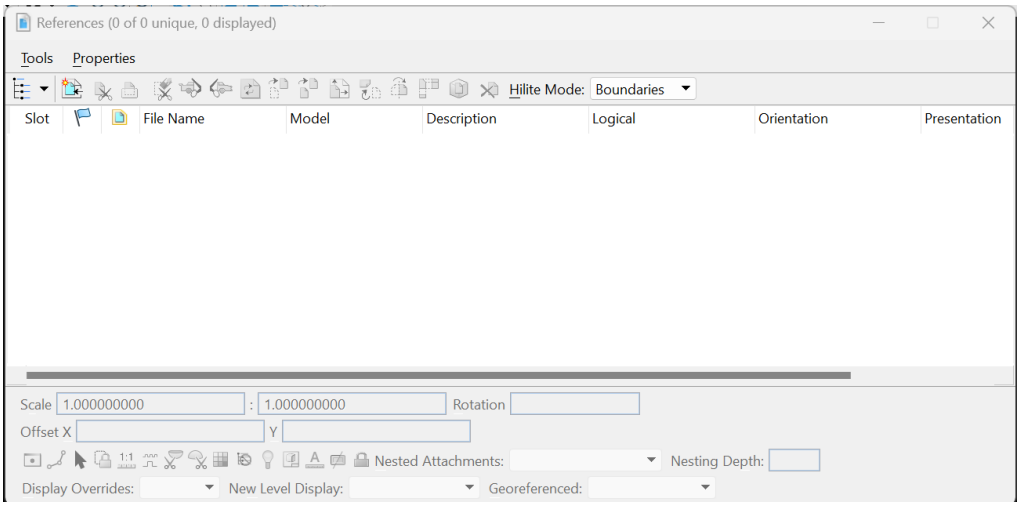
ORD Lesson 4: Developing and Annotating a Horizontal Alignment in ORD

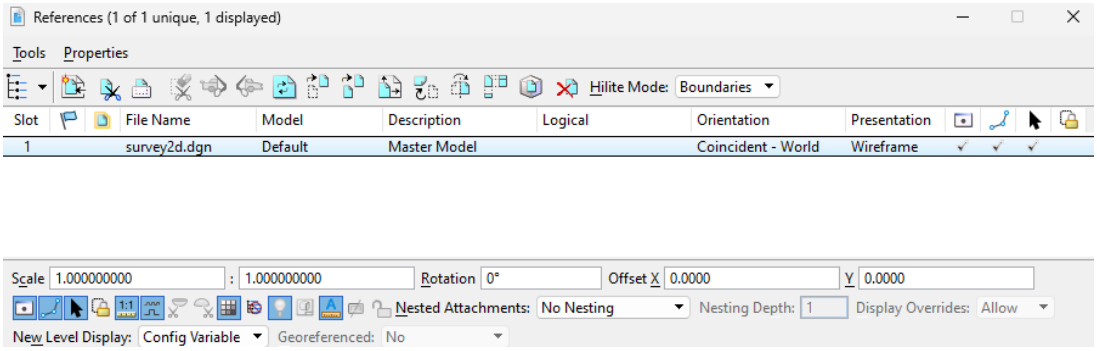
Learning Objective: This lesson is intended to teach how to create and annotate a road centerline alignment, as well as create other civil geometry features. This lesson will also introduce you how to use and attach reference files.

Task 1: Attaching a Reference File

1. Open the *Lesson2.dgn* file you have used in previous lessons.
2. Navigate to the **Home** Ribbon Tab and select the **Attach Tools** icon. The reference window shown below should appear.



3. Select “Tools” in the top left of the reference window and then “Attach”.
4. Navigate to the *survey2d.dgn* file supplied with this lesson and confirm the settings as shown below, making sure that the **Orientation** is set to **Coincident-World.**



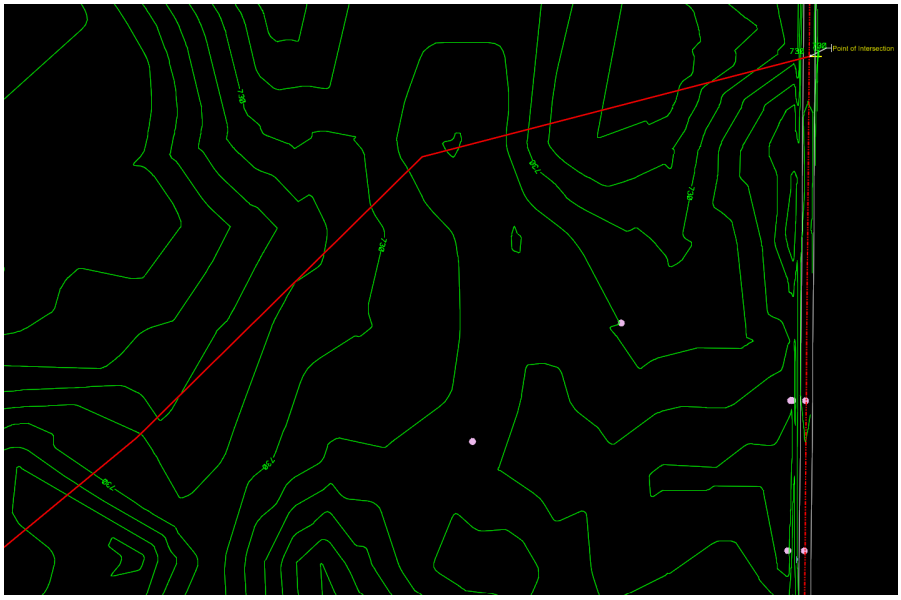
5. If you do not see the attached reference file, hit the **Fit View** button.
6. Congratulations, you have just attached your first reference file.

Task 2: Creating a Proposed Road Alignment

A road alignment is typically defined by many features. These features include, but not limited to, centerline alignment, edges of pavement (also referred to as the edge of metal), front and/or back of curb, and the right-of-way lines. In this task, we will create a new centerline alignment and right and left edge of pavement lines using OpenRoads features.

For this lesson we will create a **proposed two-lane roadway with a design speed of 45 mph and maximum super elevation of 6%.**

- Creating Centerline Tangents:
    1. Locate the point labeled "Point of Intersection" on the eastern edge of the referenced survey file.
    2. Using Civil Geometry Tools, draw a line (tangent) from the point of intersection with a length of 800' and an angle of intersection with the existing roadway of 75 degrees. Make sure to make the Geom Baseline feature definition active.
    3. From the left (western) end of the line you just created, create another tangent section that forms a Δ=30 degrees and has a length of 800'.
    4. Create a third tangent section with a length of 450' and a Δ=5 degrees. Once complete, your drawing should look like the picture shown below.



- Creating Curves:

In this step, we will use the tables and information below to determine proper radii for the two curves in the alignment you have created. Remember, the design speed is 45 mph with a maximum superelevation of 6%. We would like to create curves that **do not** need spirals.

1. First, identify the minimum radius (using the max superelevation) of the two curves from the table below:

U.S. Customary															
e (%)	V_d = 15 mph	V_d = 20 mph	V_d = 25 mph	V_d = 30 mph	V_d = 35 mph	V_d = 40 mph	V_d = 45 mph	V_d = 50 mph	V_d = 55 mph	V_d = 60 mph	V_d = 65 mph	V_d = 70 mph	V_d = 75 mph	V_d = 80 mph
	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)
NC	868	1580	2290	3130	4100	5230	6480	7870	9410	11100	12600	14100	15700	17400
RC	614	1120	1630	2240	2950	3770	4680	5700	6820	8060	9130	10300	11500	12900
2.2	543	991	1450	2000	2630	3370	4190	5100	6110	7230	8200	9240	10400	11600
2.4	482	884	1300	1790	2360	3030	3770	4600	5520	6540	7430	8380	9420	10600
2.6	430	791	1170	1610	2130	2740	3420	4170	5020	5950	6770	7660	8620	9670
2.8	384	709	1050	1460	1930	2490	3110	3800	4580	5440	6200	7030	7930	8910
3.0	341	635	944	1320	1760	2270	2840	3480	4200	4990	5710	6490	7330	8260
3.2	300	566	850	1200	1600	2080	2600	3200	3860	4600	5280	6010	6810	7680
3.4	256	498	761	1080	1460	1900	2390	2940	3560	4250	4890	5580	6340	7180
3.6	209	422	673	972	1320	1740	2190	2710	3290	3940	4540	5210	5930	6720
3.8	176	358	583	864	1190	1590	2010	2490	3040	3650	4230	4860	5560	6320
4.0	151	309	511	766	1070	1440	1840	2300	2810	3390	3950	4550	5220	5950
4.2	131	270	452	684	960	1310	1680	2110	2590	3140	3680	4270	4910	5620
4.4	116	238	402	615	868	1190	1540	1940	2400	2920	3440	4010	4630	5320
4.6	102	212	360	555	788	1090	1410	1780	2210	2710	3220	3770	4380	5040
4.8	91	189	324	502	718	995	1300	1640	2050	2510	3000	3550	4140	4790
5.0	82	169	292	456	654	911	1190	1510	1890	2330	2800	3330	3910	4550
5.2	73	152	264	413	595	833	1090	1390	1750	2160	2610	3120	3690	4320
5.4	65	136	237	373	540	759	995	1280	1610	1990	2420	2910	3460	4090
5.6	58	121	212	335	487	687	903	1160	1470	1830	2230	2700	3230	3840
5.8	51	106	186	296	431	611	806	1040	1320	1650	2020	2460	2970	3560
6.0	39	81	144	231	340	485	643	833	1060	1330	1660	2040	2500	3050

Table 3-8 A Policy on Geometric Design of Highways and Streets 7th Edition (AASHTO)

Question 1:

R_{min} = _____ feet

(This value will be the same for both curves)

2. Compute the minimum curve **radius** based on the design speed.

Important Notes:

- AASHTO Article 3.3.13 states *"The minimum length for horizontal curves on main highways L_{min}, should be 15 times the design speed expressed in mph."*
- The value found for minimum length will need to be converted to a minimum radius using general horizontal curve formulas.

Question 2:

Curve 1 (Δ=30°): R_{min} = _____ feet

Curve 2 (Δ=5°): R_{min} = _____feet

3. Do the radii found in Step 2 need to be spiraled per the table below?

U.S. Customary	
Design speed (mph)	Maximum radius (ft)
15	114
20	203
25	317
30	456
35	620
40	810
45	1025
50	1265
55	1531
60	1822
65	2138
70	2479
75	2846
80	3238

Table 3-18. A Policy on Geometric Design of Highways and Streets 7th Edition (AASHTO)

Question 3:

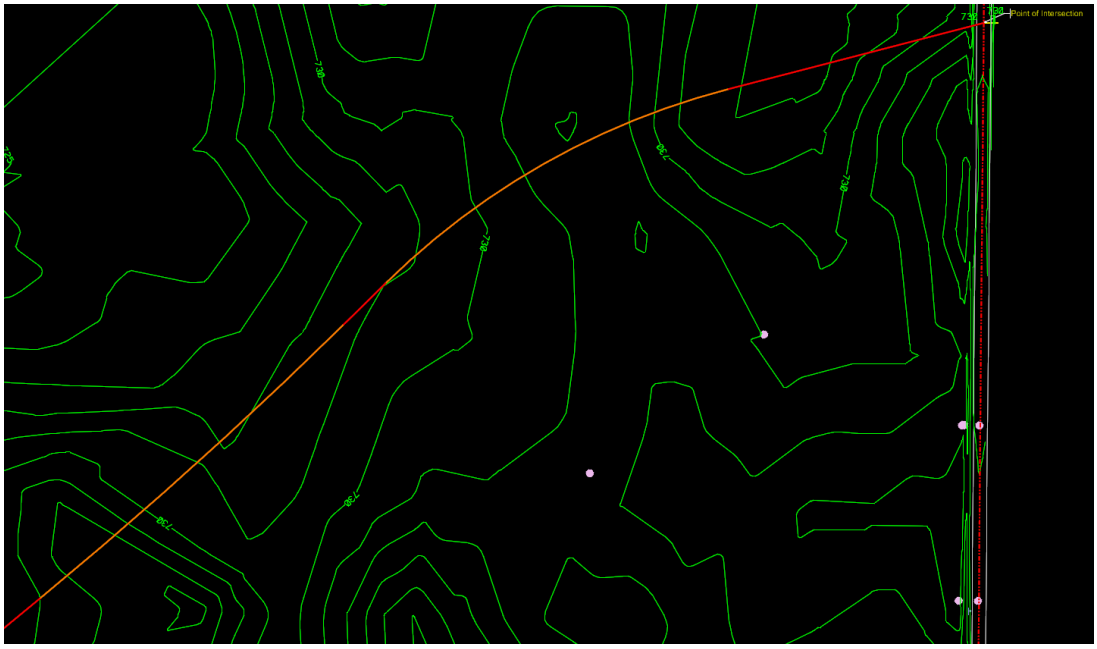
Curve 1 (Δ=30°): Yes No

Curve 2 (Δ=5°): Yes No

4. Keeping in mind that we would like to select radius values that do not require the use of spirals, which radii value would you choose for the design of the two curves (round to nearest 100')?

Question 4:	
Curve 1 (Δ=30°):	R_{min} = _____ feet
Curve 2 (Δ=5°):	R_{min} = _____feet

5. Use the **Arcs** Tool to draw the two curves you found radii for in Step 4. Your drawing should look like the figure below.

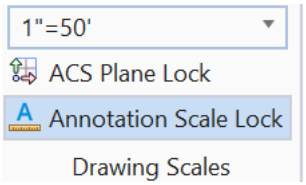


- Creating and Reviewing the Alignment Geometry:
  1. Use the **Complex Geometry** Tool to create your alignment. Be sure to select the elements from right (east) to left (west). Make sure the Feature Definition is Geom_Baseline.
  2. Review the geometry by doing the following:
     a. Use the **Element Selection** Tool to select the alignment.
     b. Once selected, hover over the alignment. The box shown below should appear.

c. Select the "Horizontal Geometry Report" icon to review the information related to the alignment. Document the length of both of your curves below. Once complete, close the report.

Question 5:
Curve 1 (Δ=30°): L = _____ feet
Curve 2 (Δ=5°): L = _____ feet

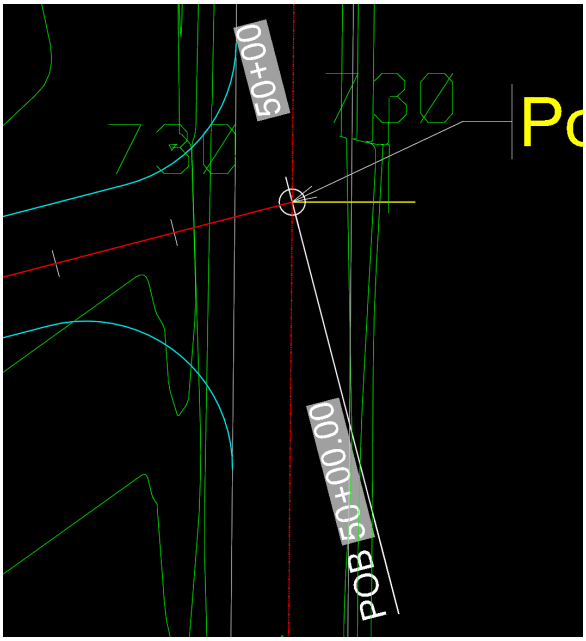
- Annotating the Alignment:
  1. Select the *Drawing Production* ribbon tab and set your drawing scale settings to those shown below.



  2. Within the *Drawing Production* ribbon tab, select the **Element Annotation** Tool under the *Annotations* ribbon group. Select your alignment.
  3. Your alignment should now display stationing and data for the two curves. If you do not see this, make sure all Levels are visible. If your text is very small, highlight around all of the text, and under the *Text* ribbon group, select the *Change Text Attributes* tool to make the Height and Width larger. Select the drawing after to see the change.
  4. Your alignment by default will start with stations beginning at STA 0+00. Update the stationing to begin at STA 5+000 by doing the following:
     a. Return to the *Geometry* tab. Select the drop down under the Modify Tool found in the *Horizontal* ribbon group.
     b. Select **Start Station** from the list.
     c. Set the start distance to 0+00 and start station to 5+000.
     d. The alignment station labeling should be updated to reflect this new beginning station.
  5. Congratulations, you have successfully created and annotated the alignment!

- Creating Edge of Pavement Alignments:
  1. In the *Feature Definition* toolbar (under Standards on the Geometry Tab), change the active feature definition to **Road_EdgeofPavement**. This can be found under: Linear, then Pavement.
  2. Switch back to the *Geometry* ribbon tab and select the drop down next to the *Offset and Tapers* Tool. Select the **Single Offset Entire Element** Tool from the list.
  3. Follow the on-screen prompts and set the off-set distance to 12', and say "Yes" to mirror the element. You should see an edge of pavement line for both sides of your proposed roadway.

4. Notice the edge of pavement you just created extends past the existing edge of pavement at the intersection. Use the Arcs Tool to draw a 25’ arc on each side of the new centerline that connects the existing edge of pavement (gray line) to the new edge of pavement (blue line).

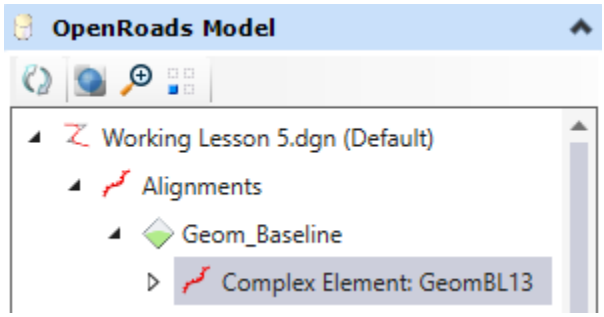


Important Notes:

- AASHTO Article 9.6.1.4 states, *“Curb radii should accommodate the expected amount and type of traffic and allow for appropriate turning speeds at intersections. A curb radius of 15 ft is commonly used for the intersection of a residential street with another residential street, collector, or arterial, while a curb radius of 25 ft is commonly used for the intersection of arterial streets or at locations that are truck or bus routes”.*
- AASHTO further states, *“In freight corridors, larger curb radii will be needed where turns to access freight destinations are anticipated. The turning paths of design vehicles can be evaluated in CAD software to assess the compatibility of selected curb return radii with specific design vehicles”.*

Task 3: Generating a Horizontal Alignment Report

1. From the OpenRoads Model panel in the Explorer, right click on Complex Element: GeomBL13, then select Horizontal Geometry Report.



2. Submit your report, as well as answers to questions 1 through 7 along with your *Lesson2.dgn* file.