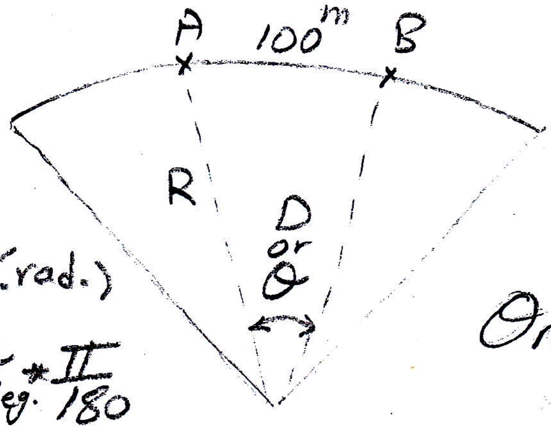
Degree of curve

Two defination of degree of curve :

1. Arc defination (θ or D) : is an angle subtended at the center of the curve by an arc 100^m Long.



Arc length $A \to B = 100^m$

Arc length $A \to B = R * \theta(\text{rad.})$

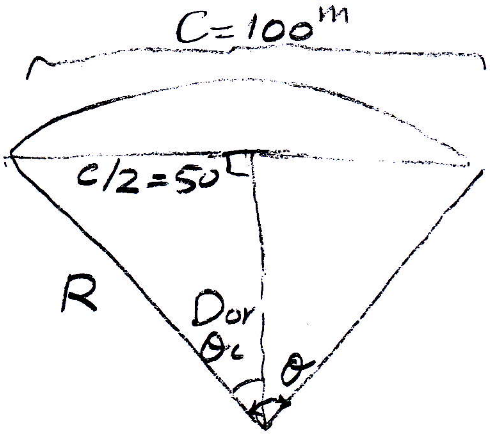
$\theta_{rad.} = \theta_{deg.} * \frac{\pi}{180^\circ}$

$\therefore$ Arc length $A \to B = R * \theta_{deg.} * \frac{\pi}{180}$

$$\therefore R = \frac{\text{Arc length } A \to B * 180^\circ}{\theta_{deg.} * \pi}$$

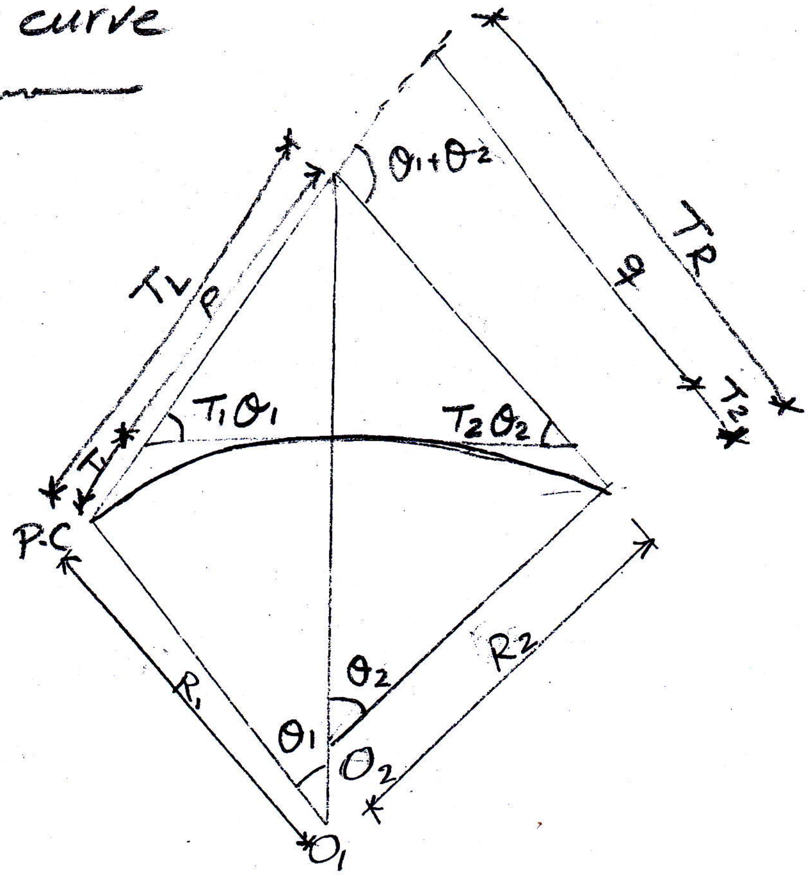
$$R = \frac{100 * 180^\circ}{\theta_{deg.} * \pi} \simeq \frac{5730}{\theta_{deg.}}$$

2. Chord defination (θ_c or D) : is an angle subtended at the center of the curve by chord having a length of 100 m.

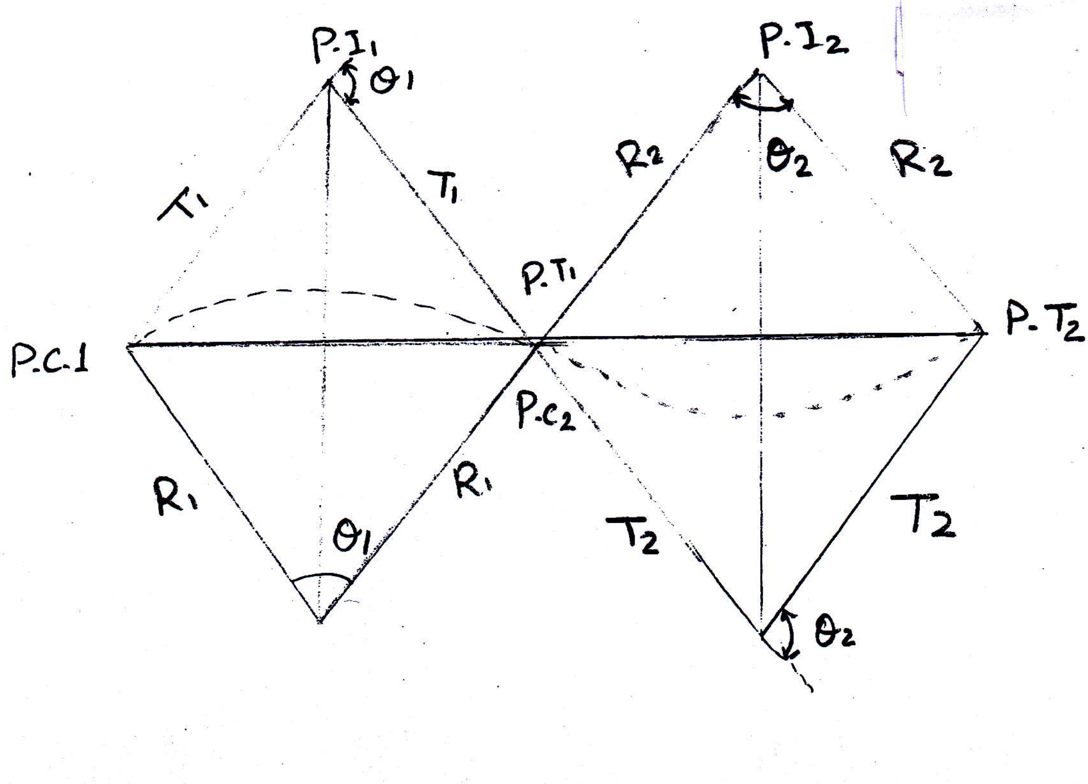


$$\sin \theta_c = \frac{50}{R}$$

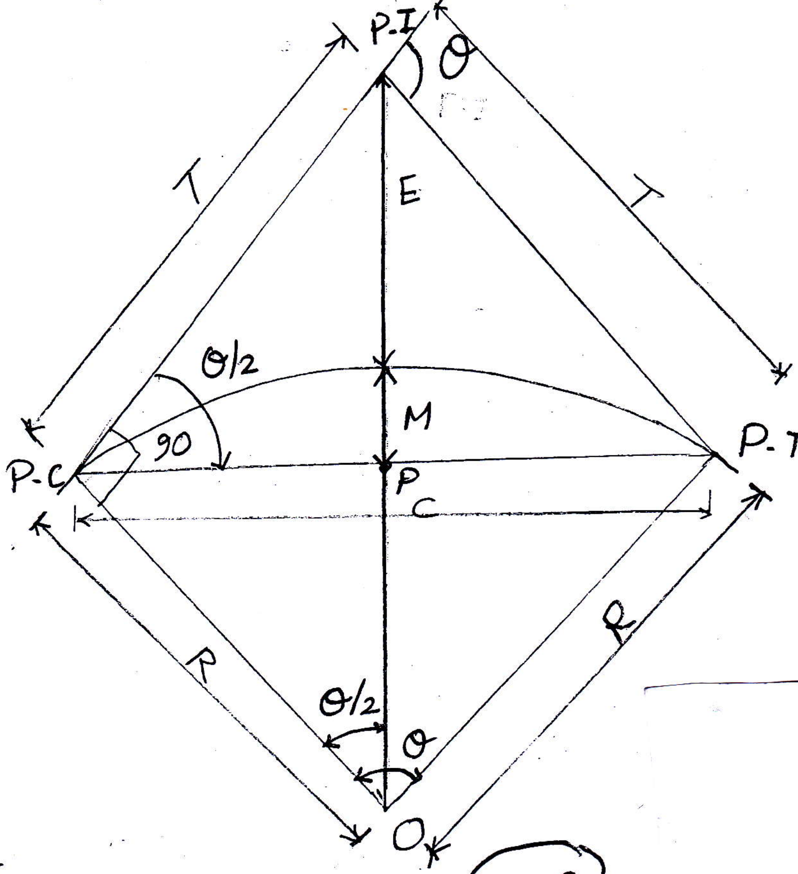
Compound circular curve



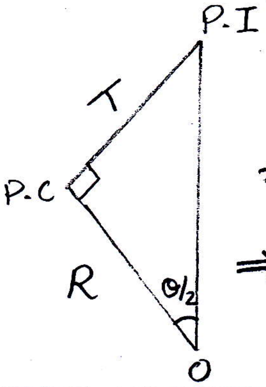
Reverse circular curve



To compute T, C, L, E, M



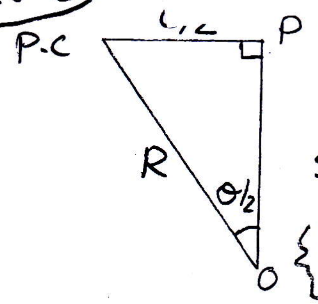
1. T



$$\tan\frac{\theta}{2} = \frac{T}{R}$$

$$\Rightarrow \boxed{T = R\tan\frac{\theta}{2}}$$

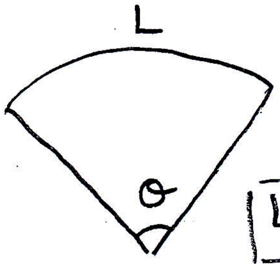
2. C



$$\sin\frac{\theta}{2} = \frac{C/2}{R}$$

$$\boxed{C = 2R\sin\frac{\theta}{2}}$$

3. L

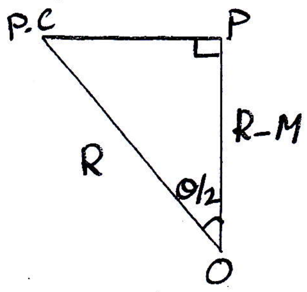


$$\frac{L}{\theta} = \frac{2\pi R}{360}$$

$$\boxed{L = \frac{\pi R\theta}{180}}$$

$$\text{OR } L = R * \theta_{deg} * \frac{\pi}{180}$$

$$\boxed{L = \frac{R\theta_{deg} * \pi}{180}}$$



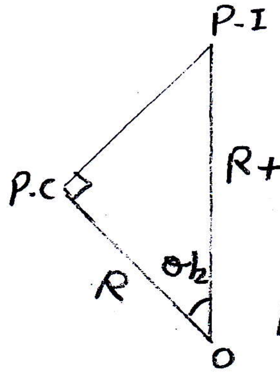
$$\cos\frac{\theta}{2} = \frac{R-M}{R}$$

$$R\cos\frac{\theta}{2} = R-M$$

$$M = R - R\cos\frac{\theta}{2}$$

$$\boxed{M = R(1-\cos\frac{\theta}{2})}$$

4. E



$$\cos\frac{\theta}{2} = \frac{R}{R+E}$$

$$R\cos\frac{\theta}{2} + E\cos\frac{\theta}{2} = R$$

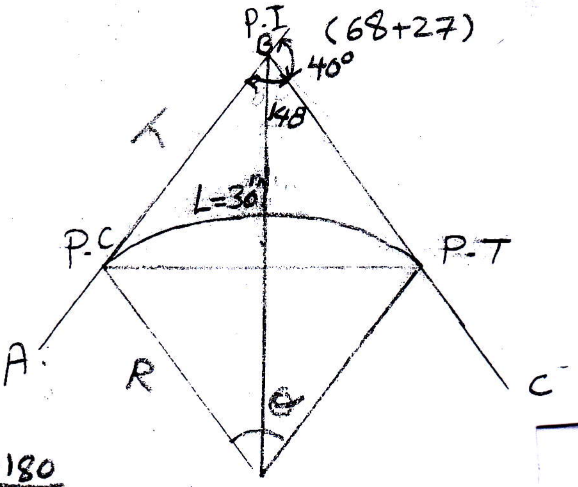
$$E = R\left(\frac{1}{\cos\theta/2} - 1\right)$$

$$\boxed{E = R(\sec\frac{\theta}{2} - 1)}$$

station P.C = station P.I − T

station P.T = station P.C + L

Example 1) The lines AB and BC intersected at station (68+27) with intersection angle 140° to connect these lines by simple circular curve. The degree of curve is 5° according to the arc defination. Find the radius of curve and distance of the tangent points (P.C, P.T) if the length of arc was 30m at this degree of curve, and 1 station equal to 100m.



$\theta = 180° - 140° = 40°$

sol.

$\because L = \frac{\pi R \theta}{180} \Rightarrow R = \frac{L * 180}{\pi \theta}$

$R = \frac{30 * 180}{\pi 5} = 343.77 \, m$

$T = R \tan \frac{\theta}{2} = 343.77 \tan 20° = 125.12 \, m$

$L = \frac{\pi R \theta}{180} = \frac{\pi * 343.77 * 40°}{180°} = 240 \, m$

sta. P.C = sta. P.I − T
= (68+27) − (1+25.12) = 67+1.88

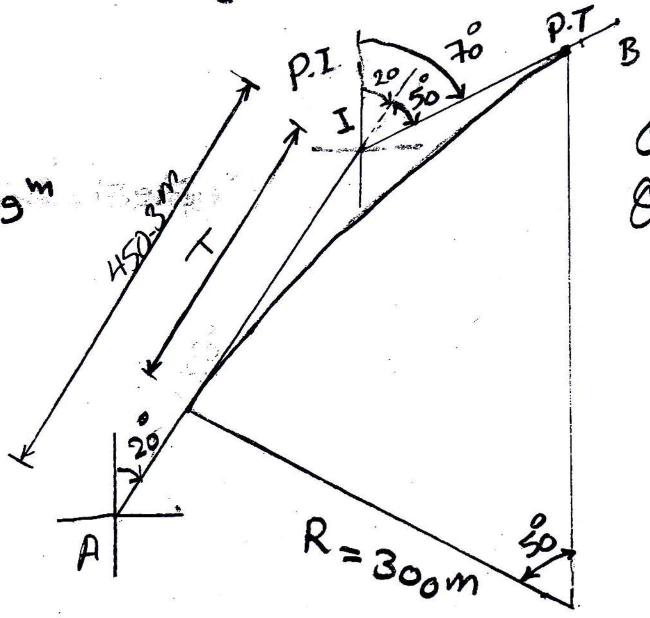
sta. P.T = sta. P.C + L
= (67+1.88) + (2+40) = 69+41.88

Example 2) The table below illustrated the straights information:

line	W.C.B	length (m)
AI	20°	450.30
IB	70°	275.00

if the radius of the curve joining the straights is 300 m. Compute the tangent points (P.C and P.T).

Sol.



θ = deflection angle

$\theta = 70^\circ - 20^\circ$

$= 50^\circ$

$T = R\tan\frac{\theta}{2} = 300\tan 25^\circ = 139.89^m$

$P.C = P.I - T$

$= 450.30 - 139.89$

$= 310.41\ m$

$L = \frac{\pi R\theta}{180} = \frac{\pi * 300 * 50}{180}$

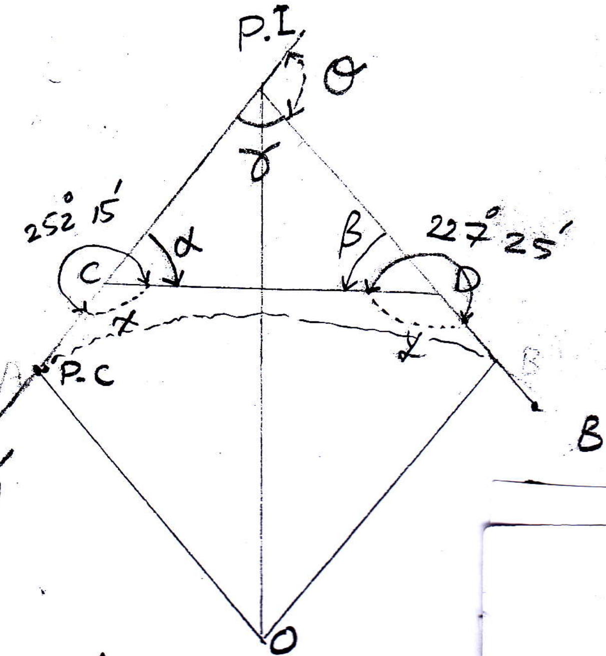
$= 261.80\ m$

$P.T = P.C + L$

$= 310.41 + 261.80 = 572.21\ m$

Example 3) If the exterior angles of traverse ACDB were as follows:

the angle ACD was $252^\circ 15'$, while the angle CDB was $227^\circ 25'$. The length of sides AC and CD were 559.28 m and 256.50 m, respectively. Compute the tangent point (P.C) if the straights are to connected by a 300 m radius of curve. The figure below shown the traverse



$x = 360^\circ - 252^\circ 15' = 107^\circ 45'$

$\alpha = 180^\circ - 107^\circ 45' = 72^\circ 15'$

$y = 360^\circ - 227^\circ 25' = 132^\circ 35'$

$\beta = 180^\circ - 132^\circ 35' = 47^\circ 25'$

$\gamma = 180^\circ - 47^\circ 25' - 72^\circ 15' = 60^\circ 20'$

θ (deflection angle) $= 180^\circ - 60^\circ 20'$

$= 119^\circ 40'$

$$\frac{l_{P.I \to C}}{\sin \beta} = \frac{l_{C \to D}}{\sin \gamma} \Rightarrow \frac{l_{P.I \to C}}{\sin 47^\circ 25'} = \frac{256.50}{\sin 60^\circ 20'}$$

$$\Rightarrow l_{P.I \to C} = 217.349 \text{ m}$$

$$P.I = AC + l_{P.I \to C} = 559.280 + 217.349 = 776.629 \text{ m}$$

$$T = R \tan \frac{\theta}{2} = 300 \tan \frac{119^\circ 40'}{2} = 516.142 \text{ m}$$

$$P.C = P.I - T = 776.629 - 516.142 = 260.487 \text{ m}$$