Introduction to Horizontal Curves

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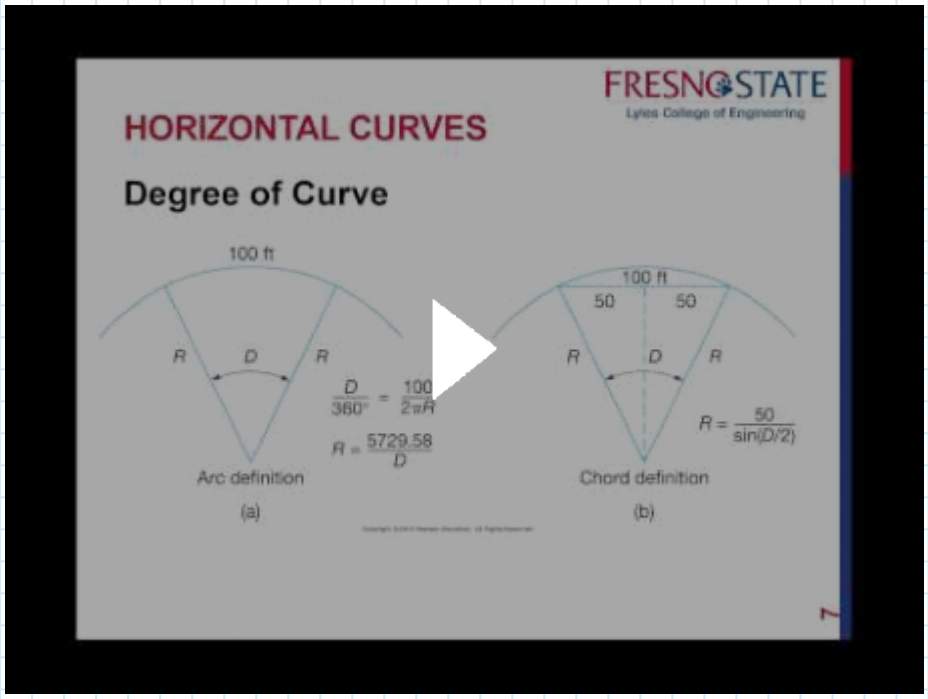
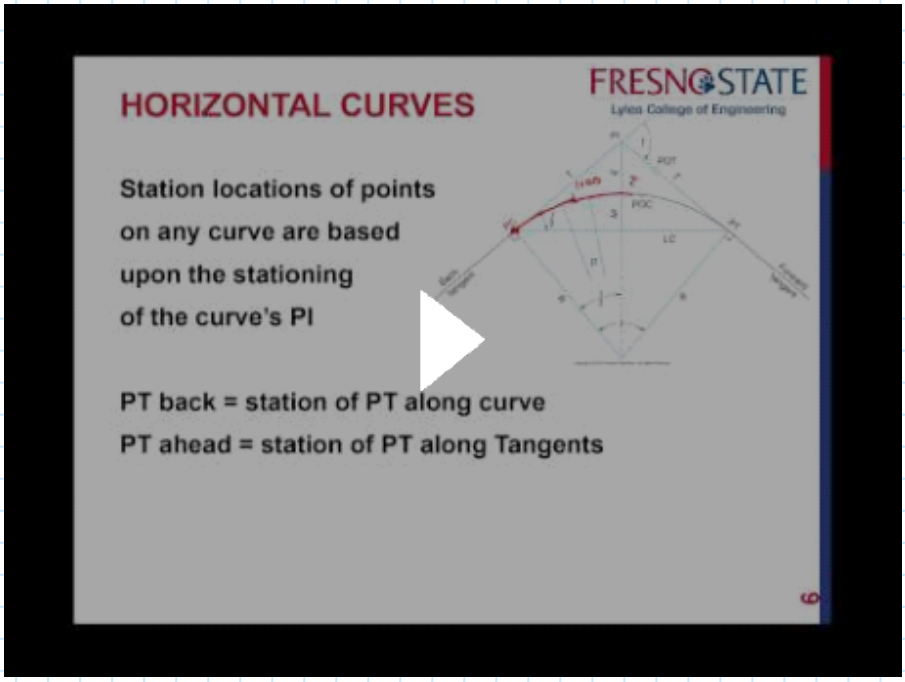
Horizontal Curves



Horizontal curve Formulas



Roadway Geometry - Alignment in Plan View

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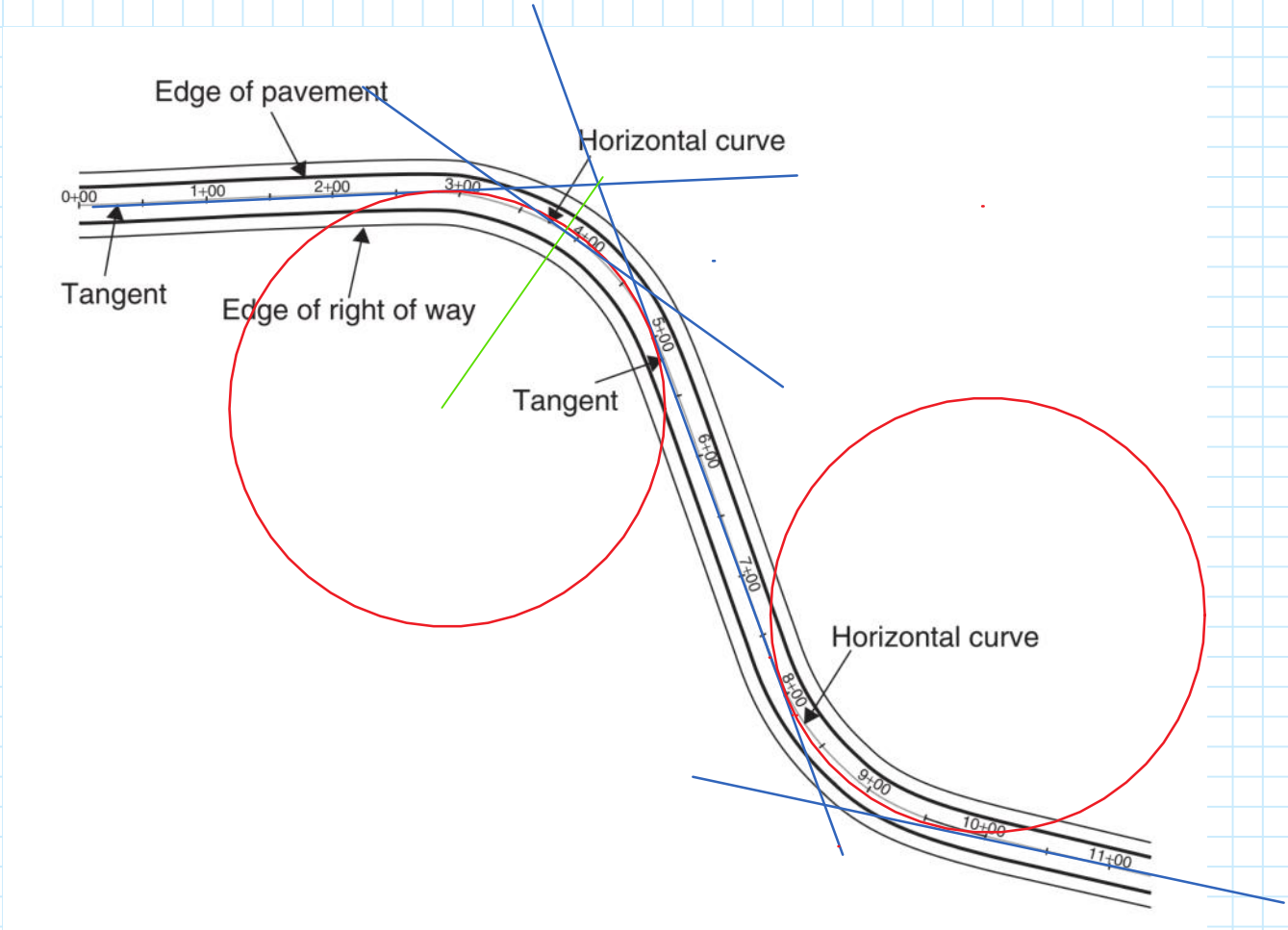

For design of vertical and horizontal curves, see
https://knowledge4civil.wordpress.com/page/101/

Roadway Geometry - Tangents

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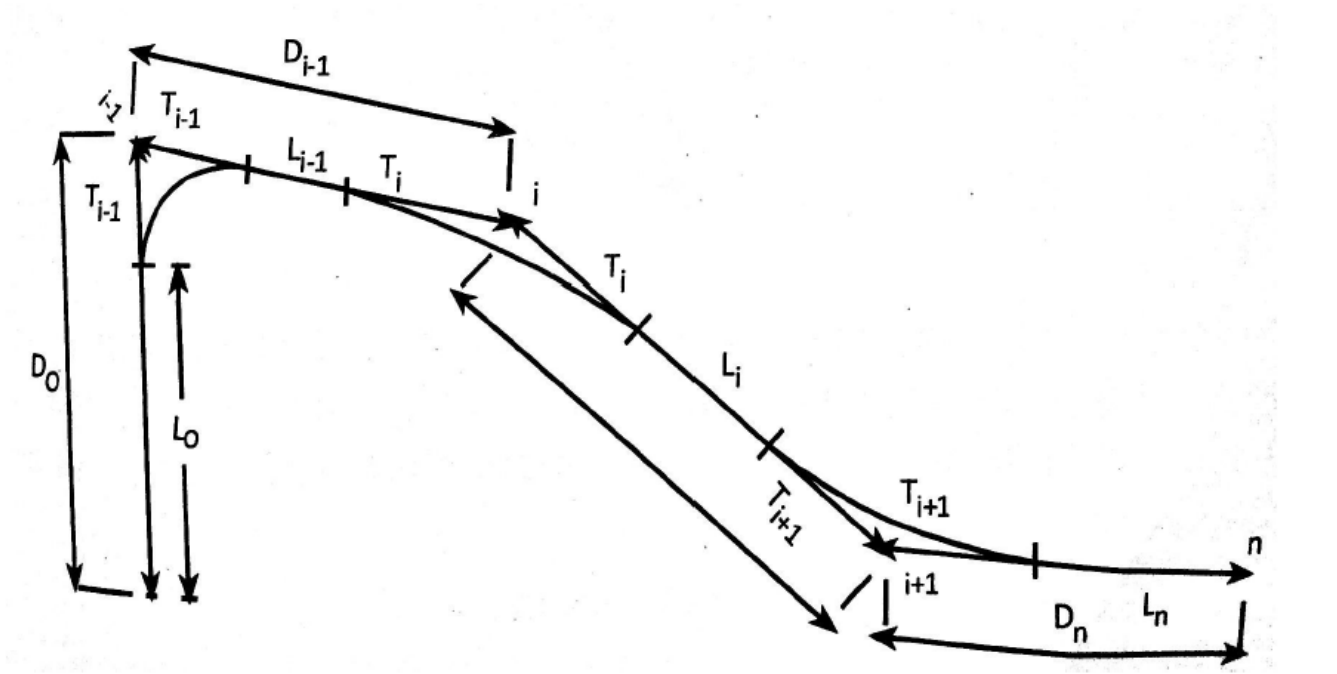

Tangents may be defined as the straight lines obtained by joining two successive points of intersections of the two straight traverse lines along the road route. Net length of tangents in between two curves is obtained by deducing tangents to the curves at adjacent deviation points or intersection points.

Net length of tangent of the first or last line
Li = Di - Ti or, Li = Di - Ti-1

And for intermediate line
Li = - (Ti + Ti+1)

Di = Distance between IPs

Ti = Tangent length of i curve

Ti+1 = Tangent length of curve next to i curve

(from WordPress.com)

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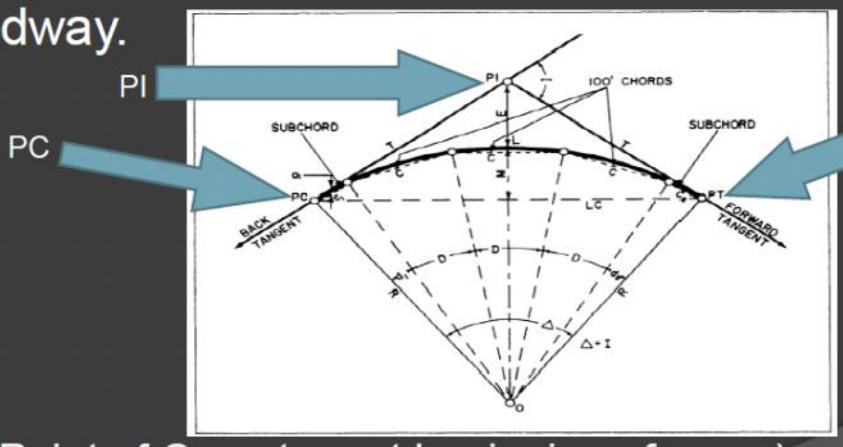
Why are Horizontal Curves Needed?

- 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

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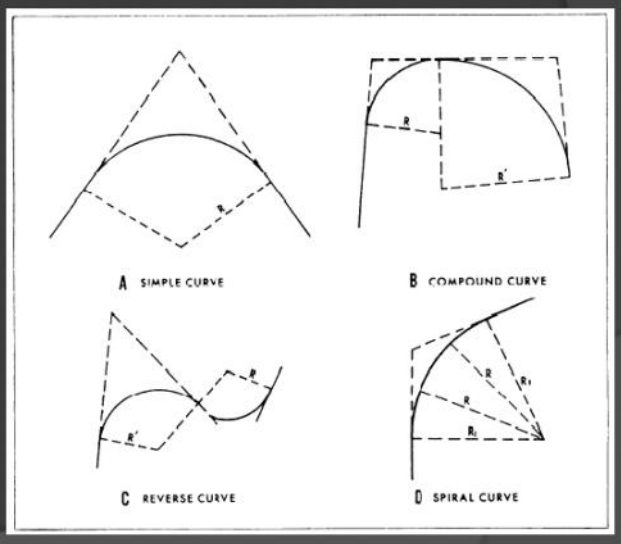
Types of Curves

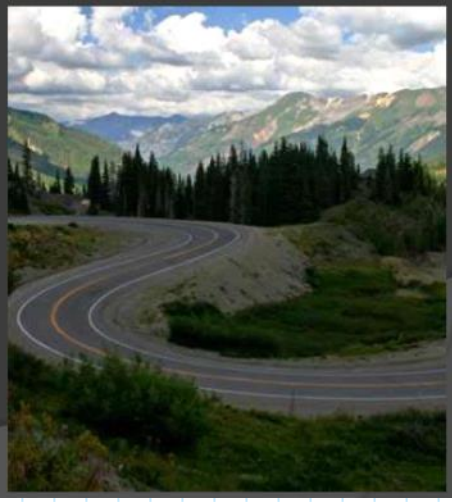
- Simple Curve
- Compound Curve
- Reverse Curve
- Spiral Curve



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

Superelevations

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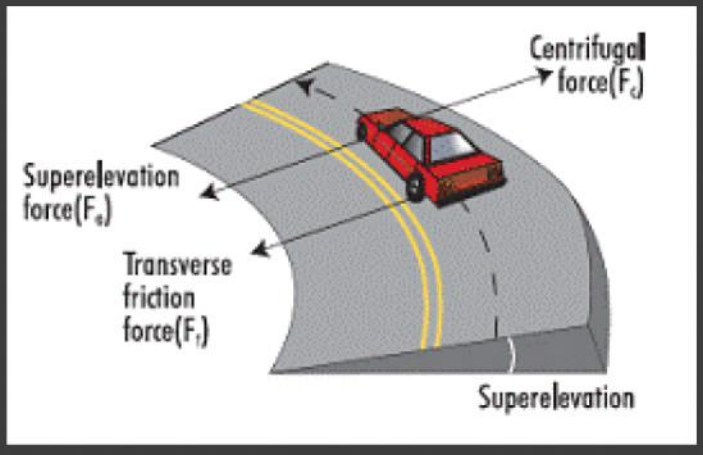
Superelevation

- 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

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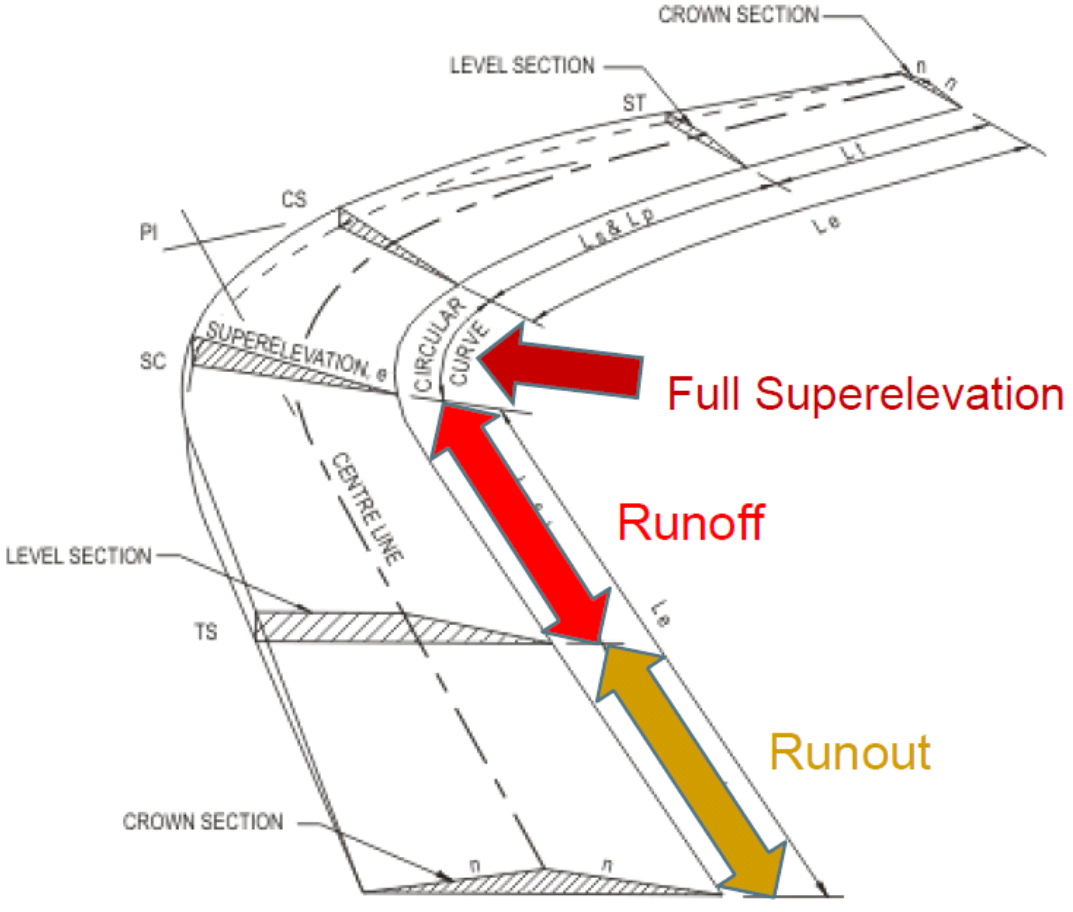
Superelevation Transitions

- 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 2/3 of the runoff on the tangent, and 1/3 of the runoff on the curve.

Superelevation Transition

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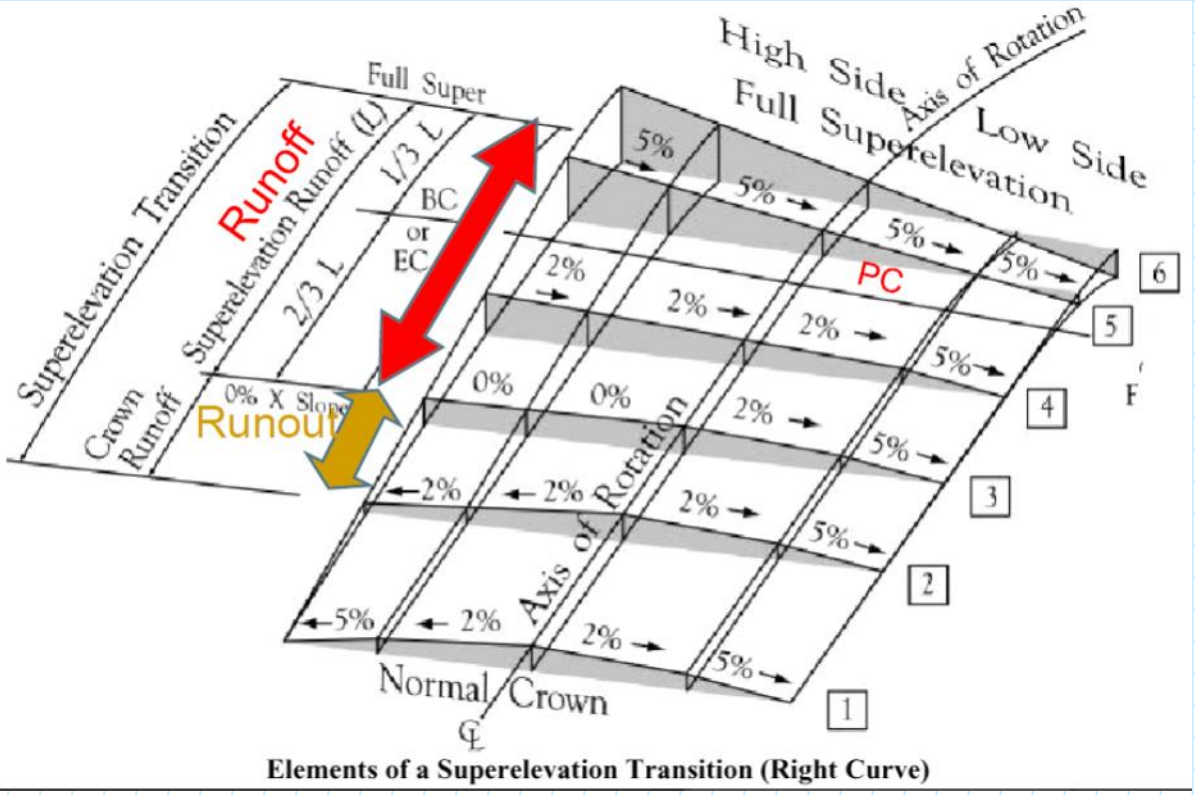

Elements of a Superelevation Transition (Right Curve)

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

- 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 (%)

Creating Alignment

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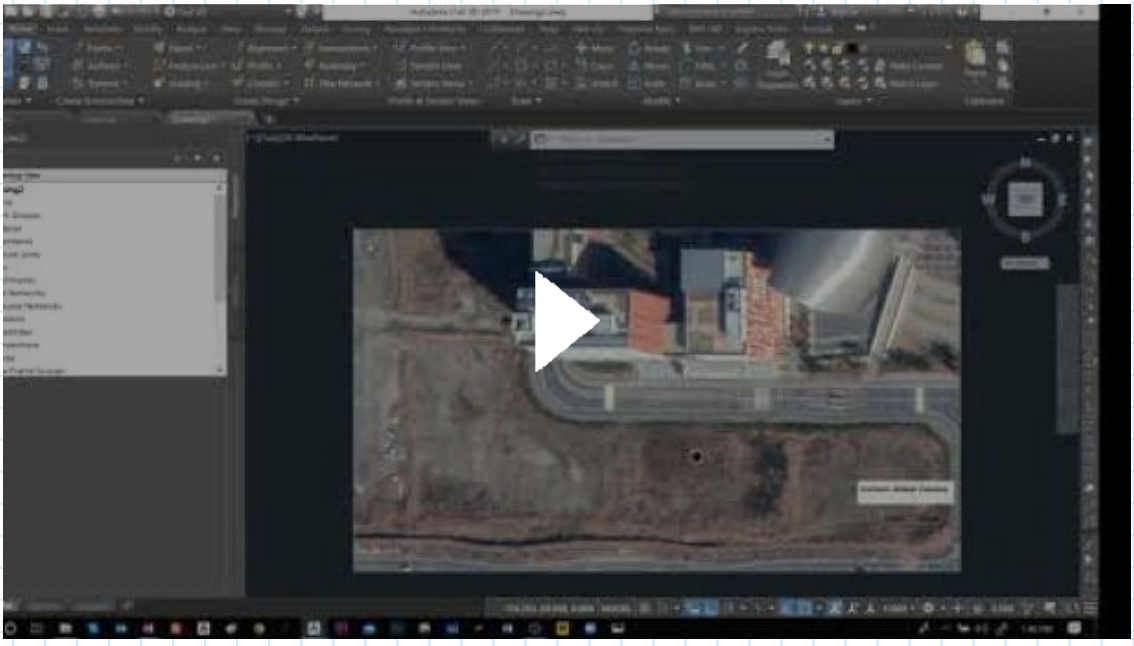
[CVEEN 1400 Horizontal Curve and Stakeout]



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

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

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

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

Blank

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