
Chapter 4

Plan & Profile Sheet Geometry

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4.1 Objectives

- Learn how to build rules based geometry that can be used to control the transition of template points.

4.2 Definitions

Point Controls are used to override the established horizontal and vertical locations of points from the original point location on the template. Point controls are the equivalent of the criteria adhoc placed on plan graphics with D&C Manager to control widths, ditch slopes, etc. Consequently, point controls are used to control horizontal and vertical locations for EOP, EOS, sidewalks, retaining walls, barriers, special ditch profiles and ditch widths, etc.

The transitional geometric elements are created using the Civil Geometry tools.

4.3 Horizontal Geometry Tools for Transitional Geometry

4.3.1 Offsets and Tapers



Offsets and Tapers construct linear elements based on various methods of offsets from a base element. The base element may be a line, arc, spiral, or complex. There are four methods:



Single Offset Entire Element

The offset element maintains a constant offset along the entire length of the base element.

Workflow

1. Select *Single Offset Entire Element*.
2. Select the base element. Data point to accept.
3. Key in the offset.
4. **Data Point** to select **Yes** to *Mirror* or strike down arrow to choose **No** to place the offset on one side only and **Data Point**.



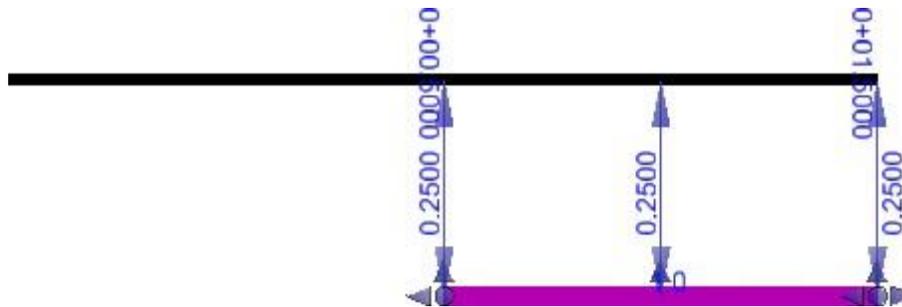
Single Offset Partial

The offset element maintains a constant offset along the given length of the base element. The length can be defined by start and stop distance (stations) of a keyed in length.

Workflow

1. Select *Single Offset Partial*.
2. Select the base element. Data point to accept.
3. Key in the offset.
4. Specify the beginning station by moving the mouse to beginning station, or if using the Civil AccuDraw Station-Offset favorite, key in the station., or press the <Alt> key to lock the beginning point to the Start station. Data point to accept.
5. Move the mouse to the ending station or press the <Alt> key to select the End station. Data point to accept.
6. **Data Point** to select **Yes** to *Mirror* or strike down arrow to choose **No** to place the offset on one side only and **Data Point**.

Manipulators (Single Offset Entire or Partial Element)



Manipulators are available for:

- Offset
- Starts distance
- End distance
- Slide End Fixed Length



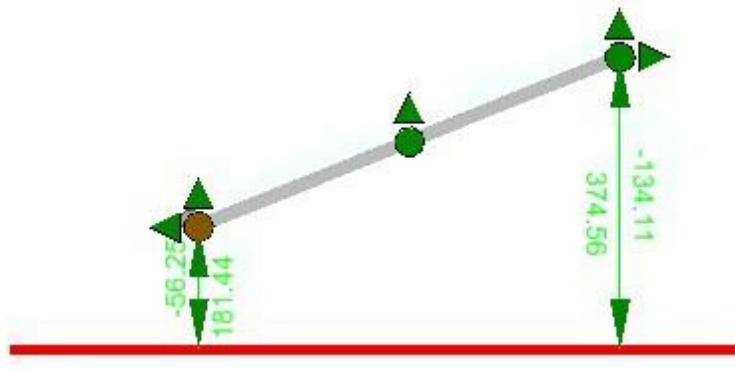
Variable Offset Taper

The offset is variable and defined by station and offset at each end of the offset element.

Workflow

1. Select the *Variable Offset Taper* placement tool.
2. Select the base element. **Data Point** to accept.
3. Select the start point, offset, and distance dynamically or by key-in. This is a dual prompt. Use left/right arrows to toggle between the two.
4. Set the end offset and distance. This is a dual prompt. Use left/right arrows to toggle between the two.

Manipulators (Variable Offset Taper)



Manipulators are available for:

- Start offset
- End offset
- Starts distance
- End distance



Ratio Defined Taper

The offset element is defined by a station offset and beginning, and the end point is defined by a ratio.

Workflow

1. Select the *Ratio Defined Taper* tool.
2. Select the base element. **Data Point** to accept.
3. Select the start point, offset, and distance dynamically or by key-in. This is a dual prompt. Use left/right arrows to toggle between the two.
4. Set the ratio and end distance. This is a dual prompt. Use left/right arrows to toggle between the two.

Manipulators (Ratio defined Taper)



Manipulators are available for:

- Start Offset
- Starts distance
- End distance
- Ratio

Use of ALT Key

During the operation of the command, the <ALT> key can be used to toggle the check marks for *Beginning of Element* and *Ending of Element*. When the prompt is for first point of the offset line, pressing <ALT> will toggle the check mark for *Beginning of Element*. When the prompt is for second point of the offset line, then pressing <ALT> will toggle the check mark for *End of Element*.

Properties

Offset Transition rule data is also accessible in the properties. The properties are identical for all methods. Changing the method in properties will expose additional manipulators on screen.

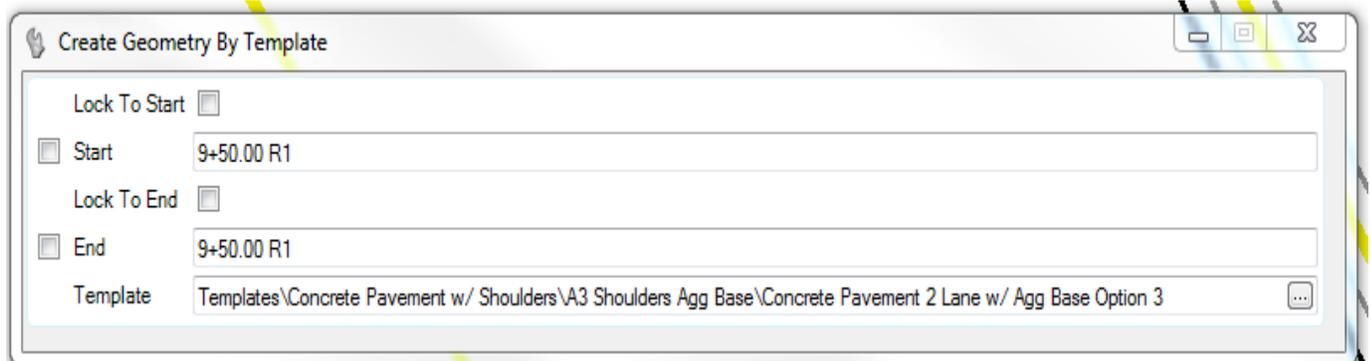
4.3.2 Templates



Create Geometry by Template

Use the *Create Geometry by Template* command to generate geometry.

1. Open the Civil Tools task pane to the Horizontal Geometry section then click the *Create Geometry by Template* tool.
2. When you move the cursor into the view, it is equipped with a command prompt requesting that you *Locate Reference Element*. Select the element to which you wish to apply the template then data point (*i.e.*, left-click).
3. The *Create Geometry By Template* dialog opens.



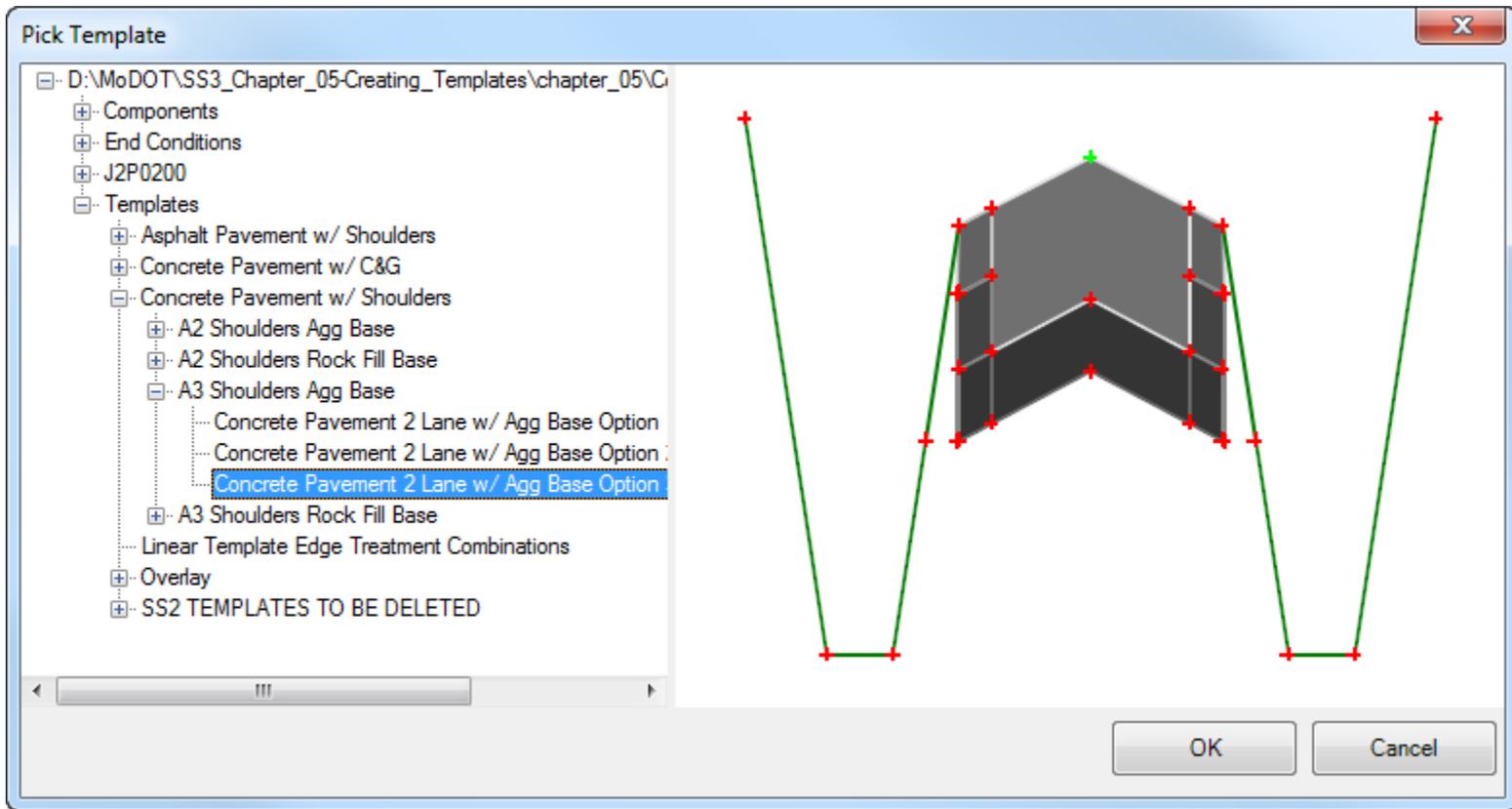
4. Checking the box next to any of the fields locks-in the associated value.
5. When prompted to *Select Template*, hold down the **Alt key and strike the down arrow** key to open the *Pick Template* dialog.



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- When the dialog opens, navigate the tree to choose from the available templates then click **OK** and data point in the view.

Note: The *Select Template* command prompt retains your last selection, so if you wish to apply multiple instances of the same template, you need only data point when the populated prompt appears.



4.4 Group Exercise: Creating Geometry for Road 1 Corridor

Design File Setup

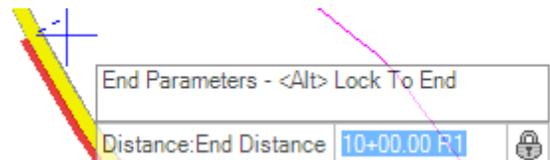
1. Within the *data_04\data* folder, open the file: **Civil_Geometry_J2P0200.dgn**.
2. Create a new file named **Plan_J2P0200.dgn** based on the 2D seed file
pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn
This new file will hold the geometry that can be used for design changes to the proposed corridor.
3. Reference in the 2D Project Civil Geometry file; **Civil_Geometry_J2P0200.dgn**.
4. Reference in the 3D Project Terrain file; **Terrain_J2P0200_Existing.dgn** and set the terrain to active.

Creating Horizontal Geometry Based on Centerline

Horizontal geometry, vertical geometry and a combination of both can be used as point controls in the corridor model. When attached to a point in a template, these geometries override the constraints put on the template point during creation. Template points and constraints are covered in detail in GEOPAK Road 1 Chapter 05 Creating Templates.

Create Geometry for a Right Passing Lane Proposed Edge of Pavement

5. **Turn Off** Civil AccuDraw.
6. **Toggle On** the *Use Active Feature Definition* on the Features Definition Toggle Bar.
7. Set the active feature to be **Design > Design Standards > Roadway > EOP New**.
8. **Toggle On** the *Use Active Feature Definition* on the Features Definition Toggle Bar.
9. Select the **Single Offset Partial**  tool. Located under the Tasks/Horizontal Geometry tool set.
10. When prompted to *Locate Element*, select **ROAD1**
11. The offset will be **24' to the right**
12. In the dialog select “**Lock to Start**”.
13. When prompted to enter the *End Distance* key in **10+00.00**.
14. The passing lane is going to only be on the South Bound lane so select **No** for the *Mirror* option.



Place a Transition Taper

15. Select **Variable Offset Taper**.  Located under the Tasks/Horizontal Geometry tool set.
16. First in the dialog set the Start and ending Offset of **24 ft. and 12 ft. to the right** respectively.
17. Secondly in same dialog set the Start and Ending station of **10+00** and “**Lock to End**” respectively.
18. When prompted to *Locate Element*, select **ROAD1** near the end of the partial offset at station **10+00 R1**.
19. When prompted for the *Start Parameters*, hover near the end of North end of the partial offset, the tool should be locked in at the location of the start point listed in the dialog.



20. Click twice to store Variable Offset Taper
21. When prompted to *Mirror* select **No**.



22. Data point to accept solution and reset to exit command.

Complex the Proposed Edge of Pavement

23. Set the active feature to be **Design > Design Standards > Roadway > EOP New**.
24. Select the **Complex by Elements**  task.
25. In the *Create Complex by Elements* dialog, verify the *Method* is set to **Automatic**.
26. When prompted to *Locate First Element*, identify the beginning of the Partial Offset element with the 24 ft offset so the direction is south.
27. Both offset elements will be highlighted. Data point to Accept Complex. The new complex geometry will be created and use the symbology defined by the **EOP_New Feature Definition**.

Placing Right of Way Line

28. Create a new file named **Land_Boundary_J2P0200.dgn** based on the 2D seed file:

pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn

This new file will hold the geometry that can be used to display Right of Way information in the Plan and XS View.

29. Reference the following files:

Civil_Geometry_J2P0200.dgn.
Terrain_J2P0200_Existing.dgn
Plan_J2P0200.dgn

30. Use the Horizontal Geometry Tool **Complex By PI** to place a line with a Feature Definition of ***RW_Controlled_Access_Proposed*** at the following locations:

a. Note: use **Civil AccuDraw** to place line accurately along the **Road1** Alignment.

Station	Offset
0+00	-100
7+53.43	-100
10+00	-125
15+00	-150
20+00	-150
23+62.95	-100
35+10.08	-100

31. Select the Terrain Model **J2P0200** and make active (if not already).

32. Open the Profile View of the just placed ***RW_Controlled_Access_Proposed*** element.

33. Give the Profile the Feature Name of “Existing”

34. Set as Active the Profile.

a. Note by setting active the Right of Way line profile, future cross section will now show a delimiter of the locations of said Right of Way line.

35. Select **File > Update Server Copy**.

4.5 Individual Exercise: Create Corridor Geometry for Route 63

If the edge of pavement and edge of shoulder of an existing road are required in the design file for visualization or for future corridor work you can use the transition tools explored in the Road 1 exercise. Another option to create geometry is to use a template that matches what the existing conditions are or proposed conditions. The **Create Geometry by Template** tool is used to apply a template along existing geometry to create additional geometry.

Placing Right of Way Line Information.

1. Continue working in **Land_Boundary_J2P0200.dgn**.
2. Use the Horizontal Geometry Tool **Complex By PI** to place a line with a Feature Definition of *RW_Controlled_Access_Proposed* at the following locations:
 - a. Note: use **Civil AccuDraw** to place line accurately along the **Route63** Alignment.

Station	Offset
9+50	150
25+67.20	150
27+67.20	150
28+00	200
30+00	200
35+00	200
40+00	200
43+00	200
43+79.95	150
45+79.95	150
70+79.95	150

3. Select the Terrain Model **J2P0200** and make active (if not already).
4. Open the Profile View of the just placed *RW_Controlled_Access_Proposed* element.
5. Give the Profile the Feature Name of “Existing”
6. Set as Active the Profile.
 - a. Note by setting active the Right of Way line profile, future cross section will now show a delimiter of the locations of said Right of Way line.
7. Select **File > Update Server Copy**.

4.6 Group Exercise Exporting and Plotting Profiles - Road 1

1. Open the **Civil_Geometry_J2P0200.dgn**.
2. Right Click and hold in a blank area and select **User Preferences**.
 - a. Verify that the **Working Directory** is empty (clear out if needed).
3. In the User Preferences dialog select **COGO Preferences**.
 - a. Verify that the **Job (GPK) Directory** is empty (clear out if needed).
4. Select the “**OK**” button twice to close the two previous preference dialogs.
5. Open Classic COGO and open the **200** gpk.
6. Select COGO Navigator and view the Chain and Profiles listed in the gpk.
7. If the **ROAD1** Chain, **ROAD1EX** or **ROAD1PR** profile is not listed, proceed to the following steps. Otherwise skip to **Step 11**.

8. Open the **ROAD1** Profile Model.
9. Select **Task > General Geometry > Export to Native**.
10. Any item listed in **Step 10** that does not exist in the 200 gpk, select and export using the **Export to Native** tool.

11. Create a new file named **Profile_J2P0200.dgn** based on the 2D seed file:

pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn

This new file will hold the profile sheet geometry.

12. Reference in the following 2D Project dgn files:

Civil_Geometry_J2P0200.dgn
Plan_J2P0200.dgn
Land_Boundary_J2P0200.dgn

13. Move to a blank area in the drawing away from the plan geometry.

14. Open **D&C Manager** by selecting the icon in the **SS2 Tool Palette**.



15. Plot the **ROAD 1** existing ground profile using the following Design and Computation Manager item:

Drafting Standards\Profile\Existing Ground Profiles\1"=50' Existing Ground Profile.

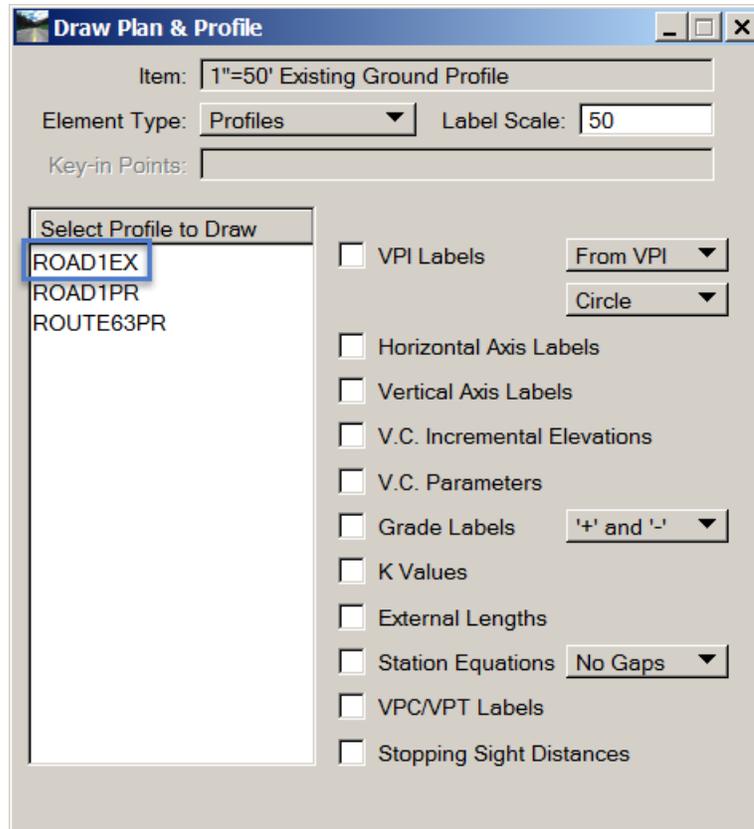
After selecting the item in D&C Manager, Click on **Draw Plan & Profile** in the **Operations Box**.



Note: If prompted select the 200 gpk

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

Choose the profile **ROAD1EX**.



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17. 16. Set the follow

Horizontal Scale: **50**
Vertical Scale: **10**
DP Station: **0+00**
DP Elevation: **800**
DP X and Y: *Data point on the screen in an open area.*
PGL Chain: **ROAD1**

18. Draw the Profile Cell with the Draw Cell at XY button.

19. Draw the profile by selecting “OK”.

Profile - ROAD1EX

Profile Range

Begin Station: 0+00.00

End Station: 35+10.08

Begin Elevation: 824.6406

End Elevation: 854.3860

Maximum Elevation: 860.4394

Minimum Elevation: 813.5742

Plot Settings

Horizontal Scale: 50

Vertical Scale: 10

Begin Station: 0+00.00

End Station: 35+10.08

Strip Grade Increment:

Profile Reference Point

Reference Station: 0+00.00

Reference Elevation: 800

X: 1681988.0497

Y: 1260342.0467

Profile Cell

PGL Chain: ROAD1

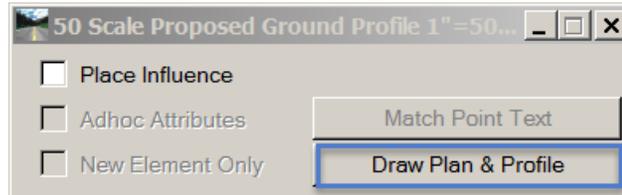
Draw Cell at XY Identify Cell

OK Cancel

20. Plot the proposed profile using the following Design and Computation Manager item:

Drafting Standards\Profile\Proposed Ground Profiles\50 Scale Proposed Ground Profile 1"=50' H & 1"=10' V.

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

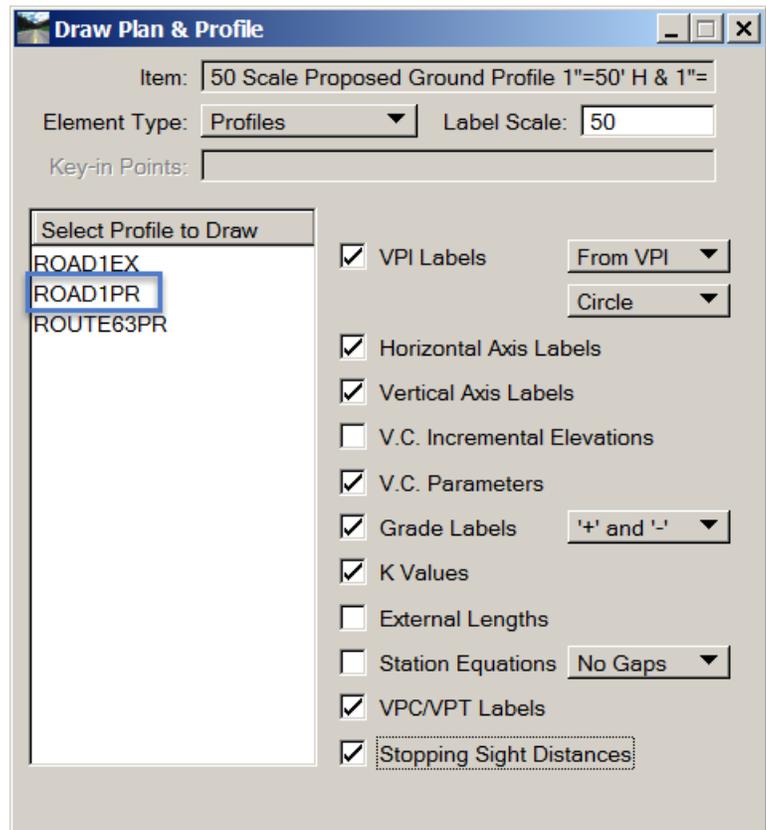


Note: If prompted select the **200 gpk**

21. 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 **ROAD1PR**.



18. (Continued)

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

Plot the profile **ROAD1PR** by selecting the **OK** button.

The screenshot shows a dialog box titled "Profile - ROAD1PR" with the following sections and fields:

- Profile Range:**
 - Begin Station: 0+00.00
 - End Station: 35+10.08
 - Begin Elevation: 824.6406
 - End Elevation: 854.3860
 - Maximum Elevation: 861.3717
 - Minimum Elevation: 818.7239
- Plot Settings:**
 - Horizontal Scale: 50.00000
 - Vertical Scale: 10.00000
 - Begin Station: 0+00.00
 - End Station: 35+10.08
 - Strip Grade Increment: (empty)
- Profile Reference Point:**
 - Reference Station: 0+00.00 R 1
 - Reference Elevation: 800.000000
 - X: 1681988.0497
 - Y: 1260342.0467
 - DP button
- Profile Cell:**
 - PGL Chain: ROAD1 (dropdown menu)
 - Draw Cell at XY button
 - Identify Cell button (highlighted with a blue border)
- Buttons:** OK, Cancel

22. Exit **D&C Manager**.

23. Select **File > Update Server Copy**.

4.7 Individual Exercise Exporting and Plotting Profiles - Route 63

1. Open the **Civil_Geometry_J2P0200.dgn**.
2. Right Click and hold in a blank area and select **User Preferences**.
 - a. Verify that the **Working Directory** is empty (clear out if needed).
3. In the User Preferences dialog select **COGO Preferences**.
 - a. Verify that the **Job (GPK) Directory** is empty (clear out if needed).
4. Select the “**OK**” button twice to close the two previous preference dialogs.
5. Open Classic COGO and open the **200** gpk.
6. Select COGO Navigator and view the Chain and Profiles listed in the gpk.
7. If the **ROUTE63** Chain, **ROUTE63EX** or **ROUTE63PR** profile is not listed, proceed to the following steps. Otherwise skip to **Step 11**.

8. Open the **ROUTE63** Profile Model.
9. Select **Task > General Geometry > Export to Native**.
10. Any item listed in **Step 10** that does not exist in the **200 gpk**, select and export using the **Export to Native** tool.

11. Open the dgn file named **Profile_J2P0200.dgn**
12. Move to a blank area in the drawing away from the plan geometry.
13. Open **D&C Manager** by selecting the icon in the **SS2 Tool Palette**.

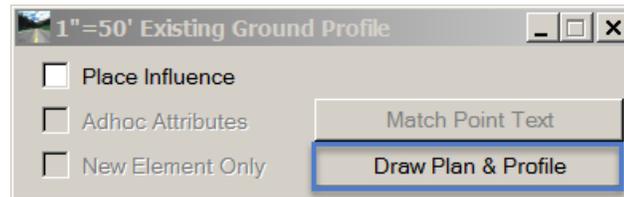


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14. Plot the **ROUTE 63** existing ground profile using the following Design and Computation Manager item:

Drafting Standards\Profile\Existing Ground Profiles\1"=50' Existing Ground Profile.

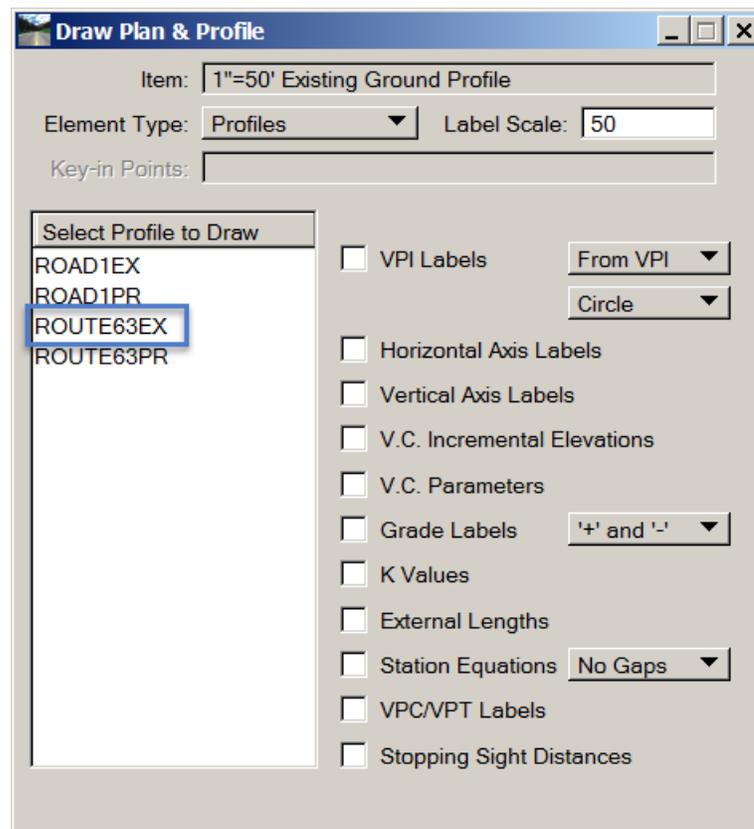
After selecting the item in D&C Manager, Click on **Draw Plan & Profile** in the **Operations Box**.



Note: If prompted select the **200 gpk**

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

Choose the profile **ROUTE63EX**.



16. Set the following parameters:

Horizontal Scale: **50**
Vertical Scale: **10**
DP Station: **9+50**
DP Elevation: **800**
DP X and Y: *Data point on the screen in an open area.*
PGL Chain: **ROUTE63**

17. Draw the Profile Cell with the Draw Cell at XY button.

18. Draw the profile by selecting “OK”.

Profile - ROUTE63EX

Profile Range

Begin Station: 9+50.00

End Station: 70+79.95

Begin Elevation: 844.9301

End Elevation: 859.4108

Maximum Elevation: 859.7595

Minimum Elevation: 820.6000

Plot Settings

Horizontal Scale: 50.00000

Vertical Scale: 10.00000

Begin Station: 9+50.00

End Station: 70+79.95

Strip Grade Increment:

Profile Reference Point

Reference Station: 9+50.00

Reference Elevation: 800.000000

X: 681889.8425

Y: 257208.2825 **DP**

Profile Cell

PGL Chain: ROUTE63

Draw Cell at XY Identify Cell

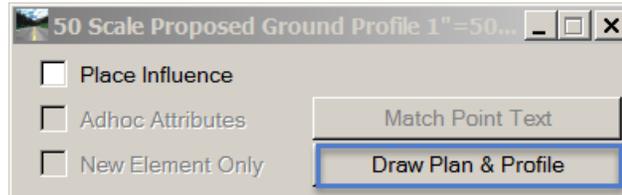
OK Cancel

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19. Plot the proposed profile using the following Design and Computation Manager item:

Drafting Standards\Profile\Proposed Ground Profiles\50 Scale Proposed Ground Profile 1"=50' H & 1"=10' V.

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

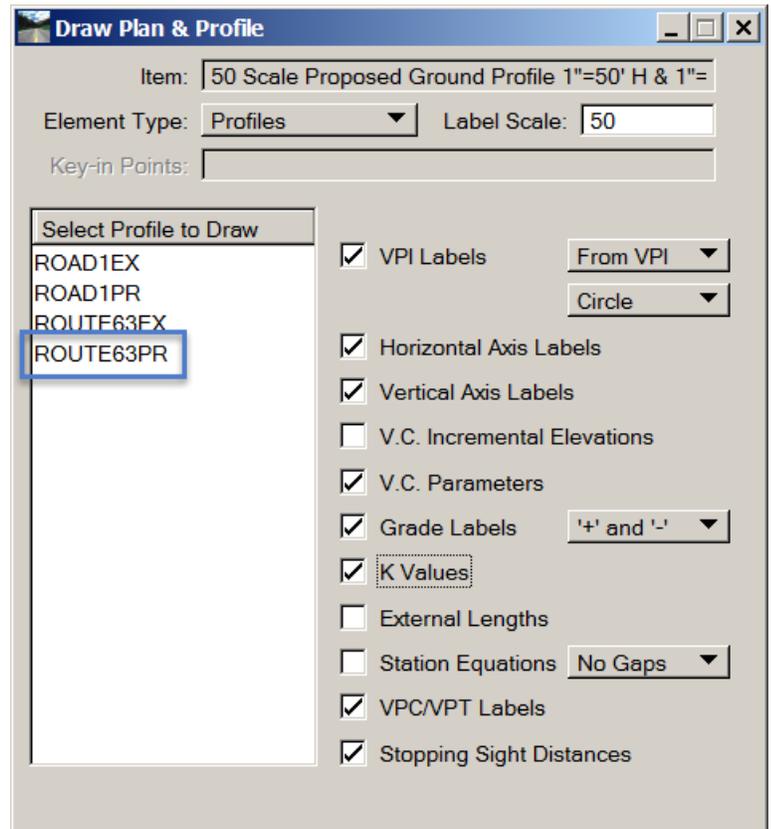


Note: If prompted select the **200 gpk**

20. 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**

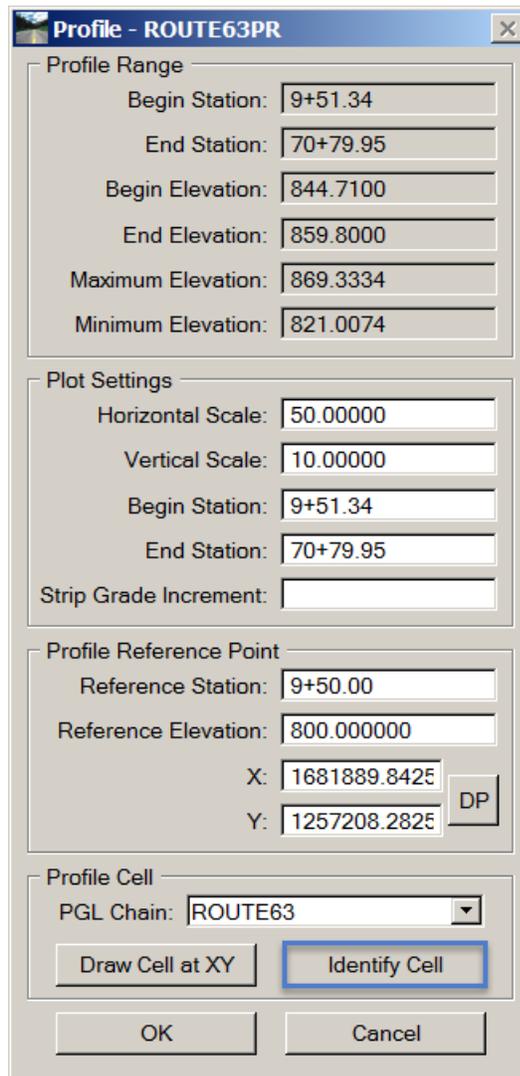
Choose the profile **ROUTE63PR**.



20. (Continued)

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

Plot the profile **ROUTE63PR** by selecting the **OK** button.



24. Exit **D&C Manager**.

25. Select **File > Update Server Copy**.