```
Criteria for Shape Cluster
  shape cluster baseline  = RTE179
  shape cluster profile   = RTE179PR
  shape cluster tie       = 0.000
   side slope LTRT
      include t:\gpk_std\criteria\setup.x
      include t:\gpk_std\criteria\pvmt_layers.x
      include t:\gpk_std\criteria\shldr_a2_a.x
      include t:\gpk_std\criteria\sideslope_rock_transition.x
```

5. In the **Define Variables** set the following values for the given variables:

"NAME OF PLAN FILE"	RTE179_PLAN.dgn
"NAME OF CROSS-SECTION FILE"	XS_EARTHWORK_RUN#1.dgn
"NAME OF SHAPE/PATTERN FILE"	RTE179_pattern_shape.dgn
"NAME OF BASELINE"	RTE179
"PAVEMENT LAYER 1 THICKNESS (MM OR IN)"	10.75
"ROCK FILL BASE THICKNESS (M OR FT)"	2
"SHOULDER LAYER 1 THICKNESS (MM OR IN)"	10.75
"SHOULDER LAYER 2 THICKNESS (MM OR IN)"	0.00
"SHOULDER LAYER 3 THICKNESS (MM OR IN)"	0.00
"FILL SLOPE 2 (1:X OR X:1)"	3
"FILL SLOPE 2 PROFILE LEFT"	FILLSLOPE
"FILL SLOPE 2 PROFILE RIGHT"	FILLSLOPE
"FILL SLOPE 1 WIDTH (M OF FT)"	20

6. Process the cross sections.

7. From Project Manager select **Earthwork**. Copy the **MoDOT** run to **RUN#1** & enter the run.

8. In the **XS DGN File** section adjust the tolerance to 0.10000

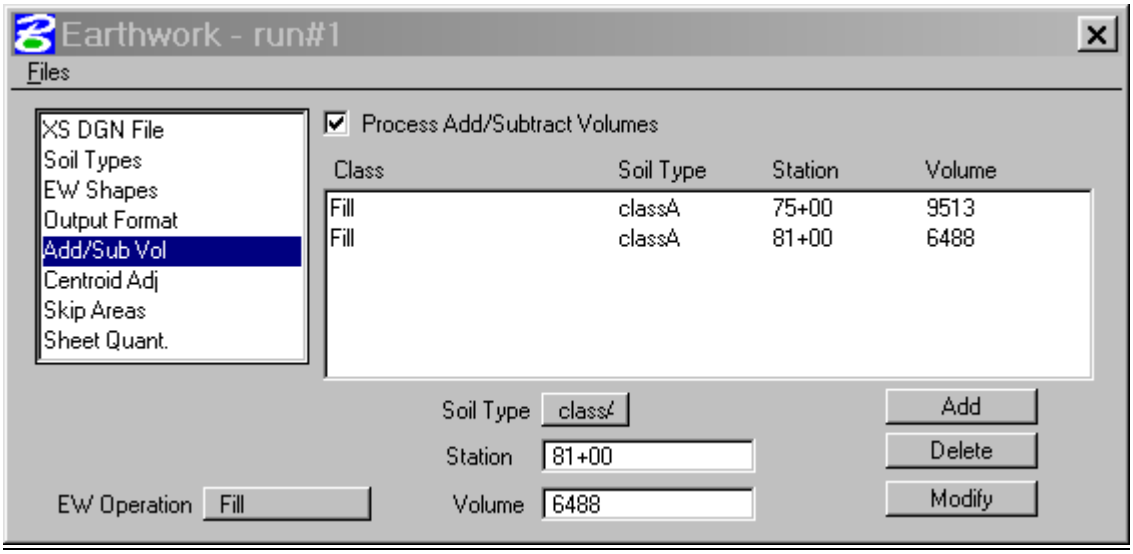
9. In the Soil Types section of the dialog, create the following classifications and soil types with the given parameters:

Class	Soil Type	Search Criteria	Excavation Multi-Factor
Existing Ground	ClassA	Level = 57 Color = 90	0.87000
Proposed Undercut	Rockbase	Level = 46 Color = 71	0.87000
Proposed Finish Grade	ClassA	Level = 18,20, 24, 33 Color = 0, 4, 35,60-63	0.87000

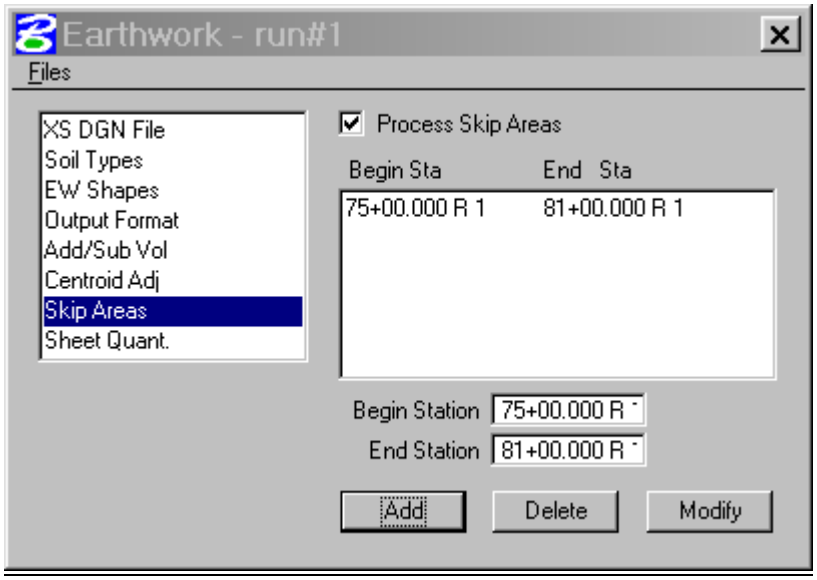
10. Change the **Output Format** to:

    Excavation
    Fill

11. In the Add/Subtract Volume section of the dialog, add the following Add Volumes:



12. In the Skip Area section of the dialog, skip the following section:



13. Process the earthwork.

Set the Log File setting to **Log File** and name the log file **Earthwork Run #1.log**

14. Earthwork log file reports **shortage of 48,929 cu yards** of material

At this point you would go in and tweak your chain and more likely the profile until you get a closer earthwork balance. But for this exercise we're going to continue on.

15. **Save** the MicroStation file XS_Earthwork_Run#1.dgn

The **Soil Survey Report** has just Arrived.

16. Next do a **Save As** and save the drawing as **XS_Earthwork_Run#2.dgn**

Do a MicroStation **Edit > Select All** and then select the **Delete** icon.

17. In Microsoft Excel, open the file **Borehole_Location.xls**. Save this file as a CSV (comma delimited) file. **Rename** Borehole_Location.csv to **Borehole_Location.brh**.

18. In Microsoft Excel, open the file **Borehole_Material.xls**. Save this file as a CSV (comma delimited) file. **Rename** Borehole_Material.csv to **Borehole_Material.mtl**.

19. Choose the **Geotechnical Tools** from the menu or from the Geopak Road toolbox. 

20. Create a new Geotechnical Data File by choosing **File>>New**. Name the file **Rte179.gtd**

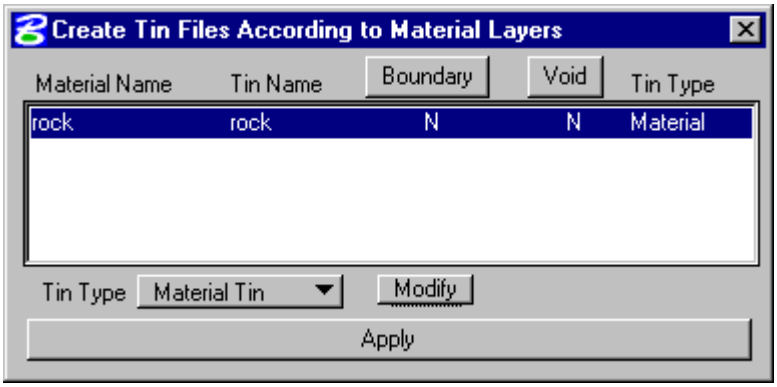
    Job **441**
    Ground Tin **179 Existing Ground.TIN**
    Toggle on Override user provided elevation using tin file.

21. Import the borehole location file **boring_location.brh** by going to **File>>Import>>CSV>>Borehole**.

22. Import the borehole material file **boring_material.mtl** by going to **File>>Import>>CSV>>Material**.

23. Verify the material alignment, and adjust if necessary.

24. Create the material tin models as shown.



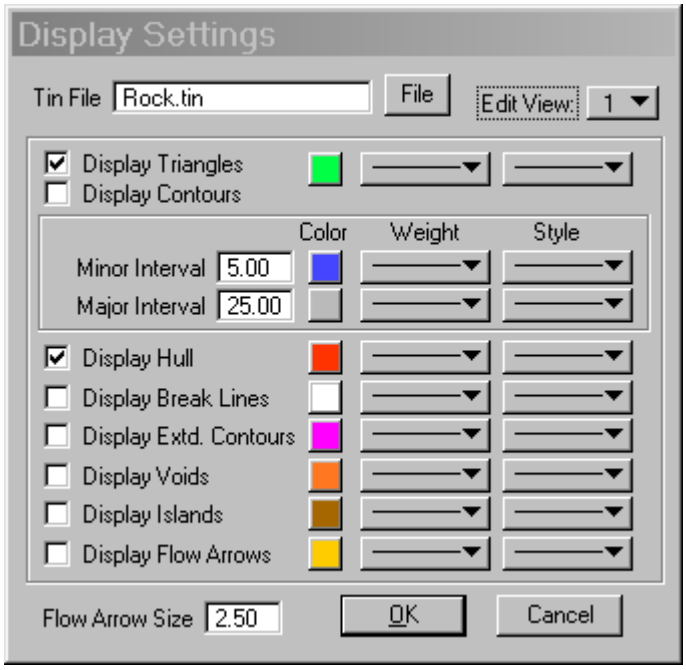
25. Open the Microstation file t:\de-proj\cole\J5U0441G\data**Rte179_Pattern_Shape.dgn**

26. Select the DTM Tools Icon from the GeoPak Road Tools. Copy the MoDOT run to **Rte179**, and enter the run. 

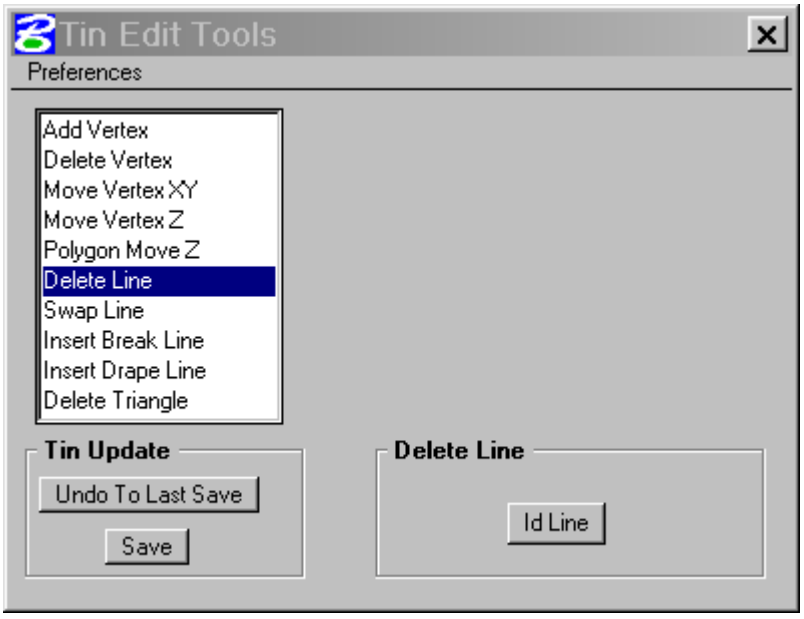
27. From the DTM Tools select Edit Triangles.

28. In the Edit Triangle **Display Settings** Dialog set the following items:

Triangle Color = 4 (Green)
Hull Color = 2 (Red)



29. Use the **Delete Line** option to Clean up the Rock.tin by removing bogus triangle legs:



30. Open the MicroStation file t:\de-proj\cole\J5U0441G\data\XS_EARTHWORK_Run#2.dgn

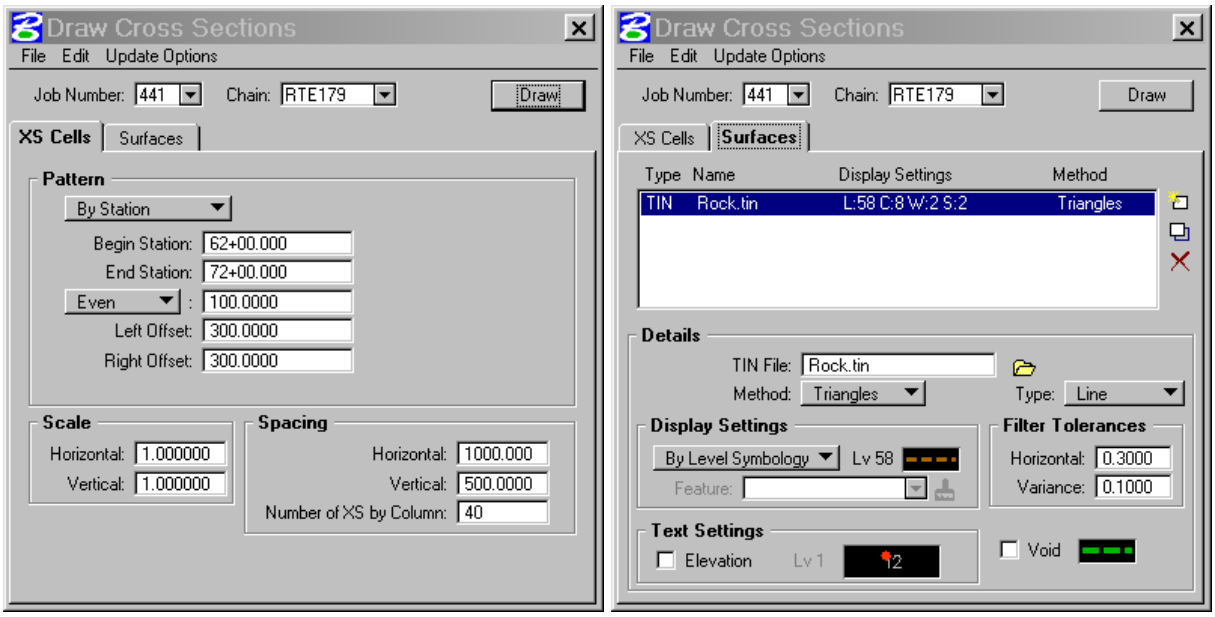
31. Select the Working Alignment button from the Project Manager dialog. Copy the **Run#1** run to **Run#2**, and enter the run..

32. In the **Run#2** working alignment, under the **Cross Section View**, change the XS DGN file to **XS_EARTHWORK_Run#2**.

Close the working alignment definition box.

33. Select the **Existing Ground Cross Sections** button from the Project Manager dialog. Copy the **MoDOT** run to **Rock**, and enter the run.

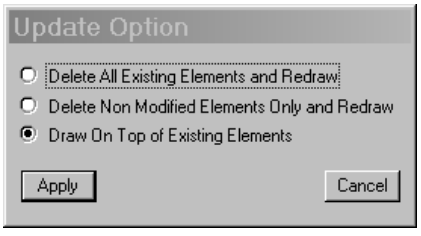
34. Set up the Draw Cross Section Dialog as Follows:



Rock.tin symbology ➔ Level=58, Color=8, Weight=2, Style=2

Add the Rock Surface to the following section ranges

Begin Station	End Station
62+00	72+00
87+00	99+00
103+00	109+00
116+00	133+00
141+00	142+71.63



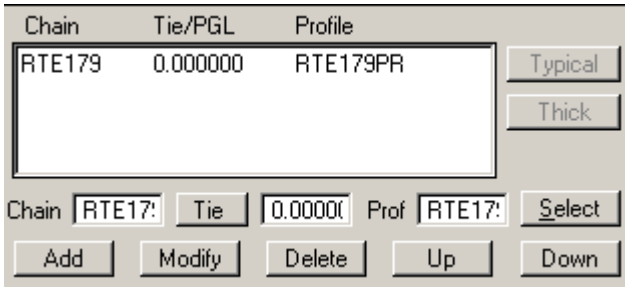
35. Use the MicroStation SmartMatch to match the subsurface layer (Rock) symbologies, and draw the subsurface layers to the end of the cross sections.

36. Select the Proposed Cross Sections button from the Project Manager dialog. Copy the **MoDOT** run to **Subsurf**, and enter the run.

37. Under the **Shapes** section, Toggle off "Use Working Alignment Definition", and set the mode to "Shapeless."

38. Setup the Shape Clusters as follows:

side slope LT
include d:\Criteria**subsurf_layers.x**



39. In the **Define Variables** set the following values for the given variables:

"DIST. BELOW EX. GRN TO DRAW SUBSURFACE (M OR FT)"	100
"NAME OF CROSS-SECTION FILE"	XS_Earthwork_Run#2.dgn
"PLOT TOP OF ROCK LAYER (Y OR N)"	Y
"PLOT BOTTOM OF ROCK LAYER (Y OR N)"	N

40. Process the cross sections. Once sections are processed, close down the Proposed XS dialog. Then process the following commands:

Select **Edit > Select All**
Select **Edit > Lock**
Select **Edit > Select None**
Select **File > Save**

41. **Open** the MicroStation file t:\de-proj\cole\J5U0441G\data**XS_Earthwork_Run#X.dgn**
Save the MicroStation file t:\de-proj\cole\J5U0441G\data**XS_Earthwork_Run#2.dgn**

42. Select the **Proposed Cross Sections** button from the Project Manager dialog. Copy the **Run#1** run to **Run#2**, and enter the run.

43. In the **Define Variables** set the following values for the given variables:

"NAME OF CROSS-SECTION FILE"	**XS_Earthwork_Run#2.dgn**
"BENCH WIDTH"	**15**
"ROCK WALL HEIGHT (M OR FT)"	**30**

Process the cross sections.

44. From Project Manager select Earthwork. Copy the **Run#1** run to **RUN#2** & enter the run.

45. In the Soil Types section of the dialog, **create/modify** the following classifications and soil types with the given parameters:

Class	Soil Type	Search Criteria	Excavation Multi-Factor
Existing Ground	**ClassC**	Level = 57 Color = 90	**1.20000**
Proposed Undercut	**ClassC**	Level = 46 Color = 71	**1.20000**
Existing Suitable Material	**ClassA**	**Level = 58** **Color = 8**	**0.87000**
Proposed Finish Grade	ClassA	Level = 18,20, 24, 33 Color = 0, 4, **22**,35,60-63	0.87000

Save Setting and then **Process Earthwork Run**

46. Earthwork log file reports shortage of **49,602 cu yds** of material.

Using the Vertical Alignment Generator, modify the profile Fillslope with the following parameters:

Station	Elevation (Slope value)
61+00.00	3:1
86+00.00	3:1
87+00.00	2:1
143+00.00	2:1

47. Do a MicroStation **Edit > Select All** and then select the **Delete** icon. Then select **Save**.

48. Select the **Proposed Cross Sections** button from the Project Manager dialog. Select **Run#2**, and reprocess the cross sections run.

49. Select the **Earthwork** button from the Project Manager dialog. Select **Run#2**, and reprocess the Earthwork run

Set the Log File setting to **Log File** and name the log file **Earthwork Run #2.log**

50. **Save** the MicroStation file **XS_Earthwork_Run#2.dgn**

51. Next do a **Save As** and save the drawing as **XS_Earthwork_Run#3.dgn**

52. Do a MicroStation **Edit > Select All** and then select the **Delete** icon. Then select **Save.**

The **Bridge Memorandum** has just Arrived.

53. Select the Working Alignment button from the Project Manager dialog. Copy the **Run#2** run to **Run#3**, and enter the run..

54. In the **Run#3** working alignment, under the **Pattern Section**, change the **Color to 2**.

Also under the **Cross Section View**, change the XS DGN file to **XS_EARTHWORK_Run#3**.

Close the working alignment definition box.

55. Open the file t:\de-proj\j5p0441G\data**Rte179_Pattern_Shape.dgn**.

56. Select the **Draw Pattern** button from the Project Manager dialog. Copy the **MoDOT** run to **Run#3**, and enter the run.

57. Create pattern lines for the alignment (at Bridge Exception Location).

Job: **441**
Chain: **Rte179**

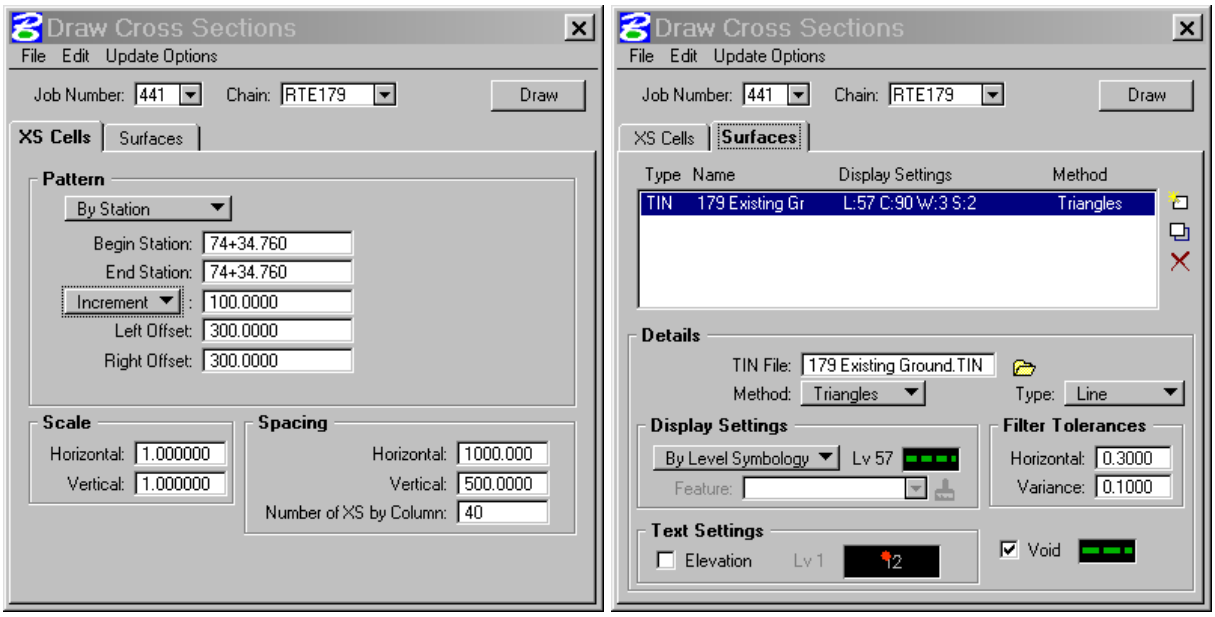
Beginning		Ending	
Offset LT:	**300**	Offset LT:	**300**
Station:	**74+34.76**	Station:	**81+02.94**
Offset RT:	**300**	Offset RT:	**300**

Once (Each)

58. Open the file t:\de-proj\j5p0441G\data\ **XS_Earthwork_Run#3**.

59. Select the **Existing Ground Cross Sections** button from the Project Manager dialog. Enter the **Rock** run.

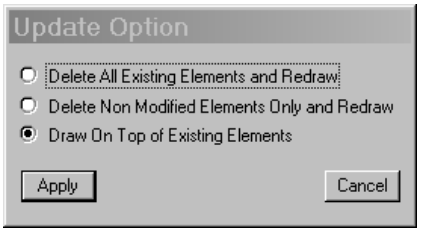
60. Set up the Draw Cross Section Dialog as Follows:



179Existing Ground.tin sybology ➔ Level=57, Color=90, Weight=3, Style=2

Add the Existing Ground Surface to the following section ranges

Begin Station	End Station
74+34.76	74+34.76
81+02.94	81+02.94



61. Select the Proposed Cross Sections button from the Project Manager dialog. Enter the **Subsurf** run.

Modify the following Variable:

"NAME OF CROSS-SECTION FILE" **XS_Earthwork_Run#3.dgn**

62. Process the cross sections.

63. In the **Run#3** working alignment, under the **Pattern Section**, change the **Color to 0 and 2**.

Close the working alignment definition box.

64. Select the **Proposed Cross Sections** button from the Project Manager dialog. **Copy** the **Run#2** run to **Run#3**, and enter the run.

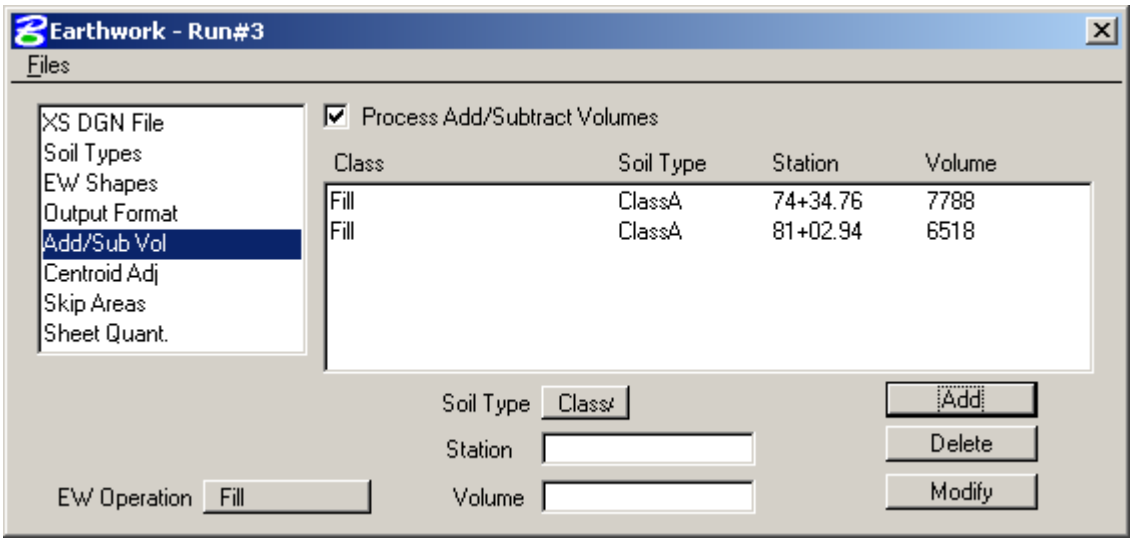
65. In the **Define Variables** set the following values for the given variables:

"NAME OF CROSS-SECTION FILE" **XS_Earthwork_Run#3.dgn**

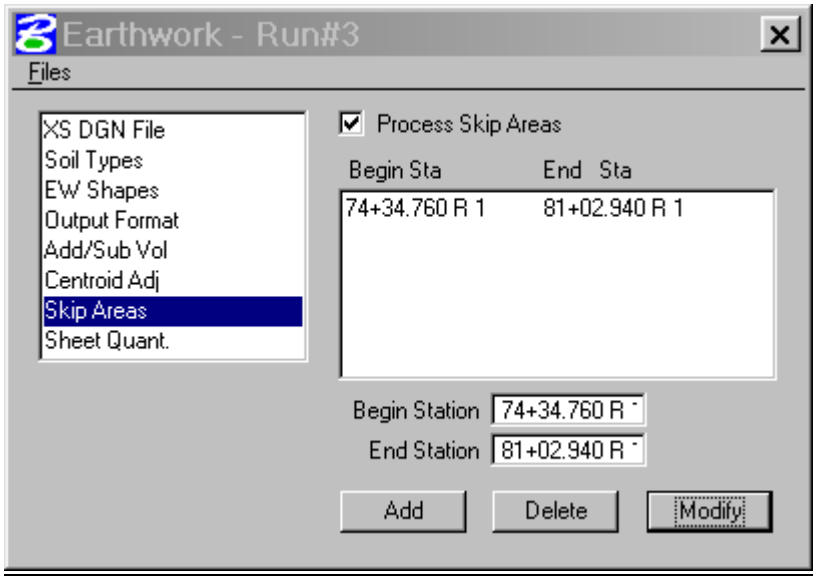
66. Process the cross sections.

67. From Project Manager select **Earthwork**. Copy the **Run#2** run to **Run#3** & enter the run.

68. In the **Add/Subtract Volume** section of the dialog, modify the following Add Volumes:



69. In the Skip Area section of the dialog, skip the following section:



70. 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	+
5	ClassC	Common Exec	Endarea	+
5	ClassC	Subgrade Exec	Endarea	+
5	ClassC	Subsoil Exec	Endarea	+
6	ClassC	Common Exec	Unadjusted Volumes	+
6	ClassC	Subgrade Exec	Unadjusted Volumes	+
6	ClassC	Subsoil Exec	Unadjusted Volumes	+

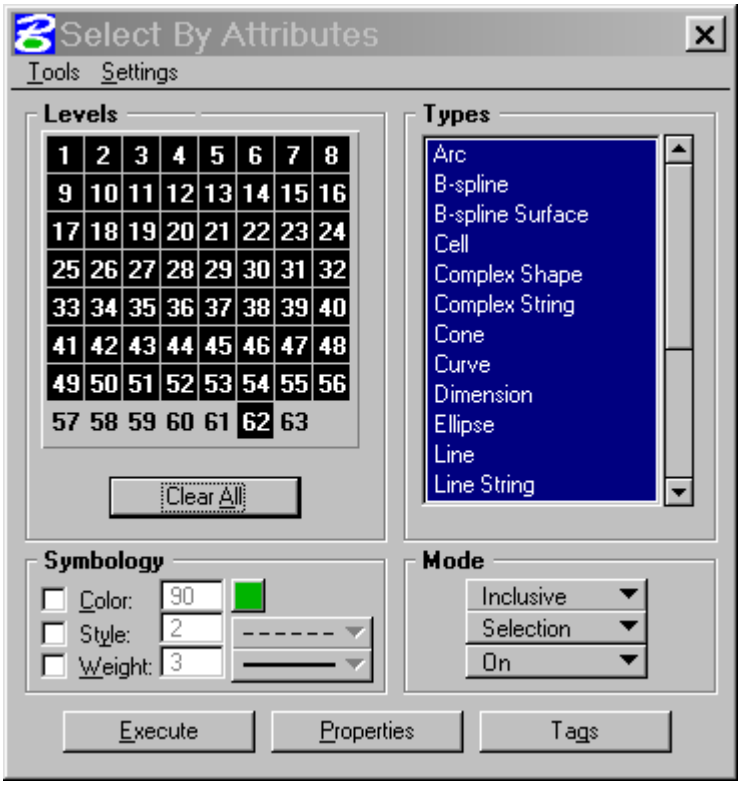
71. Process the earthwork.

72. Earthwork output Dialog reports surplus of **13,675 cu yds** of material.

Using the Vertical Alignment Generator, modify the profile Fillslope with the following parameters:

Station	Elevation (Slope value)
61+00.00	3:1
112+00.00	3:1
114+00.00	2:1
143+00.00	2:1

73. Select **Edit > Select By Attributes** and select all levels except for **57-61 and 63** and then select the **Delete** icon. Then select **Save.**



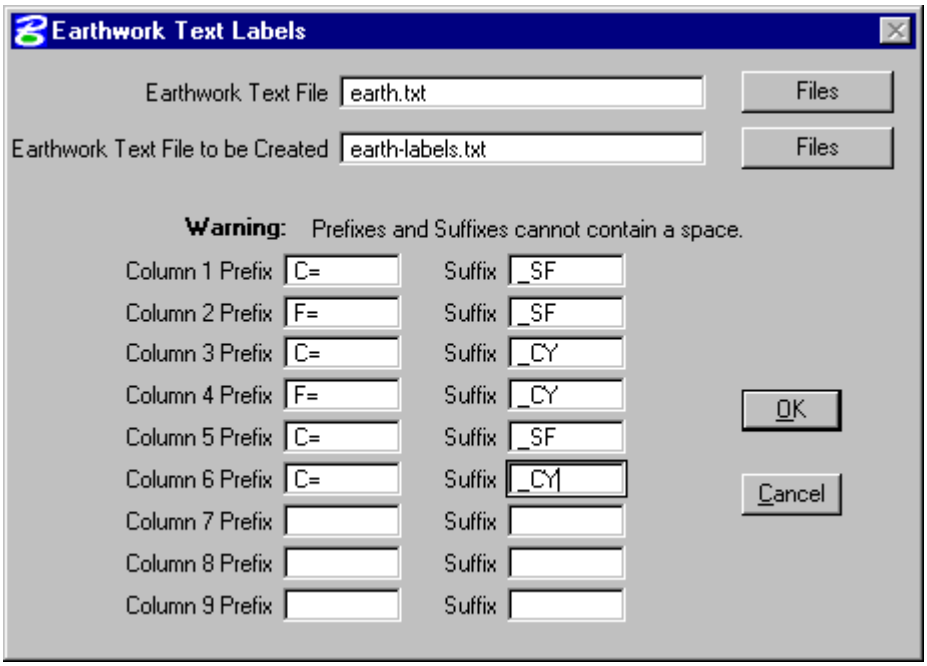
74. Select the **Proposed Cross Sections** button from the Project Manager dialog. Select **Run#3**, and reprocess the cross sections run.

75. Select the **Earthwork** button from the Project Manager dialog. Select **Run#3**, and reprocess the Earthwork run

Set the Log File setting to **Log File** and name the log file **Earthwork Run #3.log**

76. **Save** the MicroStation file **XS_Earthwork_Run#3.dgn**

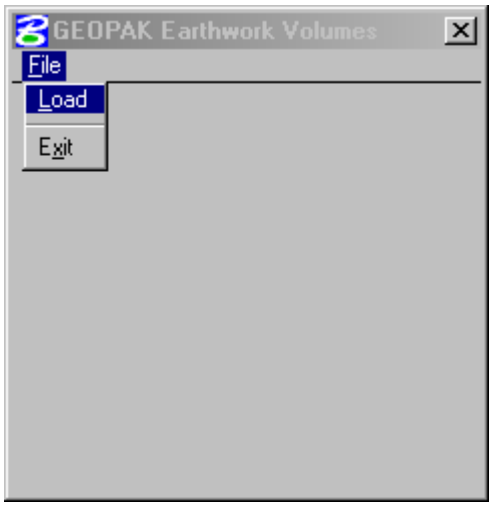
77. Open **D&C Manager**, and use the **Earthwork Text File Labels 3PC Tool** to set up the cross section sheet labels as shown below.



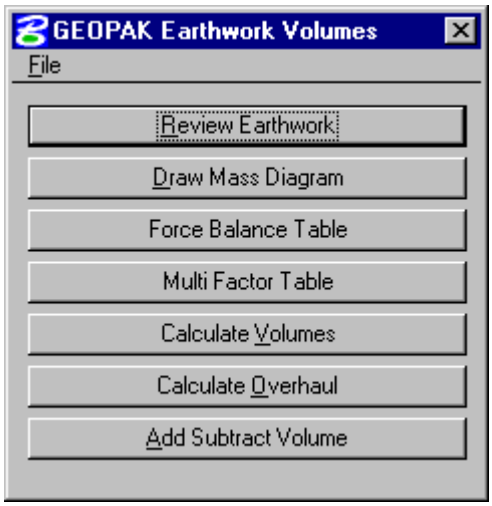
78. **Open** the Earthworks tool. 

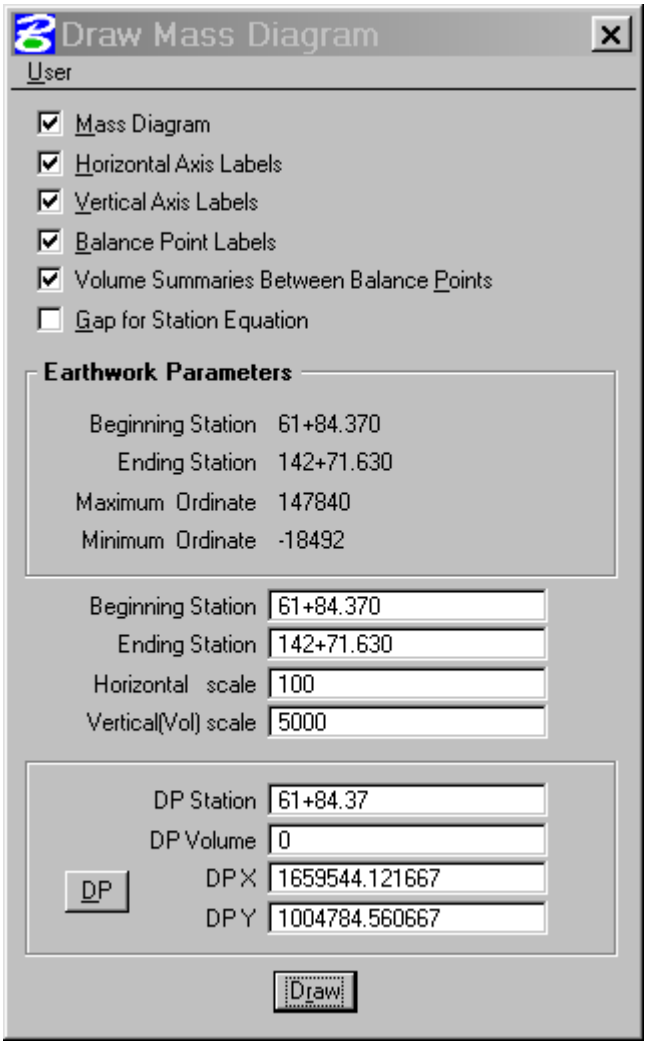
Open the MicroStation file T:\de-proj\Cole\J5U0441G\data**Rte179_Mass_Diagram.dgn**

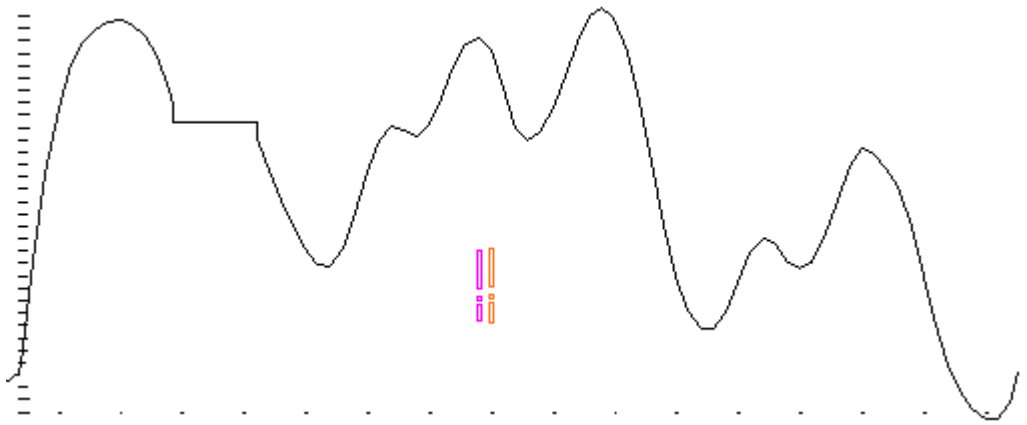
Load the file T:\de-proj\Cole\J5U0441G\data**Earthwork.Run #3.log**



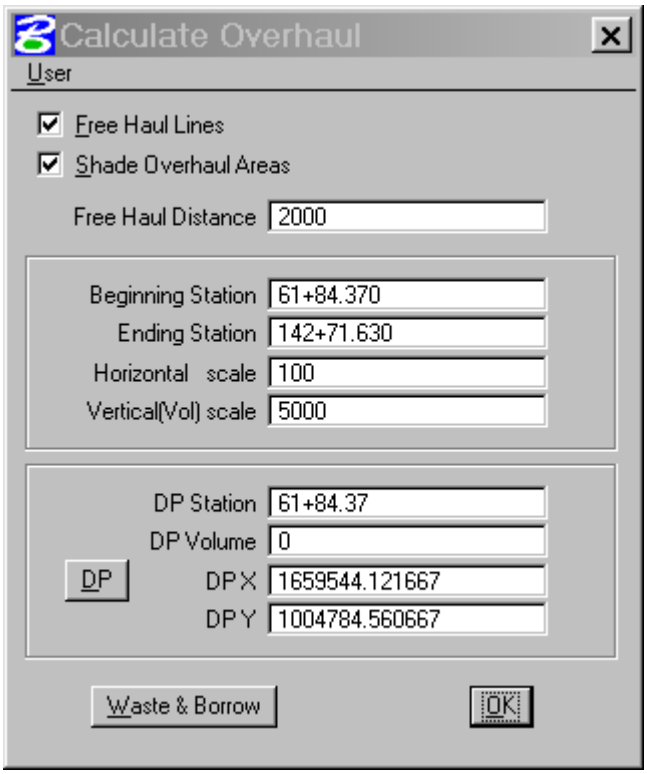
79. Draw the mass diagram with the following settings. Set the DP X and DP Y by using the DP button.



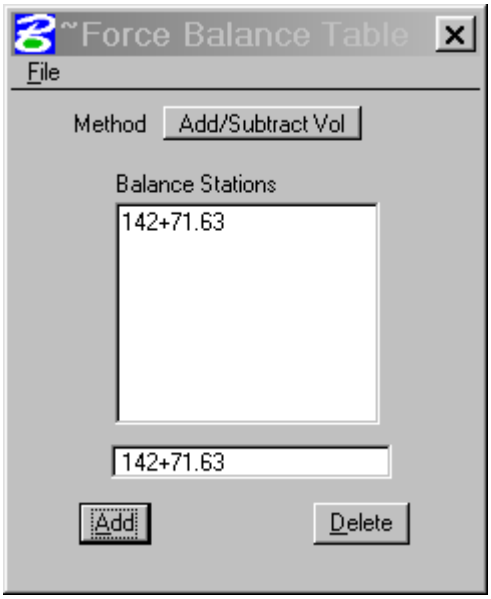




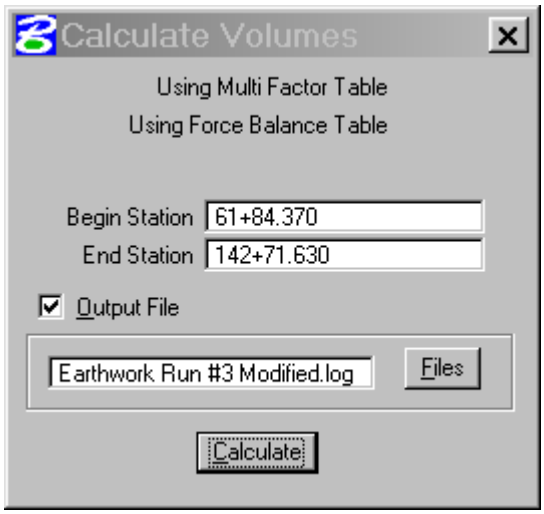
80. Calculate the amount of overhaul using the following settings. Use the same DP as used for the mass diagram.



81. Force a balance point at station 142+71.63.



82. Calculate the volumes with the new balance point.
Name the output file **Earthwork Run #3 Modified.log**.



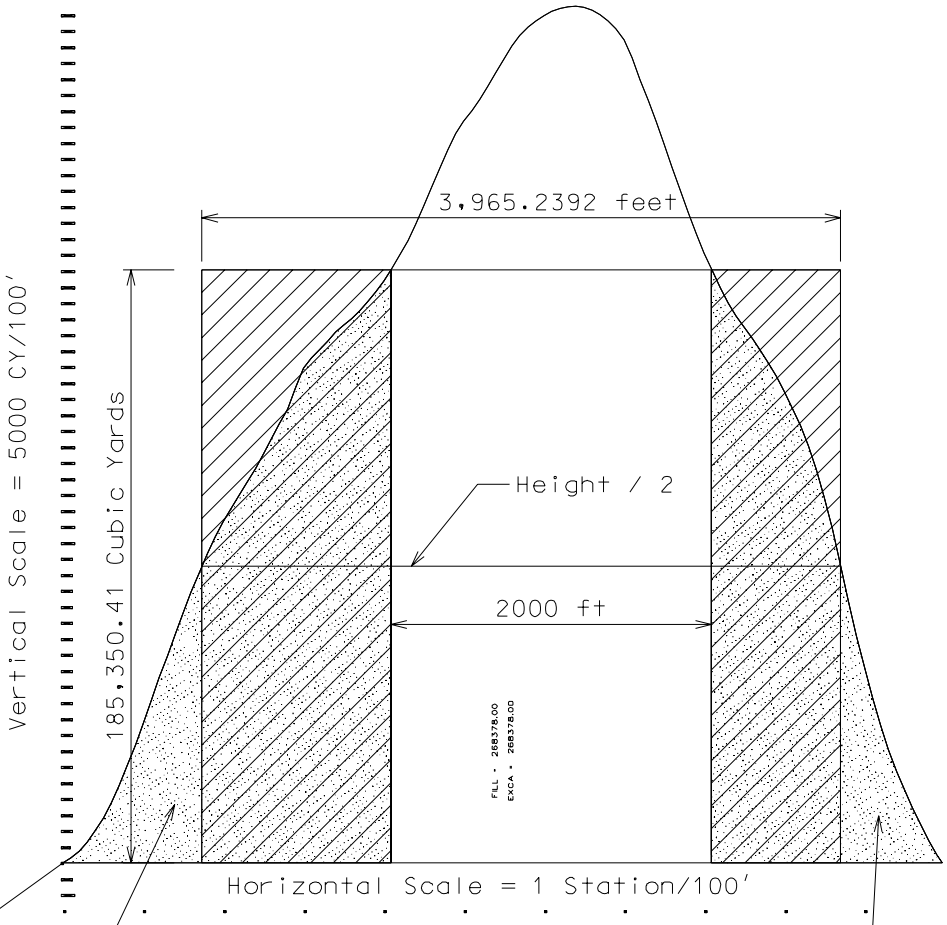
Old MoDOT Method

(Height) (Width - Freehaul)

(185,350.41 Cu Yds) (3,985.2392 ft - 2000 ft) = 367,964,899.70 Cu Yd Feet

= 3,642,580.68 Cu Yd Sta.

= 69,690.32 Cu Yd Miles (Yard Miles)



GeoPak/Curve Method

Area of Haul Shape = 4,071,376.53 Cu Yd Sta./2

Area of Haul Shape = 2,857,884.90 Cu Yd Sta./2

Total Area of Haul Shape = 6,929,261.43 Cu Yd Sta./2

Total Area of Haul Shape = 3,464,630.72 Cu Yd Sta.

= 65,618.00 Cu Yd Miles (Yard-Miles)

The scale is accounted for in the scenario above. (H = 100, V=5000). The vertical scale is 5000 CY/100'. The horizontal scale is 1STA/100'. To get CY STA, you need to multiply the vertical and horizontal ratios.

(5000 CY/100') * (1 STA/100') = 5000 CY-STA/10000 SF = 1 CY-STA/2 SF

In the drawing above, the curve method divides the computed area by 2. This would take into account the scale factor. If the mass diagram was plotted at a vertical scale of 10000 instead, the user would end up with a vertical - horizontal ratio of 1 CY-STA/1 SF