

Civil 3D 2009 Intersection Design 101

This document is intended for people who already have built corridors and want to take their knowledge to the next level.

To get the most out of this paper:

- You have a basic understanding of corridor design.
- You understand how to create and modify both Alignments and Profiles.
- You understand how to build assemblies.
- You can perform some minor style modifications.

Conventions used:

- Underlined items denote project specific object names.
- **Bold** items refer to AutoCAD Civil 3D commands.

In this example we will create a very basic intersection:

- Aspen Lane and Maple Road have same cross section.
- Both streets maintain crown through the intersection.
- The streets are perpendicular to each other.
- The radii of the curbs are equal.

Figure 1 shows the layout of the intersection. The dark arrows indicate the direction of the alignments. As you can see, there are six alignments needed to control the intersection in the X-Y plane.

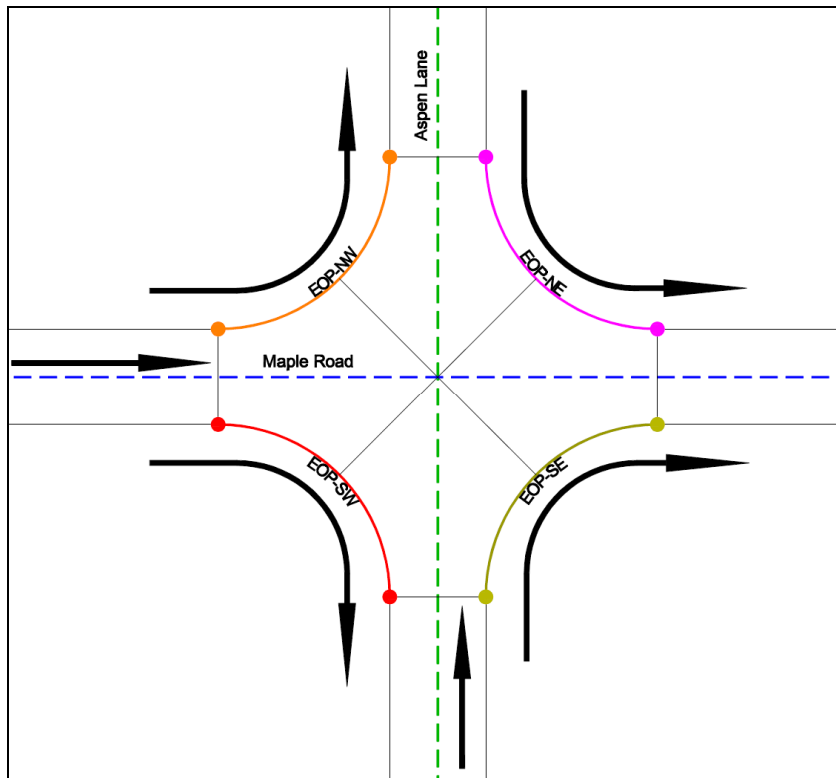


Figure 1

1. Start out by having your assemblies ready to go.

You need at least 4 assemblies:

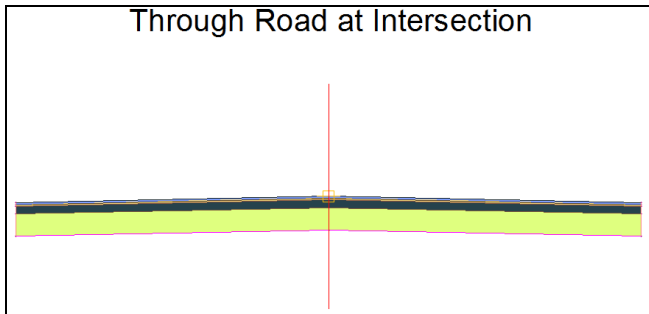


Figure 2

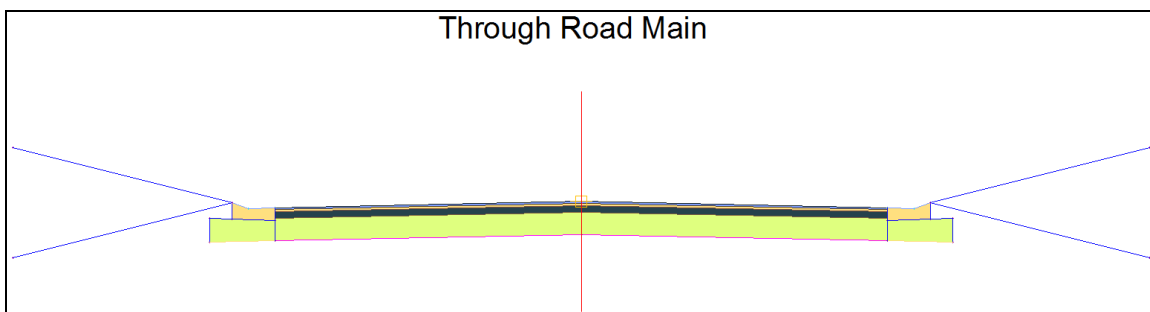


Figure 3

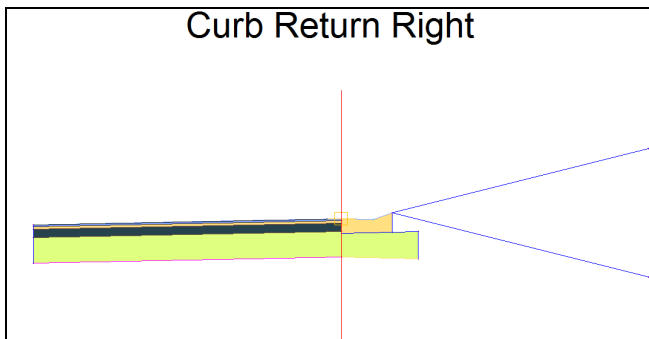


Figure 4

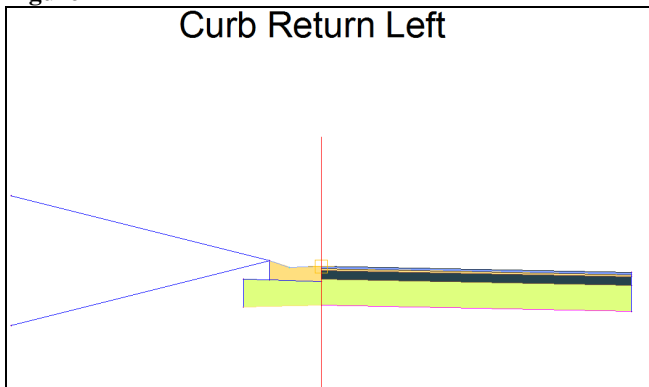
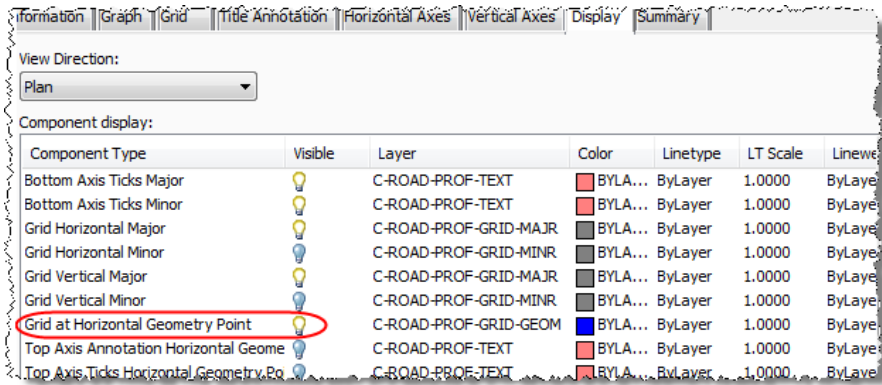


Figure 5



To see the intersection locations on your profile view, make sure your profile view style has the **Grid at Horizontal Geometry Point** turned on.

Figure 8

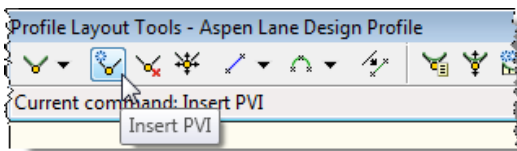


Figure 9

7. Add a VPI at the horizontal geometry point for both proposed profiles. Use the nearest snap and make sure you are snapping on the horizontal geometry point.

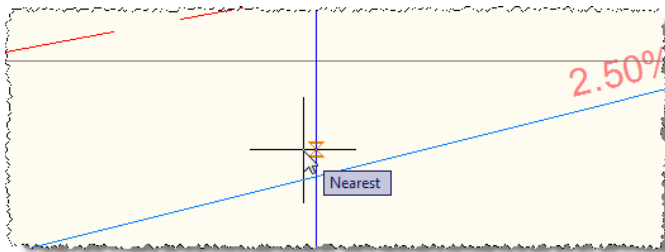


Figure 10

8. To get a better feel for the geometry, add grade break and slope labels to the design profile if you do not currently see them. Right-click on the design profile, then select **Edit Labels** (Figure 11).

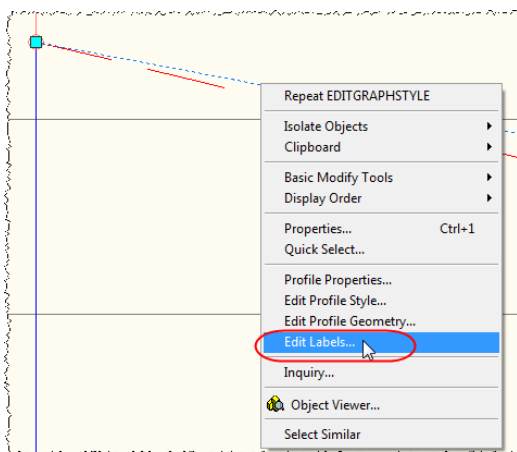


Figure 11

9. Set your active labels to show grade breaks and lines (Figure 12).

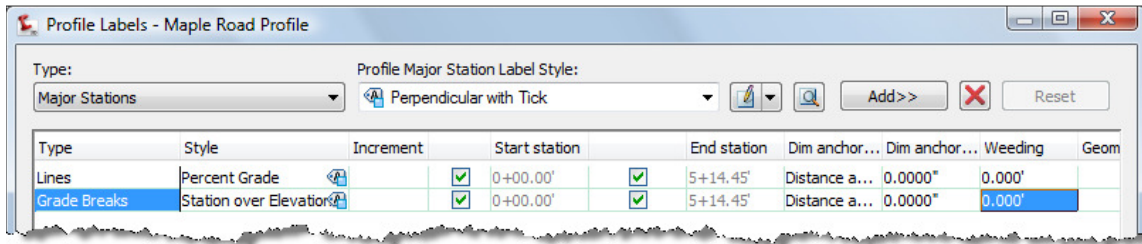


Figure 12

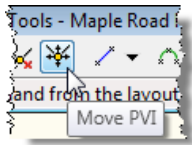


Figure 13

10. Adjust the new VPI's to have the same elevation using the Move PVI command from the Profile Layout Tools (Figure 13). In this case, set the elevations in both profiles to 921.20.

11. Make sure that the new elevation does not create a sag in either profile.

12. Create a preliminary corridor for Aspen and Maple.

- Add Aspen Lane as the first baseline.
- Choose the Aspen Lane design profile.
- Choose the **Through Road at Intersection** assembly
- Click **Add Baseline** and choose Maple Road.
- Choose the Maple Road design profile.
- Choose the **Through Road at Intersection** assembly

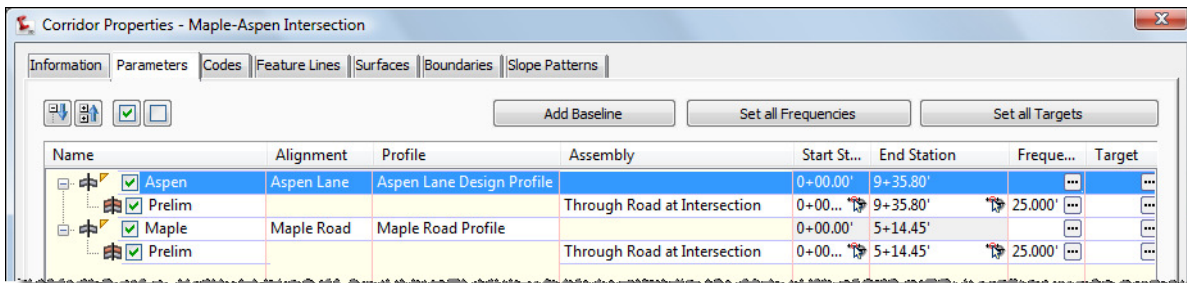


Figure 14

13. Switch to the **Surfaces** tab

- Create a corridor surface out of top links.
- Toggle on **Add as Breakline** to ensure a correct surface in the intersection later on (see Figure 15).
- Click **OK**.

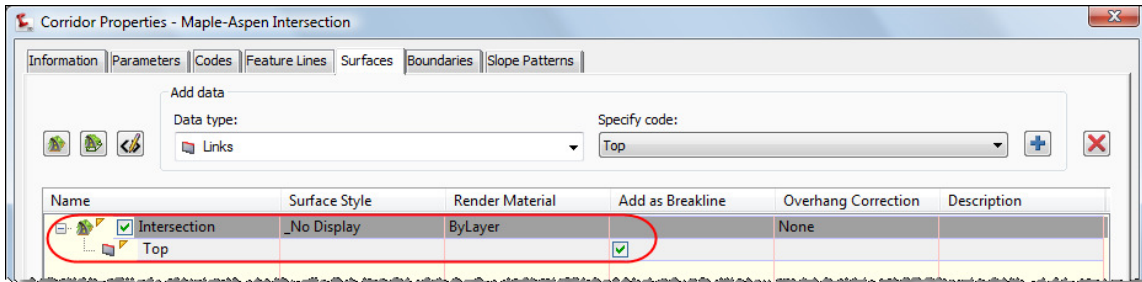


Figure 15

We will use this surface to create proposed profiles for the EOPs

14. Go to **Profiles > Create Profile from surface**

15. Set the active alignment to **EOP-SW**

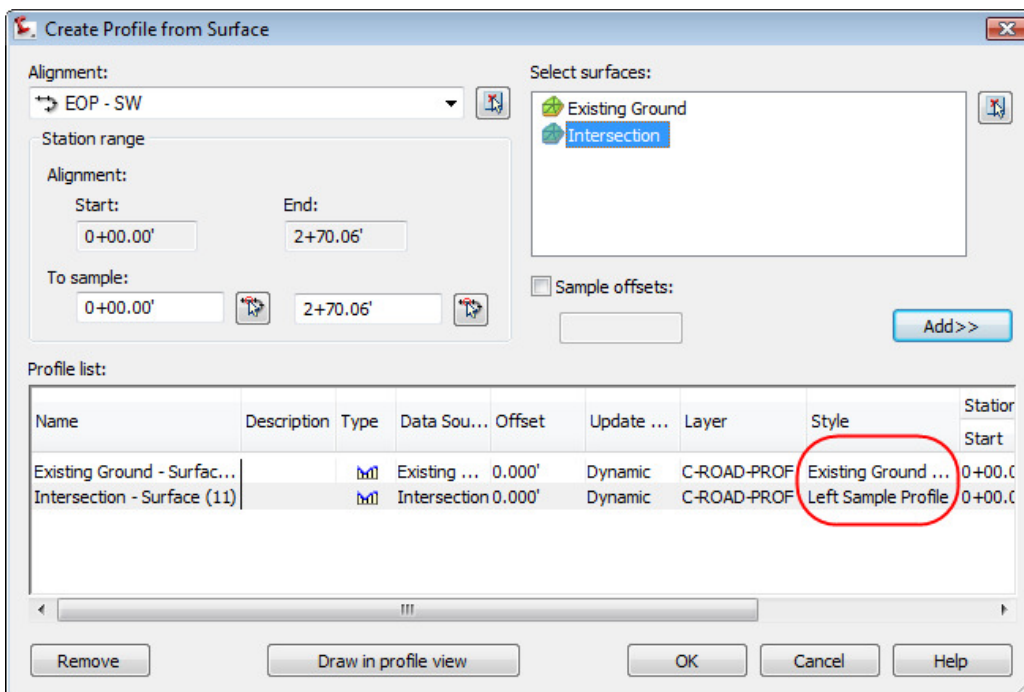


Figure 16

- a. Add samples for both the Existing ground surface and the Intersection surface.
- b. Be sure to give the profiles different styles so you can differentiate them (see Figure 16).
- c. Click **Draw in Profile View**
- d. Click **Create Profile View**

Figure 17 shows the existing ground profile for the entire length of EOP-SW. The blue vertical gridlines in the profile view show horizontal geometry points at the beginning of the alignment, PC (point of curvature) station, PT (point of tangency) station, and the end of the alignment.

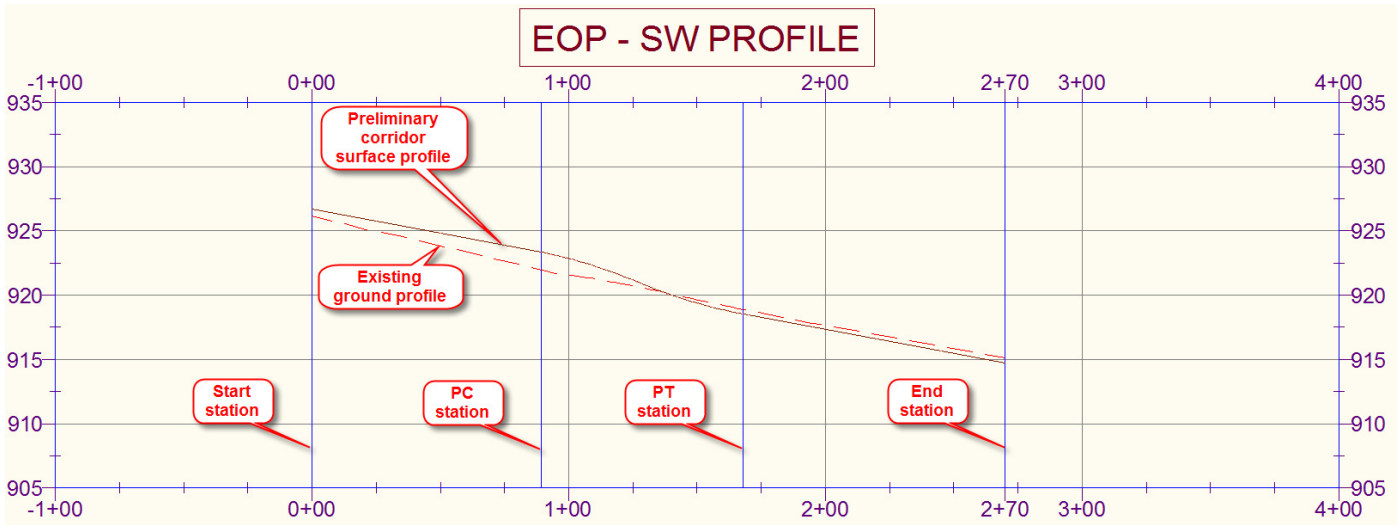


Figure 17

16. To create a design profile, go to **Profiles > Create Profile by Layout**.

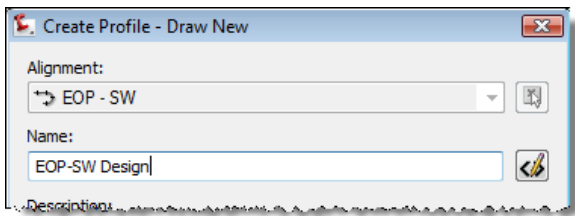


Figure 18

17. Click the profile view in which the design will be created.

18. Give the profile a descriptive name as shown in Figure 18.

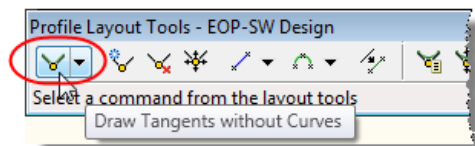


Figure 19

19. From the Profile Layout tools, Click **Draw Tangents** (see Figure 19).

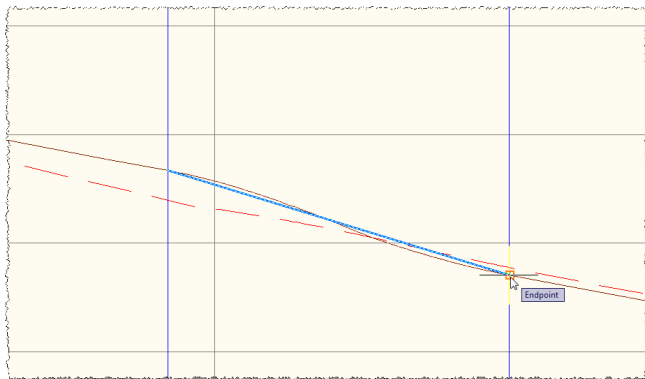


Figure 20

20. Using the end point object snap, create the design profile between the two curvature stations.

If you wish to add additional VPIs you can do so now.

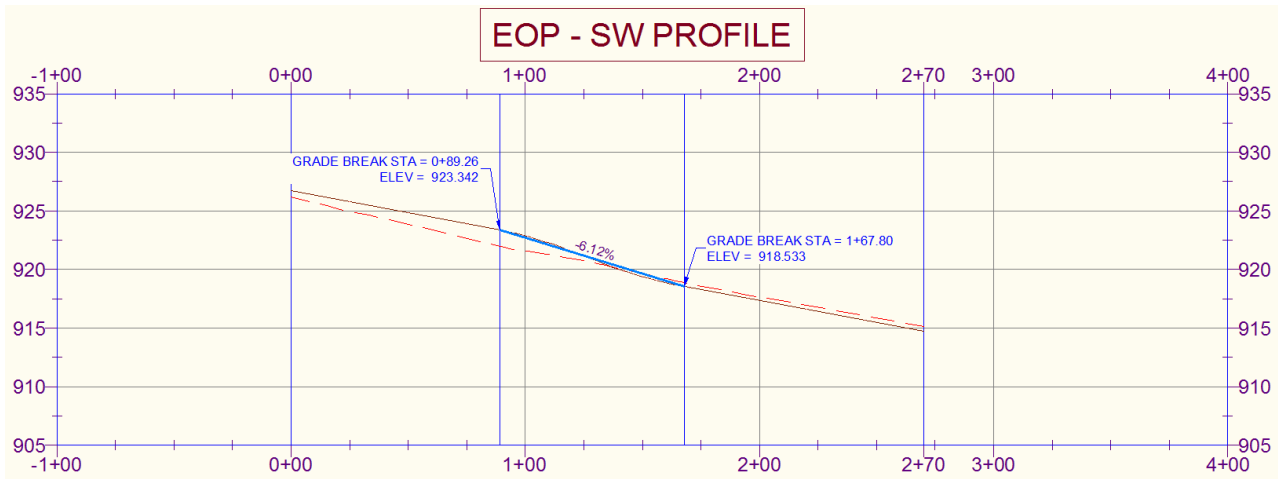


Figure 21

21. Repeat steps 16-21 for all edge of pavement profiles in your project.

Once all the alignments have design profiles created for them, it is time to plug in all the designs to the corridor.

First, we take care of the more traditional regions outside of the intersection. The regions will contain a stationing gap that will be filled in later steps with data from alternate baselines inside the intersection.

22. Go to Maple-Aspen corridor properties and switch to the **Parameters** tab.
23. Rename the region Prelim under baseline Aspen to Aspen Before Intersection.
24. Change the assembly to Through Road Main.

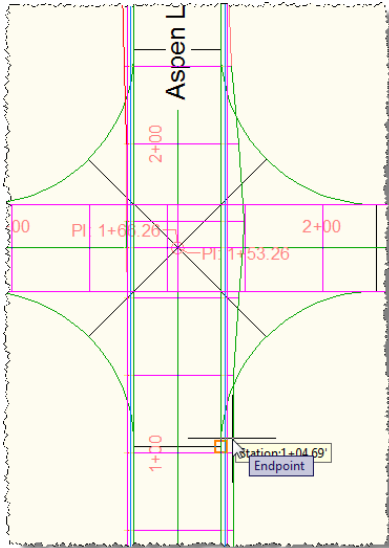



Figure 22

25. Click the pick station icon for the end station of the region. 
26. In the cad graphic, use object snaps to accurately select the PC station of EOP-SE (Figure 22).

27. Right-click on the Aspen Before Intersection region and select **Insert Region**.
28. Select the assembly Through Road Main.
29. Double-click in the region to rename it to Aspen After Intersection.

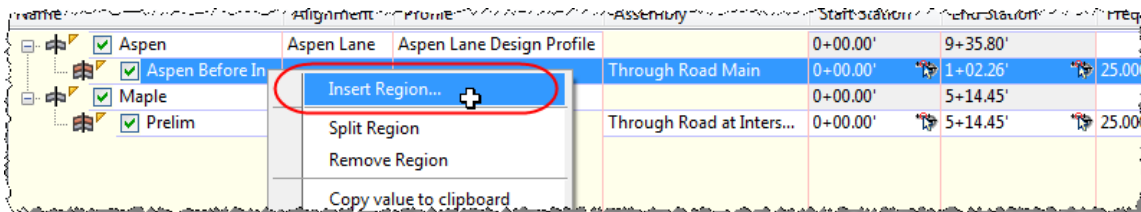



Figure 23

30. Click the pick station icon for the **Start Station** of the region. 
31. In the cad graphic, use object snaps to accurately select the PT station of EOP-NE.
32. Repeat the procedure described in steps 23-32 for the Maple Road baseline alignment.

Now we are ready to fill the intersection with data based on our EOP alignments and profiles. We will use the Curb Return Left and Curb Return right assemblies, which will use the EOP's as their baselines. These assemblies will “stretch out” to their respective targets filling out the intersection and creating a smooth, correct surface model. In this example we will work through all the steps for EOP-NE.

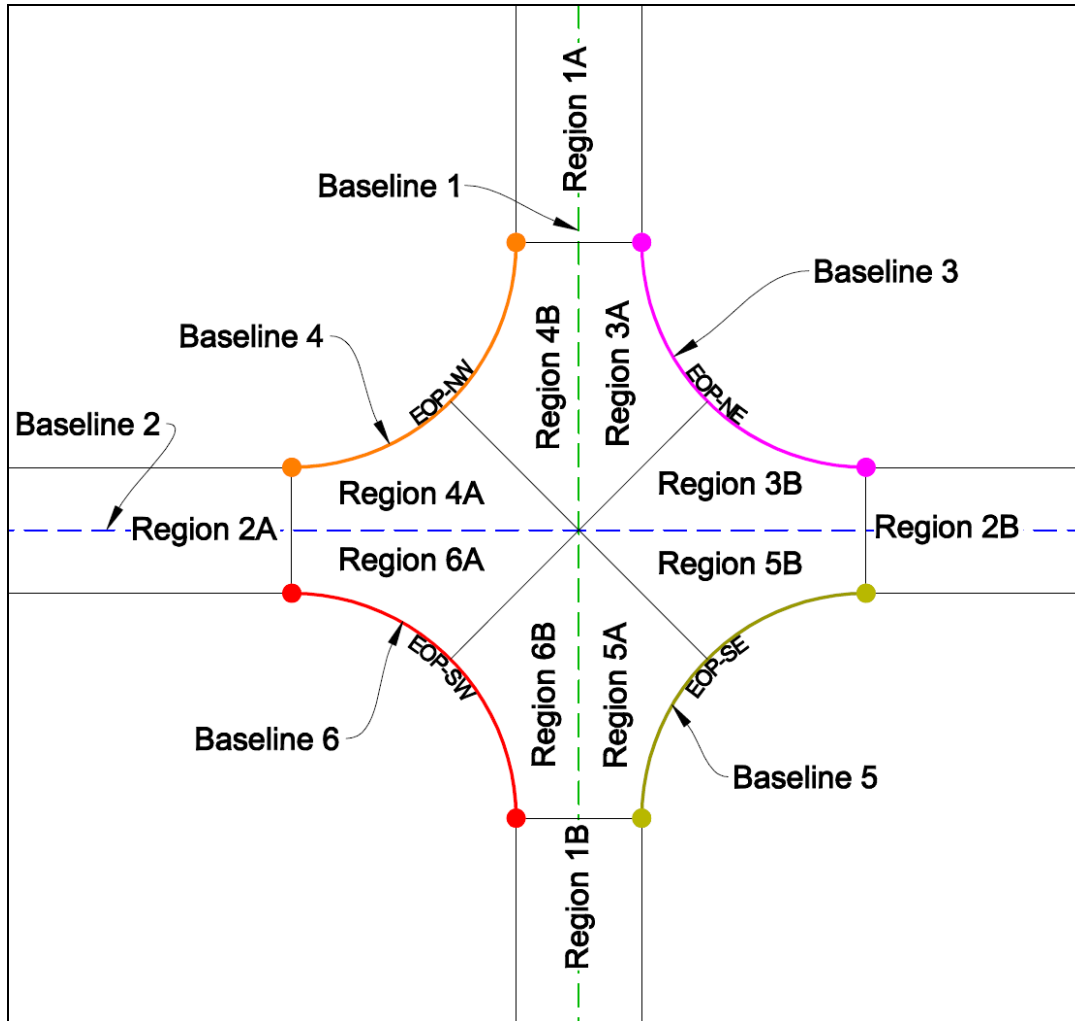


Figure 24

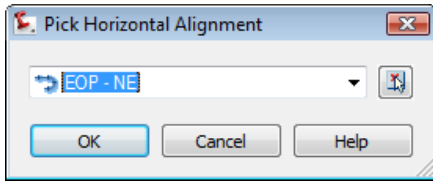


Figure 25

33. Click **Add Baseline**

34. Select EOP-NE

35. Click **OK**

36. Rename the new baseline to EOP-NE

37. Click the **Profile** field for the new baseline (Figure 26).



Figure 26

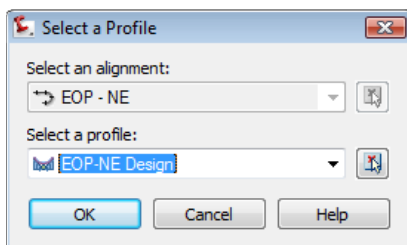


Figure 27

38. Select the EOP-NE Design profile.

39. Click **OK**.

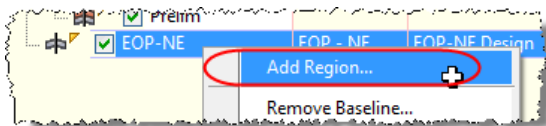


Figure 28

40. Right-click on the baseline and select **Add Region** (Figure 28).

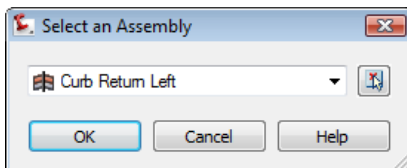


Figure 29

41. Select the Curb Return Left assembly.

42. Click **OK**.

43. Rename the new region to Aspen-Target

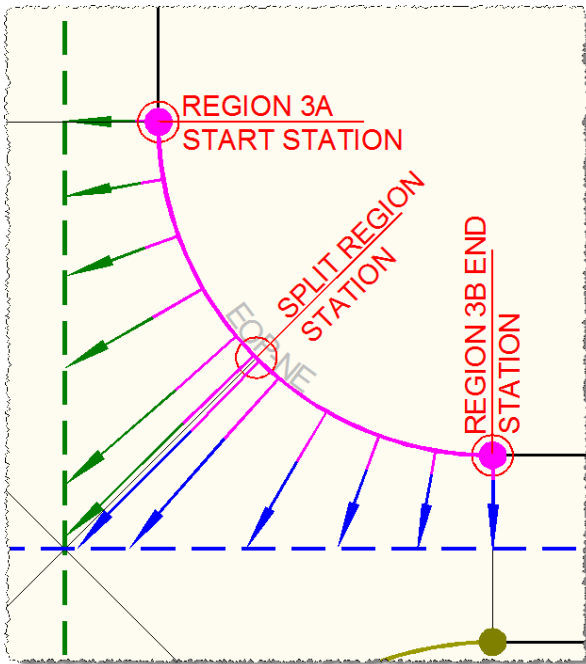


Figure 30

44. Next, click the Pick button for the Start Station.
45. Use object snaps to select the PC station of EOP-NE (labeled Region 3A start station in Figure 30).
46. Click the Pick button for the End Station.
47. Snap to the PT station of EOP-NE (labeled Region 3B End Station in Figure 30).

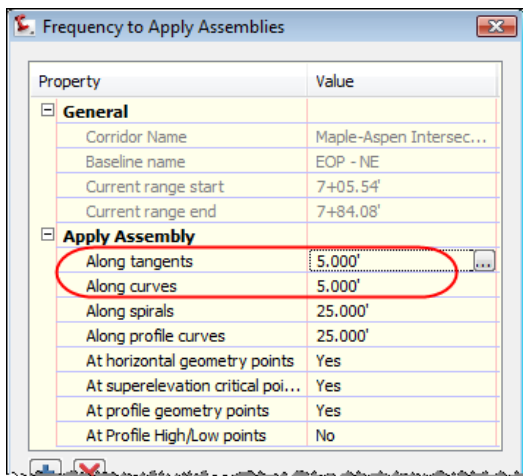


Figure 31

48. Click on the ellipsis button in the Frequency field.
49. Set the frequency **Along Tangents** and **Along Curves** both to 5' (Figure 31).
50. Click **OK**.

51. Right-click on the region and select **Split Region** (Figure 32).

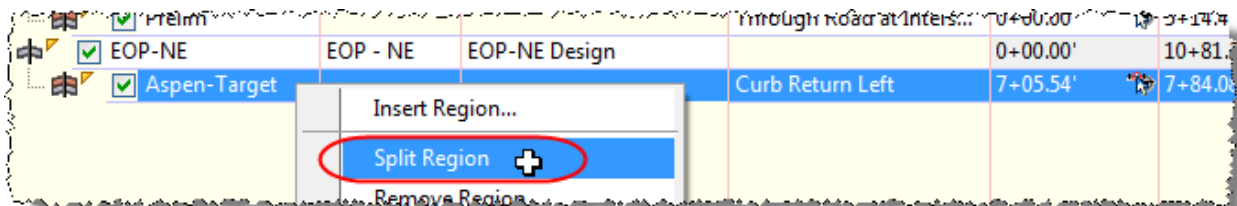


Figure 32

52. Click once by snapping to the location where the two centerlines intersect.
53. The command line should confirm that a new region was created. Hit **Enter**.
54. You should now have two regions with correct stationing. Rename the newly created region to reflect its purpose, Maple-Target.

Next we set targets for each region. These targets will “stretch” the geometry of the assembly so that the width of the pavement area reaches out to the design alignment and profile.

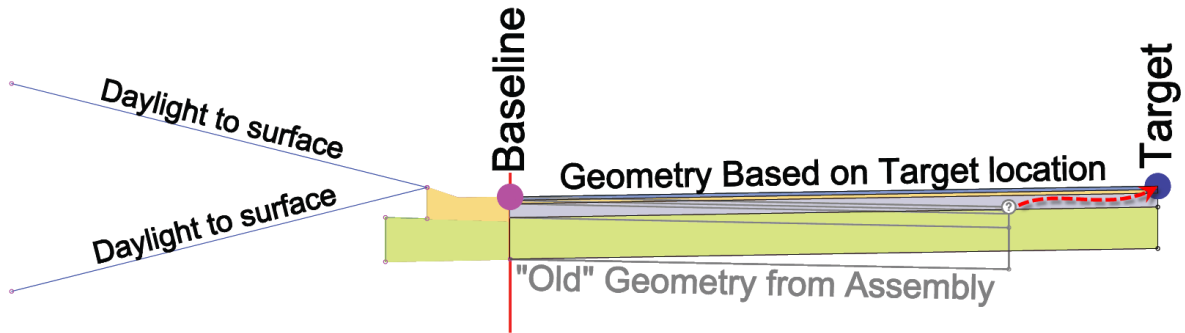


Figure 33

55. Click on the ellipsis button in the Target field for the region we called Aspen-Target. ...
56. In the Target Mapping dialog box, click in the field for **Width Alignment**.

Surfaces	<Click here to set all>		
Target Surface	Existing Ground	DaylightStandard - (11)	Left CR - Left Side
Width or Offset Targets			
Width Alignment	Aspen Lane	Lane - Left CR - Right	Left CR - Right Side
Slope or Elevation Targets			
Outside Elevation Profile	Aspen Lane-Aspen Lane Design Profile	Lane - Left CR - Right	Left CR - Right Side

Figure 34

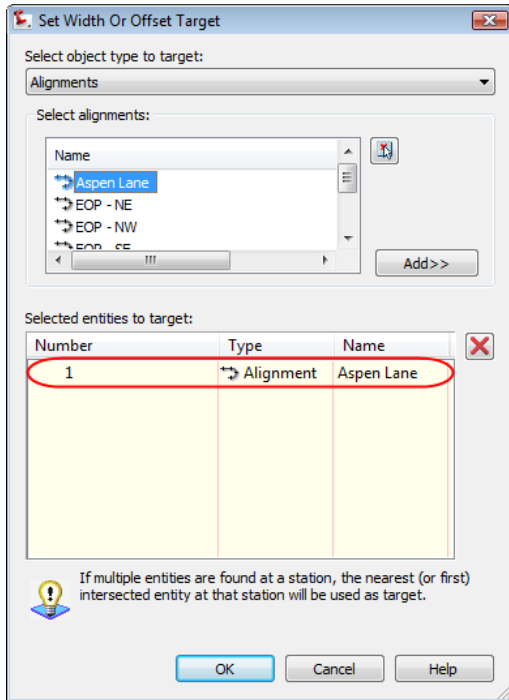


Figure 35

57. Set the Select object type to target to **Alignments**.
58. Select the Aspen Lane alignment from the list.
59. Click **Add**.
60. Click **OK**.

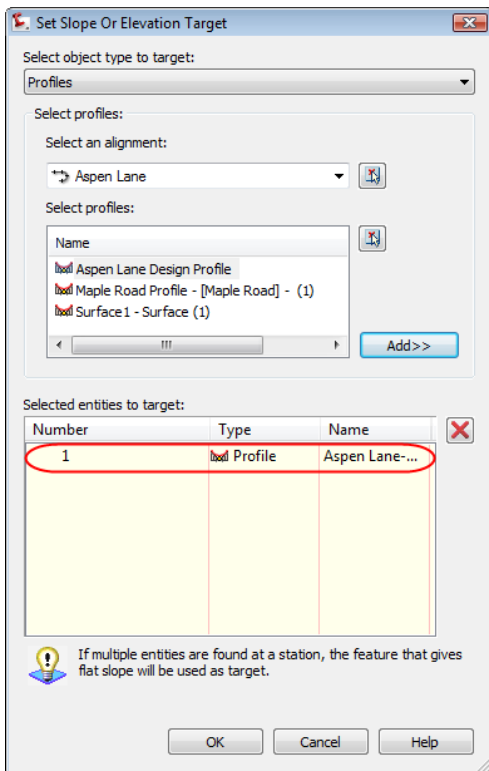



Figure 36

61. Back in the Target Mapping dialog, click in the field for **Outside Elevation Profile**.
62. Verify that the object type to target is **Profiles**.
63. Select the Aspen lane Design Profile
64. Click **Add**.
65. Click **OK**.

The Target Mapping dialog box should now resemble Figure 34.

We need to follow the same procedure for the Maple-Target portion of the EOP-NE baseline.

66. Click on the ellipsis button in the **Target** field for the region we called Maple-Target. 

67. In the Target Mapping dialog box, click in the field for **Width Alignment**.
68. Set the Select object type to target to **Alignments**.
69. Select the Maple Road alignment from the list.
70. Click **Add**.
71. Click **OK**.
72. Back in the Target Mapping dialog, click in the field for **Outside Elevation Profile**.
73. Verify that the object type to target is **Profiles**.
74. Select the Maple Road profile
75. Click **Add**.
76. Click **OK**.

Repeat steps 33-76 to accomplish the following for the three remaining quadrants:

- Add EOP baseline & rename it to reflect alignment name.
- Add Region using appropriate partial assembly.
- Set the station range for the alignment inside the corridor.
- Set frequencies to 5'
- Split region using the intersection point of the main alignments.
- Rename regions to reflect target name.
- Set targets for both regions. Don't forget to use both Width and Outside Elevation targets.

Figure 37 shows the completed corridor parameters. The numeric labels correspond to the region labels in Figure 24. (Note: The numbering is for illustration purposes and will not appear in the dialog box.)

Name	Alignment	Profile	Assembly	Start Station	End Station	Frequ...	Target
Aspen	Aspen Lane	Aspen Lane Design Profile		0+00.00'	9+35.80'	...	...
1A Aspen Before			Through Road Main	0+00.00'	1+02.26'	25.000'	...
1B Aspen After I...			Through Road Main	2+30.26'	9+35.80'	25.000'	...
Maple	Maple Road	Maple Road Profile		0+00.00'	5+14.45'	...	...
2A Maple Before			Through Road Main	0+00.00'	0+89.26'	25.000'	...
2B Maple After			Through Road Main	2+17.26'	5+14.45'	25.000'	...
EOP NE	EOP - NE	EOP-NE Design		0+00.00'	10+81.27'	...	...
3A Aspen-Target			Curb Return Left	7+05.54'	7+44.81'	5.000'	...
3B Maple-Target			Curb Return Left	7+44.81'	7+84.08'	5.000'	...
EOP-NW	EOP - NW	EOP - NW Design		0+00.00'	8+73.35'	...	...
4A Maple-Target			Curb Return Left	0+89.26'	1+28.53'	5.000'	...
4B Aspen-Target			Curb Return Left	1+28.53'	1+67.80'	5.000'	...
EOP-SE	EOP - SE	EOP-SE Design		0+00.00'	4+77.99'	...	...
5A Aspen-Target			Curb Return Right	1+02.26'	1+41.53'	5.000'	...
5B Maple-Target			Curb Return Right	1+41.53'	1+80.80'	5.000'	...
EOP-SW	EOP - SW	EOP-SW Design		0+00.00'	2+70.06'	...	...
6A Maple-Target			Curb Return Right	0+89.26'	1+28.53'	5.000'	...
6B Aspen-Target			Curb Return Right	1+28.53'	1+67.80'	5.000'	...

Figure 37

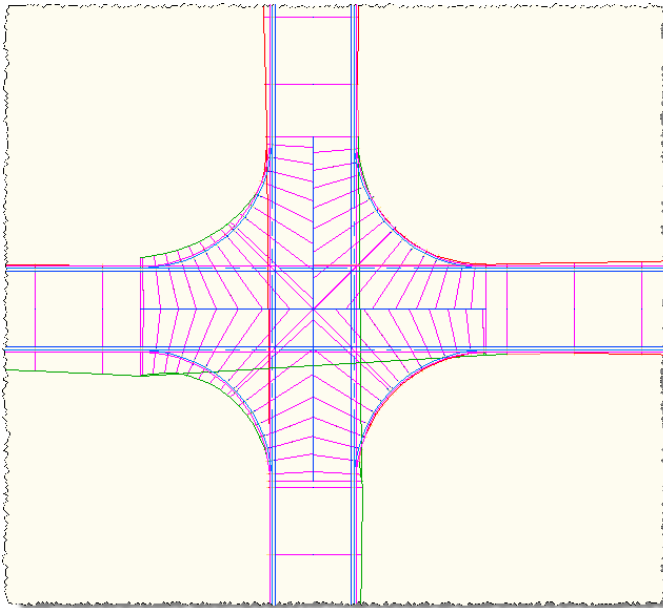


Figure 38

Figure 38 shows what the completed intersection corridor should look like in plan view.

You will see feature lines running through the intersection; however these will not affect the surface. Back in step 13 we created a surface based on links, rather than feature lines – so this is ok.

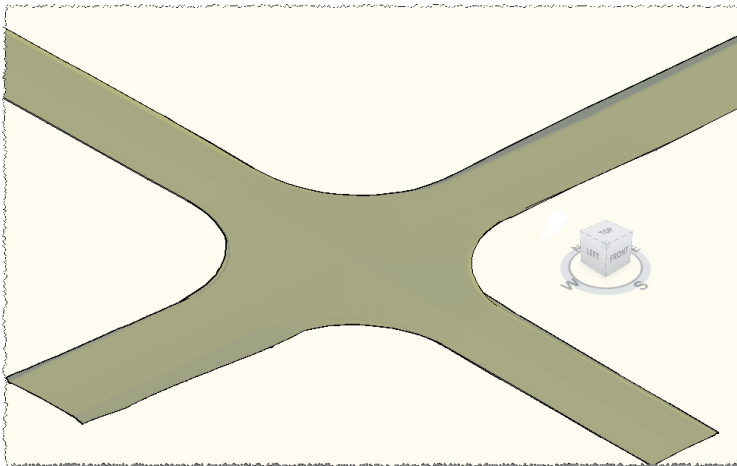


Figure 39

In the object viewer, the surface should appear smooth and free of “kinks” or “jitters.” If you have undesirable features on your surface, see the troubleshooting section for possible causes.

Common Corridor Intersection Mistakes:

“Swimming Upstream” (Figure 40)

Most Likely Causes

- The alignment stations were selected going opposite the stationing direction.
- Region stationing might overlap

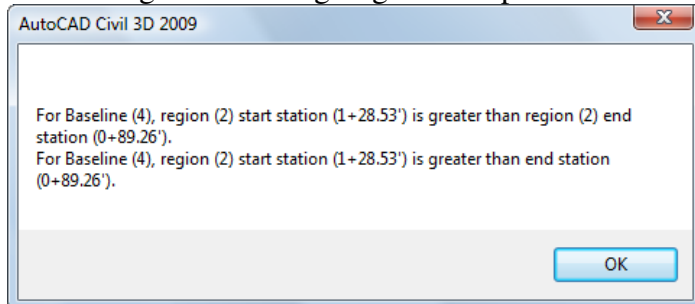


Figure 40

“The Washboard effect” (Figure 41):

Most Likely Causes

- Missing profile target
- Profile target incorrect
- Design profile on intersection baseline does not match in to corridor surface properly.

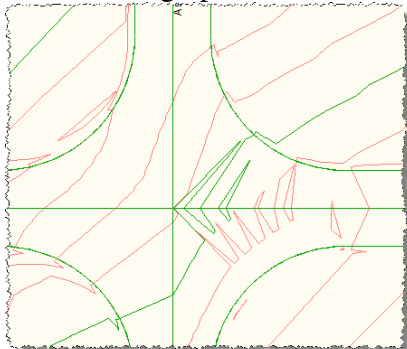


Figure 41

“The Hole” (Figure 42):

Most Likely Causes

- Missing width target alignment
- Targeted the wrong piece of your assembly to the alignment (such as a shoulder).
- You may have used a right-side assembly where a left-side assembly was needed or vice versa.

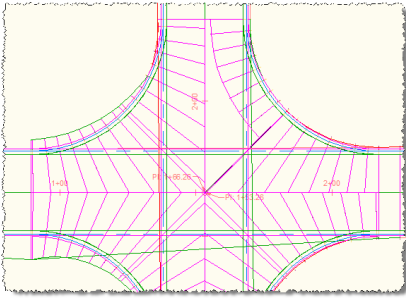


Figure 42

“Surface Freak-out”:

Most Likely causes

- Station range for an intersection region goes beyond the station range for the design profile.
- A design profile may have been unintentionally deleted.

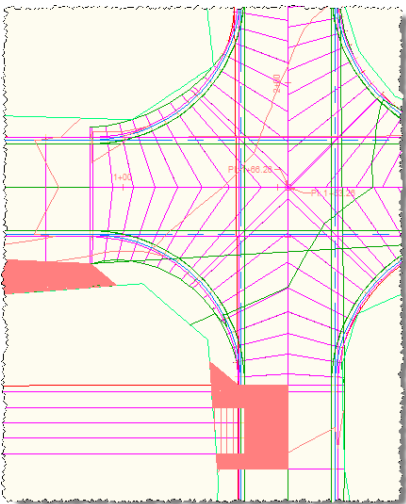


Figure 43

The Flying Subassembly:

Most Likely Causes

- Station range for intersection region goes beyond where it should stop (in this case the region should have ended at the midpoint of the EOP arc).
- Unintentionally targeted the same centerline for the width alignment on the second region for this baseline.
- Forgot to add a second region for this baseline.

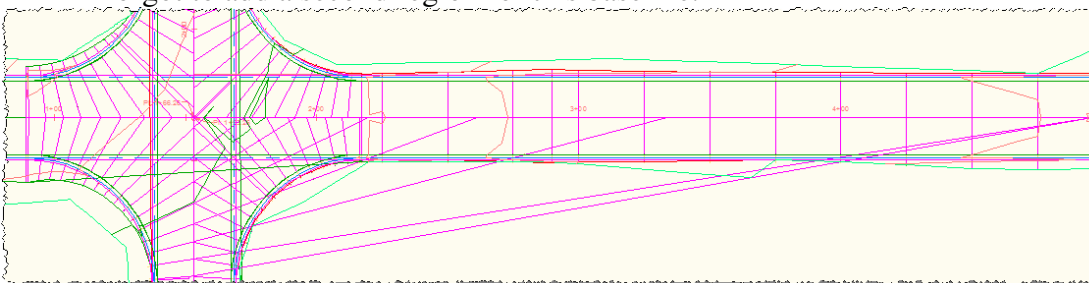


Figure 44

