

Learning Objectives

Monday, February 26, 2024 1:48 PM

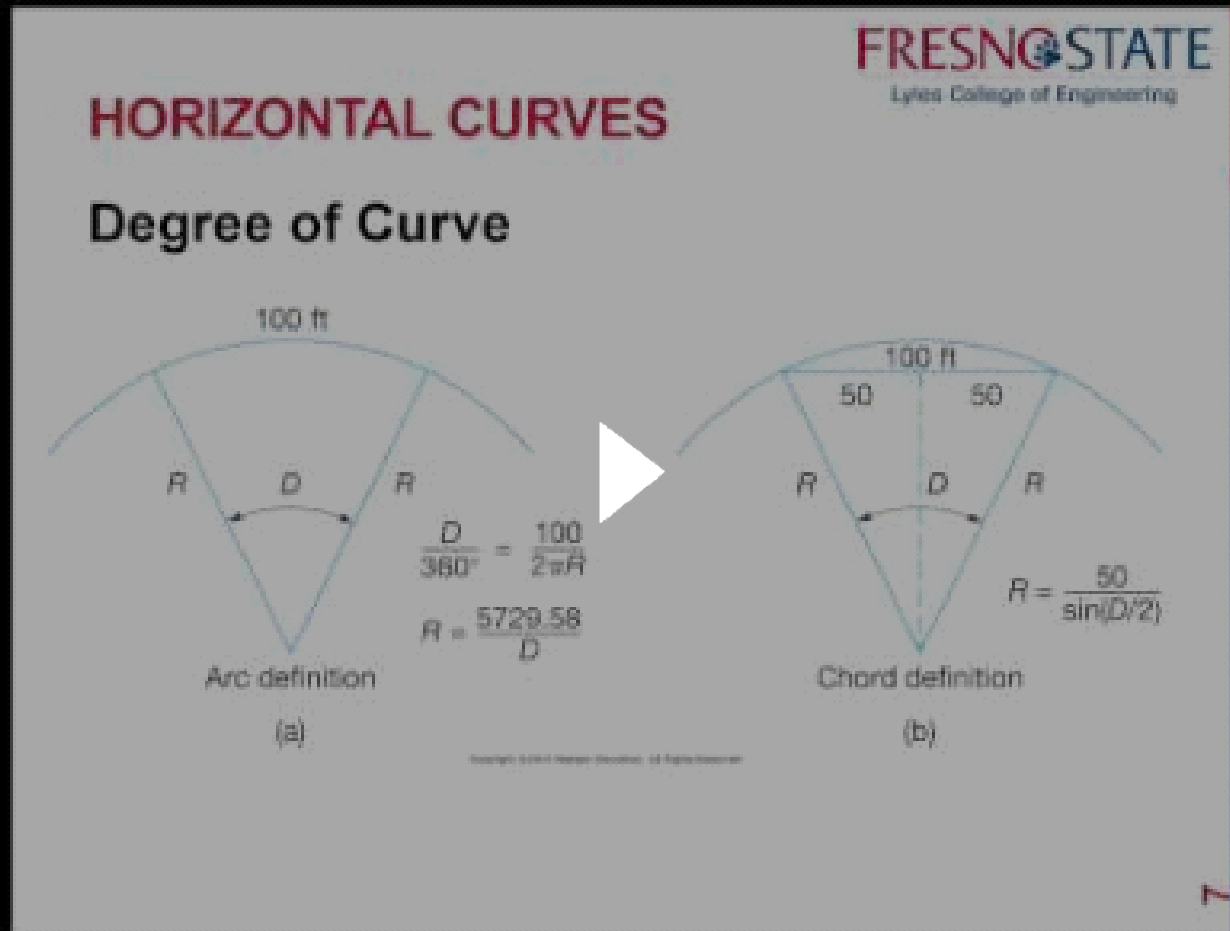
The workbooks used for L8 to L12 are found in the files folder of Canvas. Lecture 8 will use Workbook 5. The drawings used are found in <https://my.civil.utah.edu/~bartlett/CVEEN%201400/Drawings/>

1. Finish Exercise 1 – **Creating an Alignment** with the Alignment Layout Tools from Workbook 5 - AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_1 Exercise 1 _Lastname_Firstname.pdf. Upload this file to Canvas.
2. Finish Exercise 2 –**Adding Free Curves and Spirals** to an Alignment from Workbook 5 - AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_1 Exercise 2 _Lastname_Firstname.pdf. Upload this file to Canvas.
3. Finish Exercise 3 –**Adding Floating Curves** to an Alignment from Workbook 5 - AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_1 Exercise 3 _Lastname_Firstname.pdf. Upload this file to Canvas.
4. Finish Exercise 4 –**Editing the Layout Parameter Values** of an Alignment from Workbook 5 - AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_1 Exercise 4 _Lastname_Firstname.pd. Upload this file to Canvas.
5. Finish Exercise 5 –**Grip Editing an Alignment** from Workbook 5 -AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_1 Exercise 5 _Lastname_Firstname.pdf. Upload this file to Canvas.
6. Finish Exercise 6 –**Applying a Mask to an Alignment** from Workbook 5 - AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_5 Exercise 6 _Lastname_Firstname.pdf. Upload this file to Canvas.
7. Finish Exercise 7 – **Creating Offset Alignments** in Workbook 5 -AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_6A Exercise 7 _Lastname_Firstname.pdf. Upload this file to Canvas.
8. Finish Exercise 8 – **Editing and Offset Alignment** in Workbook 5 -AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_6A Exercise 8 _Lastname_Firstname.pdf. Upload this file to Canvas.
- 9.. Finish Exercise 9 – **Adding a Widening** to an Offset Alignment in Workbook 5 - AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_6A Exercise 9 _Lastname_Firstname.pdf. Upload this file to Canvas.
10. Finish Exercise 10 – **Editing an Offset Widening** in Workbook 5 -AutoCad_Civil_3D_Surface tutorial file. Save the file from this exercise to Align_6A Exercise 10 _Lastname_Firstname.pdf. Upload this file to Canvas.

Introduction to Horizontal Curves - Degree of Curves

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Horizontal Curves



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Introduction to Horizontal Curves - Formulas

Horizontal curve Formulas

HORIZONTAL CURVES

Station locations of points on any curve are based upon the stationing of the curve's PI

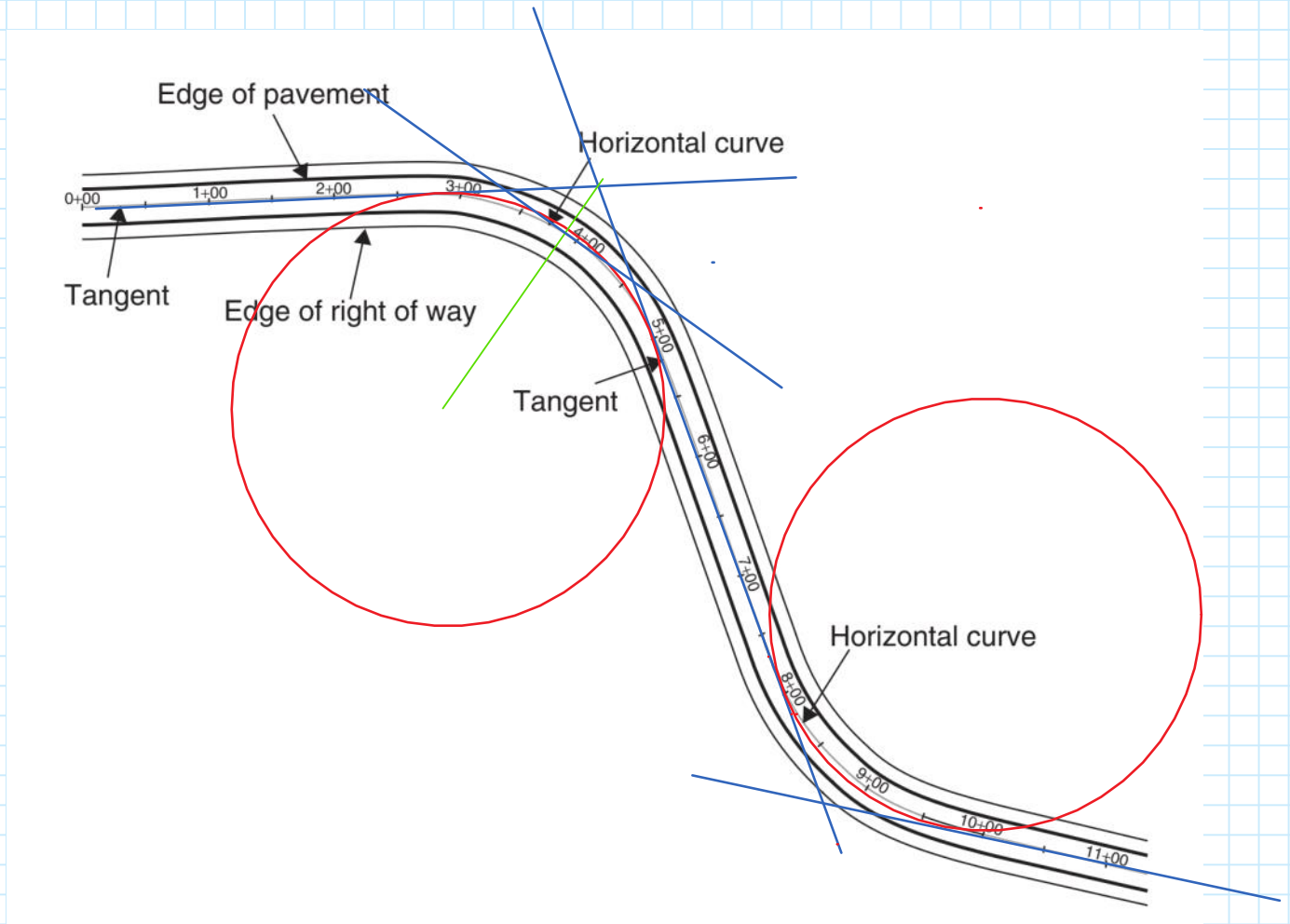
PT back = station of PT along curve
PT ahead = station of PT along Tangents

The diagram illustrates a horizontal curve with a central point of intersection (PI). The curve is defined by two tangents meeting at the PI. Key points on the curve include the Point of Beginning (PB), Point of Curvature (PC), Point of Tangency (PT), and Point of Intersection (PI). The diagram shows the relationship between the stationing of the PI and the stationing of the PT, with labels for 'PT back' and 'PT ahead' indicating the distance from the PI to the PT along the tangents. A red arrow points from the text 'Station locations of points on any curve are based upon the stationing of the curve's PI' to the diagram.

Roadway Geometry - Alignment in Plan View

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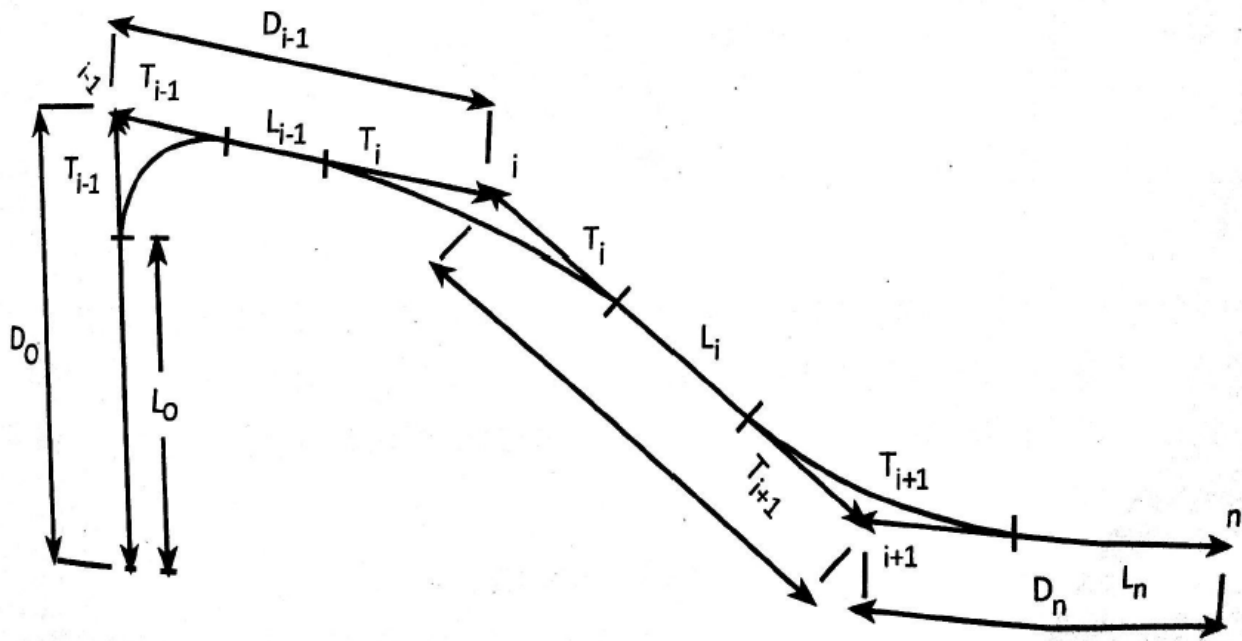


For design of vertical and horizontal curves, see
<https://knowledge4civil.wordpress.com/page/101/>

Roadway Geometry - Tangents

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Tangents may be defined as the straight lines obtained by joining two successive points of intersections of the two straight traverse lines along the road route. Net length of tangents in between two curves is obtained by deducing tangents to the curves at adjacent deviation points or intersection points.

Net length of tangent of the first or last line

$$L_i = D_i - T_i \text{ or, } L_i = D_i - T_{i-1}$$

And for intermediate line

$$L_i = - (T_i + T_{i+1})$$

D_i = Distance between IPs


T_i = Tangent length of i curve

T_{i+1} = Tangent length of curve next to i curve

(from WordPress.com)

[Engineering Stationing](#)

Scott Peterson



STATIONING

Specifies the relative position of any point along a reference line

- US survey Foot – 1 station = 100.00'
 - If I begin at 0.00' and measure 200.00' along the reference line, I am at station 2+00.00
 - If I measure an additional 45.67' (total distance of 245.67'), I will now be at station 2+45.67

Handwritten notes in red:
0 + 0 2 + 00 2 + 45.67

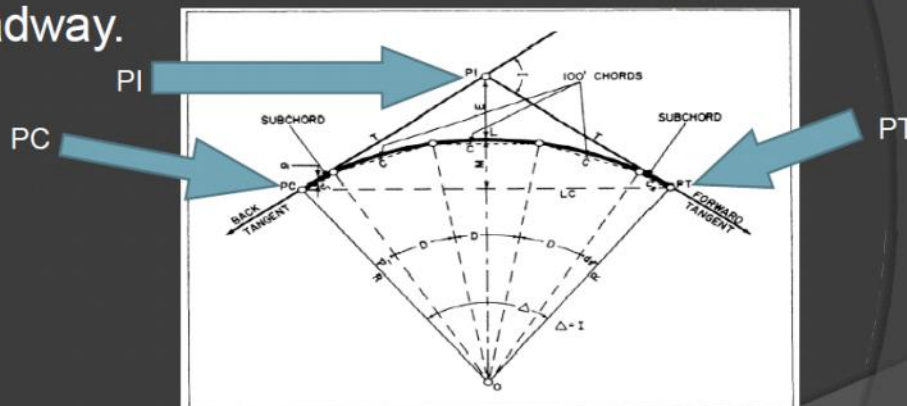
Why are Horizontal Curves Needed?

- Necessary for gradual change in direction when a direct point of intersection is not feasible
- Ex. Highways, Interstates, high speed roads with constant flow of traffic



What is a Horizontal Curve?

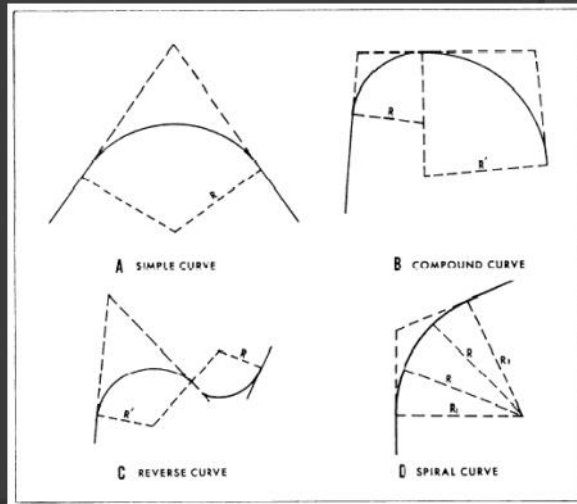
- Provides a transition between two tangent lengths of roadway.



- PC (Point of Curvature at beginning of curve)
- PI (Point of Intersection of tangents)
- PT (Point of Tangency at end of curve)

Types of Curves

- Simple Curve
- Compound Curve
- Reverse Curve
- Spiral Curve



Guidelines to Horizontal Curves

- A Policy on Geometric Design of Highways and Streets
 - Horizontal Alignment (pg.131-234) Considerations
 - Radius
 - Design Speed
 - Side Friction Factor
 - Superelevation
 - Runoff
 - Runout

Equation on pg. 133



Design Considerations

- Safe
- Economically Practical
- For the most part, **Design Speed** is used as the overall design control
- **Radius**



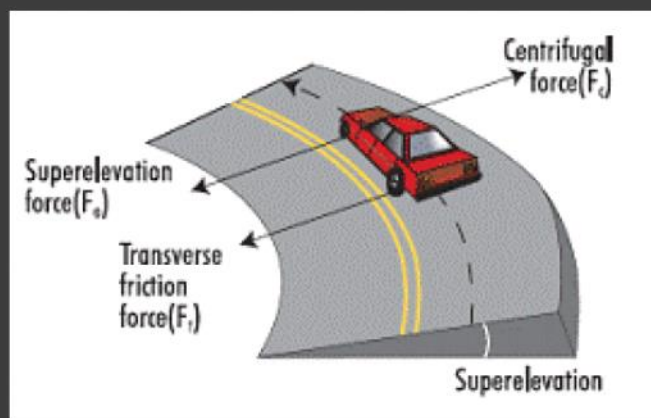
Parameters

- Design of roadway curves should be based on an appropriate relationship between design speed and curvature and on their joint relationships with superelevation and side friction



Superelevation

- Super elevation is tilting the roadway to help offset centripetal forces developed as the vehicle goes around a curve. Along with friction, they are what keeps a vehicle from going off the road.
- Must be done gradually over a distance without noticeable reduction in speed or safety



Superelevation

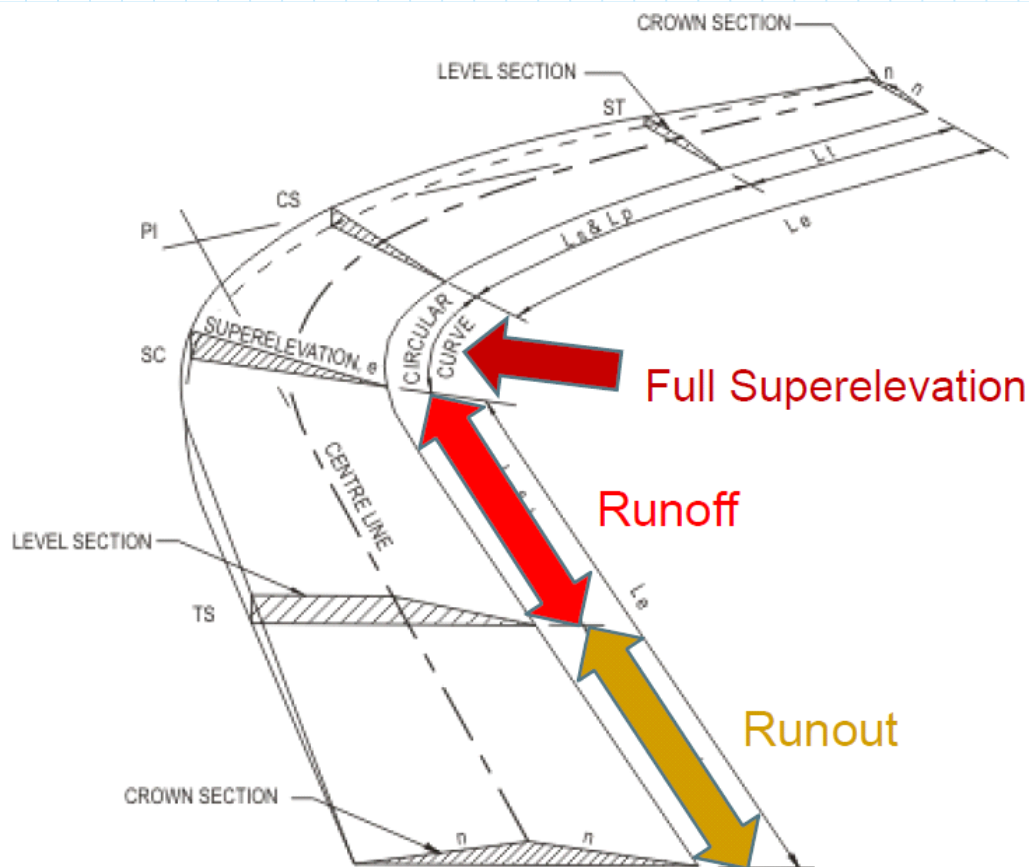
- ⦿ Practical upper limits – 6% (NDDOT)
 - Climate
 - Water
 - Ice
 - Terrain conditions
 - Flat
 - Mountainous
 - Adjacent land use (rural or urban)
 - Frequency of slow moving vehicles
 - Tractors, Etc.

Methods of Attaining Superelevation

- ⦿ Revolve traveled way with normal cross slopes about the centerline profile
- ⦿ Revolve traveled way with normal cross slope about the inside-edge profile
- ⦿ Revolve traveled way with normal cross slope about the outside-edge profile
- ⦿ Revolve traveled way with straight cross slope about the outside edge profile

Superelevation Transitions

- Consists of Runoff and Tangent Runout sections
- Runoff**: length of roadway needed to accomplish a change in outside lane cross slope from zero to full
- Runout**: length of roadway needed to accomplish a change in outside lane cross slope from normal rate to zero



Runoff

- For appearance and comfort, the length of superelevation runoff should be based on a maximum acceptable difference between the longitudinal grades of the axis of rotation and the edge of pavement
- Proper runoff design can be attained through the exclusive use of the maximum relative gradient.

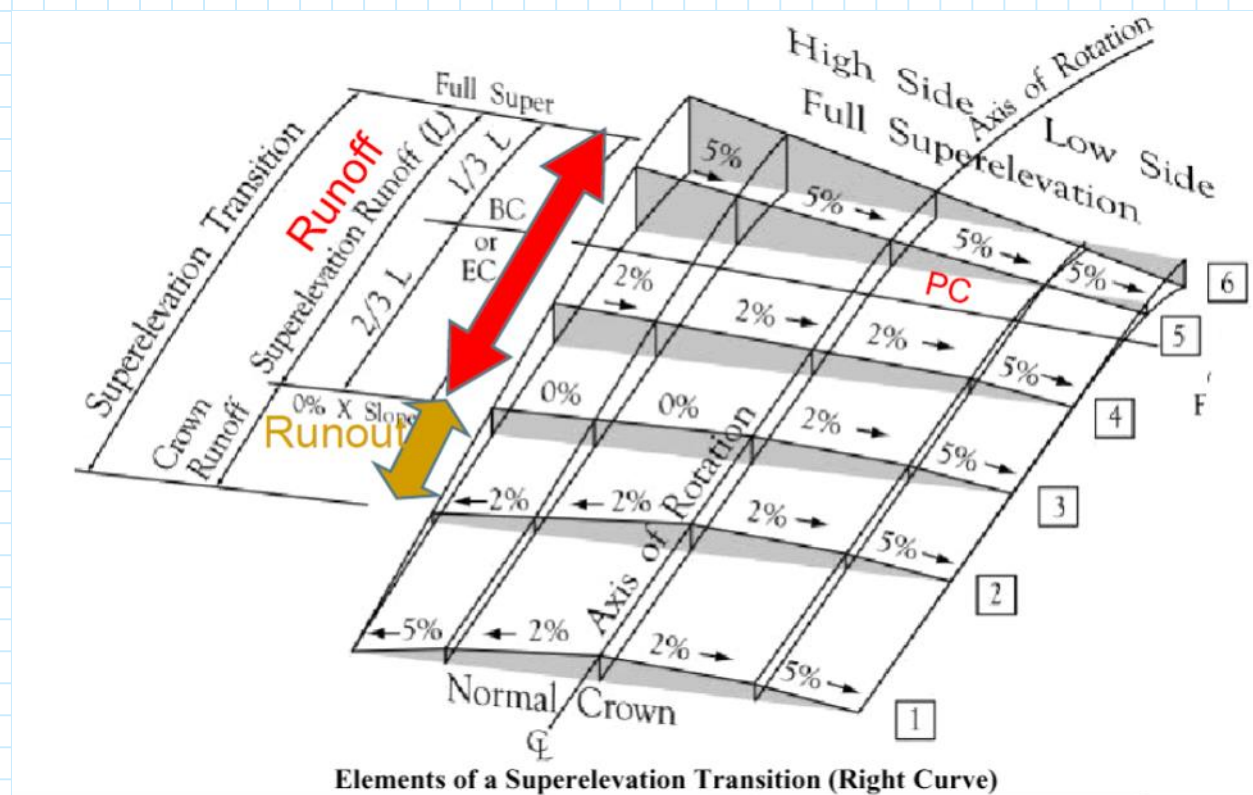
Runoff

- Locating a portion of the runoff on the tangent, in advance of the PC, is preferable, since this tends to minimize the peak lateral acceleration and resulting side friction demand.
- For non-spiral curves, the NDDOT places $\frac{2}{3}$ of the runoff on the **tangent**, and $\frac{1}{3}$ of the runoff on the **curve**.

Superelevation Transition

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$$L = \frac{(wN_1)e_d * (b_w)}{G}$$

- Equation for minimum length of superelevation runoff
- Where w = width of one traffic lane (ft)
 N = number of lanes rotated
 e = design superelevation rate (%)
 b = adjustment factor for # of lanes
 G = max relative gradient (%)

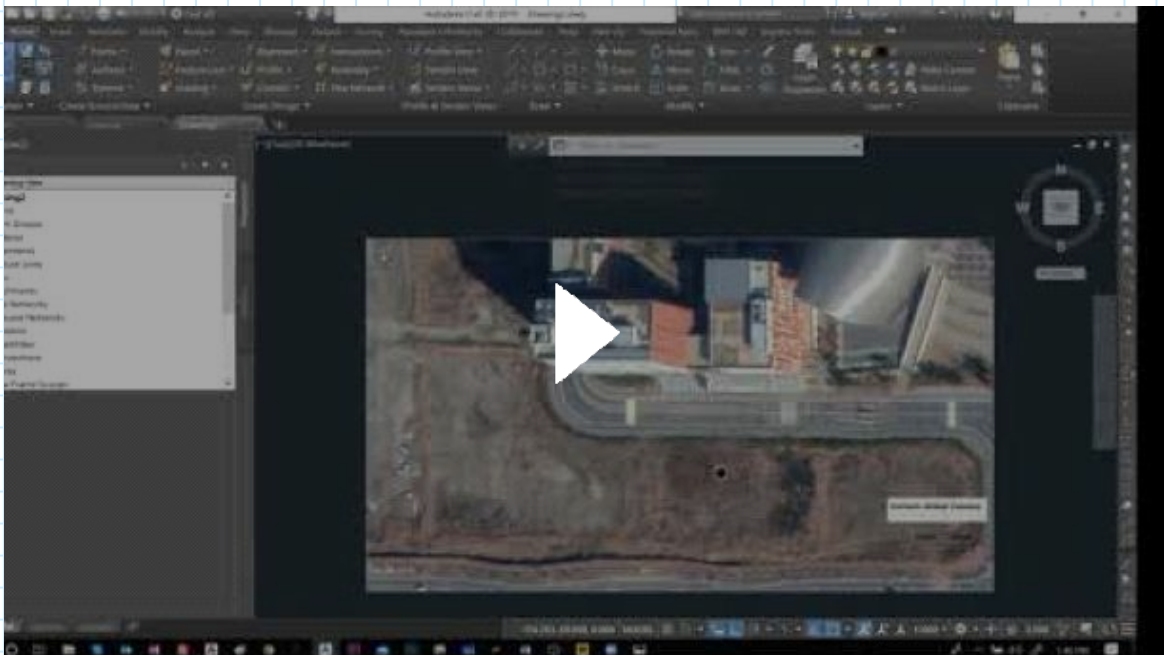
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Optional - Creating Alignment

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CVEEN 1400 Horizontal Curve and Stakeout



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Optional - Creating Alignment (cont.)

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Horizontal Curve Creation and Stakeout Instructions

- Create New Layer
- Name New layer Photo
- Select New Layer
- Attach/Incheon Global Campus Lot.jpg/open
- OK
- Select insertion point and insert
- Draw line on the 100 ft scale in photo
- Select line
- Hold down shift key
- Select photo
- Select end of line to make a hot grip (turns) red
- Press space bar 3 times
- Specify scale factor: select R for reference in command box
- Select one end of line
- Select other end of line
- Specify new length = 30.48 (100 feet = 30.48 meters)

Creating alignment from regular lines

- Home/Alignment/Create Alignment from Objects/Select both lines/Enter
- Alignment Direction (Reverse)
- Create Alignment Box Appears
 - Set Default Radius to 60.96 m (200 ft)
 - Enter
 - Alignment appears on screen



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Optional - Modify Alignment Stationing and Points

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Changing Station on Alignment

- Select alignment
- Right Click
- Edit Alignment Labels
- Major Station/Increment/50
- Minor Station/Increment/10
- Type: Major Stations
- ADD>>
- Type: Geometry Points
- ADD>>
- Apply

Creating Cogo Points at Beginning Point, BP, Point of Curvature PC, Point of Tangency PT, and End Point EP: on Alignment at Stations

- Prospector/Alignments/Centerline Alignments/Alignment - (1) (Click on this Alignment)
- Home/Points/Create Points - Alignment/At Alignment Geometry/
- The Create Points Box Appears with Select Alignment in Command Box (Ignore this box for now)
- Select Alignment (Hover over until it turns white), then Click
- Command Box asks for Starting Station <0+000.000>, we do not want to change this, strike {Enter}
- Command Box asks for Ending Station <0+308.55>, we do not want to change this, strike {Enter}
- Enter a point description (leave blank)
- Specify a point elevation (.) (leave blank)
- Repeat this several times for point description and specify point

Creating Additional Cogo Points on Alignment at Stations

- Home/Points/Create Points - Alignment/Measure Alignment
- The Create Points Box Appears with Select Alignment in Command Box
- Select Alignment
- Starting Station 0+00
- Ending Station 0+324.25
- Enter a point description (leave blank)
- Specify a point elevation (0)
- Repeat this several times



Optional - Stakeout Alignment Report

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Modifying Alignment Stationing So That Station of PC and PI can be seen

- Select Alignment
- Double Click until light blue squares appear
- Right Click
- Edit Alignment Labels
- Change Major Station increment to 100 m
- Apply
- Change Minor Station increment to 50 m
- Apply
- Type: Geometry points
- Add
- In pop-up submenu leave at default
- Ok
- Apply
- OK
- Home/Toolspace/ToolBox/Reports Manger/Alignment/Stakeout Alignment Report
- Dialog box appears
- Make sure that alignment is selected on list of alignments
- Select Angle type as Turned + (+ = clockwise)
- Select Point Occupied (use PI - Point of Intersection)
- Select Backsight Point (Point 1 point at Sta. 0+000.00)
- Station Increment = 20 m
- Station offset = 0
- Save report to: Pick folder where you want to save the report
- Create Report as CivilReport.html
- After saving, check the report to see that it is correct
- Save the drawing as IGCCurve .dwg



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Optional - Stakeout Report Continued

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Stakeout Alignment Report

Client:

Client
Client Company
Address 1
Date: 5/3/2020 3:48:00 PM

Prepared by:

Preparer
Your Company Name
123 Main Street

Alignment Name: Alignment - (1)

Description:

Station Range: Start: 0+000.00, End: 0+308.55

Stakeout Angle Type: TurnedPlus

Occupied Pt: Northing 1,707.3973, Easting 4,971.5753

BackSight Pt: Northing 1,707.3973, Easting 5,150.2290

Station Increment: 20.00

Offset: 0.00

Station	Turned.Right	Distance	Coordinate.N	Coordinate.E
0+000.00	0.0000 (d)	178.654m	1,707.3973m	5,150.2290m
0+020.00	0.0000 (d)	158.654m	1,707.3973m	5,130.2290m
0+040.00	0.0000 (d)	138.654m	1,707.3973m	5,110.2290m
0+060.00	0.0000 (d)	118.654m	1,707.3973m	5,090.2290m
0+080.00	0.0000 (d)	98.654m	1,707.3973m	5,070.2290m
0+100.00	0.0000 (d)	78.654m	1,707.3973m	5,050.2290m
0+120.00	0.0000 (d)	58.654m	1,707.3973m	5,030.2290m
0+140.00	0.0000 (d)	38.654m	1,707.3973m	5,010.2290m
0+160.00	0.0000 (d)	18.654m	1,707.3973m	4,990.2290m
0+180.00	180.9117 (d)	1.346m	1,707.4187m	4,970.2293m
0+200.00	194.4566 (d)	21.120m	1,712.6700m	4,951.1235m
0+220.00	208.0015 (d)	39.720m	1,726.0456m	4,936.5052m
0+240.00	221.5463 (d)	56.110m	1,744.6108m	4,929.5816m
0+260.00	233.5168 (d)	71.143m	1,764.5985m	4,929.2746m
0+280.00	241.2804 (d)	88.031m	1,784.5985m	4,929.2746m
0+300.00	246.4819 (d)	106.007m	1,804.5985m	4,929.2746m
0+308.55	248.1986 (d)	113.898m	1,813.1491m	4,929.2746m



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Blank

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$$6:100 = X/45$$



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