Paper: Advanced Engineering Survey

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Q.No.1A: Two tangents . . . .

. . . . External distance.

Solution:-

$\theta = 5$ chainage $= 7+31.3$

$R = 5729.58/D$.

$= \frac{5729.58}{5} = 1145.91$ ft.

Tangent length $= BT_1 = BT_2 = R\tan\left(\frac{\theta}{2}\right)$.

$BT_1 = BT_2 = 1145.91 \times \tan\left(\frac{14^\circ 13' 23''}{2}\right)$

$BT_1 = BT_2 = 142.96$ ft.

Length of curve $= L = \frac{\pi R \theta}{180^\circ}$

$L = \frac{3.14 \times 1145.91 \times 14^\circ.13'.23''}{180^\circ}$

$L = 284.31$ ft.

Chainage Intersection point B $= 7+31.3$

Minus tangent length. BT $= -(1+42.96)$

Chainage of T_1 $= 5+88.4$

Plus L $= 2+84.3$

Chainage T_2 $= 8 \cdot 72.7$

Solution ②:

length of chord = $L = 2R\sin\left(\frac{\theta}{2}\right)$.

$$L = 2 \times 1145.91 \times \sin\left(\frac{14^\circ 13' 23''}{2}\right)$$

$$\boxed{L = 283.78\ ft.}$$

Solution 3:-

Mid ordinate and External distance.

Mid ordinate = $EF = R\left(1 - \cos\left(\frac{\theta}{2}\right)\right)$.

$$EF = 1145.91\left(1 - \cos\left(\frac{14^\circ 13' 23''}{2}\right)\right)$$

$$= 1145.91\,(1 - 0.99)$$

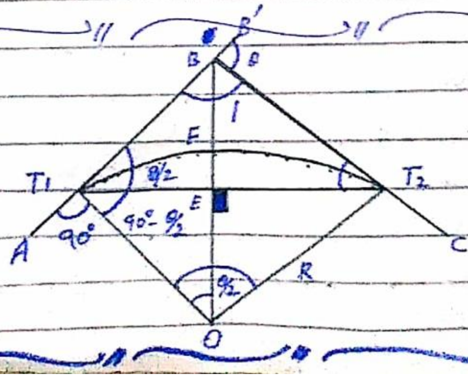
$$= 1145.91\,(0.007).$$

$$\boxed{EF = 8.021\ ft}$$

External Distance $BF = R\left(\sec\left(\frac{\theta}{2}\right) - 1\right)$

$$BF = 1145.91\left(\frac{1}{\cos\left(\frac{14^\circ 13' 23''}{2}\right)} - 1\right)$$

$$\boxed{BF = 8.88\ ft.}$$



Q1:B: find area from the .... and so on.

Chainage (m)	0	30	60	90	120	150
offset (m)	7.313	7.313+3	7.313+4	7.313-2	7.313-4	7.313-3
	7.313	10.313	11.313	5.313	3.313	4.313
	a	a_1	a_2	a_3	a_4	a_5

Given data!

$b = 30.$ $ID = 7.313.$

Solution:-

$$\text{Area} = \frac{b}{3}\left(a_0 + a_4 + 2a_2 + 4a_1 + 4a_3 + \left(\frac{a_4 + a_5}{2}\right) \times b\right.$$

$$\Rightarrow \frac{30}{3}\left(7.313 + 3.313 + 2(11.313) + 4(10.313) + 4(5.313) + \left(\frac{3.313 + 4.313}{2}\right) \times 30.\right.$$

$$\Rightarrow \frac{30}{3}(10.626 + 22.626 + 41.525 + 21.252) + \left(\frac{7.626}{2}\right) \times 30.$$

$$\Rightarrow \frac{30}{3}(95.75) + 3.813 \times 30.$$

$$\Rightarrow 10(95.75) + 114.39.$$

$$\Rightarrow 957.5 + 114.39$$

$$\boxed{\text{Area} = 1071.89}$$

Q2: A circular curve of ....

.... being 20m.

Given data!

Radius = ID − 200 = 7313 − 200 = 7113.

ϕ = 20°40′

Chainage of B = ID − 400 = 7313 − 400 = 6913.

Peg interval = 20m.

Required:

Deflection Angle = ?

Solution:-

Tangent length = $BT_1 = BT_2 = R \tan \frac{\phi}{2}$.

$= 7113 \tan \frac{20°40'}{2}$

$= 1296.92$ m.

Length of curve = $L = \frac{\pi R \times \phi}{180°}$

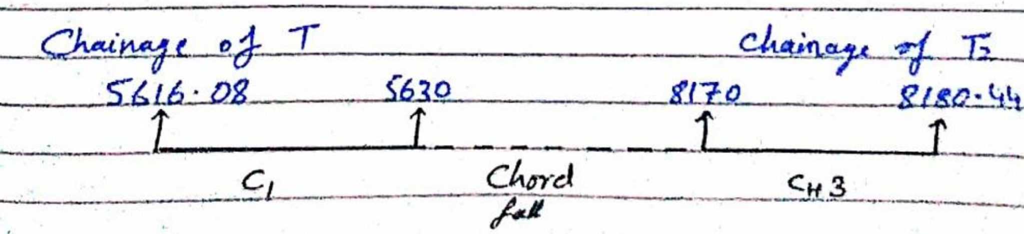
$L = \frac{3.14 \times 7113 \times 20°40'}{180°} = 2564.36$ m.

Chainage of T_1 = chainage of $B - BT_1$.

$6913 - 1296.92 = 5616.08$ m.

Chainage of T_2 = Chainage of $T_1 + L$.

$5616.08 + 2564.36 = 8180.44$ m.



$$\delta_1 = \frac{1718.91 \times C_1}{60 \times R} = \frac{1718.91 \times 13.92}{60 \times 7113} = 0^\circ 3' 21.83''$$

$$\delta_2 - \delta_{12}\ \frac{1718.91 \times C_2}{60 \times R} = \frac{1718.91 \times 20}{60 \times 7113} = 0^\circ 4' 49.99''$$

$$\delta_3 = \frac{1718.91 \times C_{43}}{60 \times R} = \frac{1718.91 \times 10.44}{60 \times 7113} = 0^\circ 2' 31.37''$$

Deflection Angle:

$$\Delta_1 = \delta_1 = 0^\circ 3' 21.83''.$$

$$\Delta_2 = \Delta_1 + \delta_2 = 0^\circ 8' 11.82''$$

$$\Delta_3 = \Delta_2 + \delta_3 = 0^\circ 13' 1.81''$$

$$\Delta_4 = \Delta_3 + \delta_4 = 0^\circ 17' 51.8''$$

$$\Delta_5 = \Delta_4 + \delta_5 = 0^\circ 22' 41.79''$$

$$\Delta_6 = \Delta_5 + \delta_6 = 0^\circ 27' 31.78''$$

$$\Delta_7 = \Delta_6 + \delta_7 = 0^\circ 32' 21.77''$$

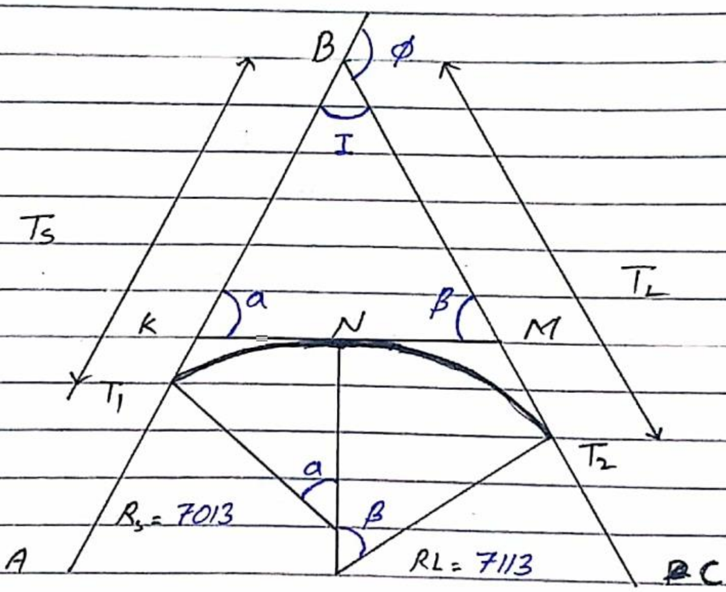
$$\Delta_8 = \Delta_7 + \delta_8 = 0^\circ 37' 11.76''$$

$$\Delta_9 = \Delta_8 + \delta_9 = 0^\circ 42' 1.75''$$

$$\Delta_{10} = \Delta_9 + \delta_{10} = 0^\circ 46' 51.74''$$

and so on.....

Q3: Two tangent AB & BC - - - - - - - -
- - - - - - - - - - - - - (ID-400)m.



Solution:-

$$a = 180^\circ - 130^\circ = 50^\circ$$
$$\beta = 180^\circ - 140^\circ = 40^\circ$$
$$\phi = a + \beta = 90^\circ$$
$$I = 180^\circ - 90^\circ = 90^\circ$$

$$KT_1 = KN = R_L \tan\left(\frac{\beta}{2}\right) = 7113 \tan\left(\frac{40}{2}\right)$$

$$KT_1 = KN = 2588.92\,m.$$

$$MN = MT_2 = R_s \tan\left(\frac{a}{2}\right) = 7013 \tan\left(\frac{50}{2}\right)$$

$$MN = MT_2 = 3270.21\,m.$$

$$KM = MT_2 + MN = 2588.92 + 3270.21$$

$$KM = 5859.13\,m.$$

find ΔBKM, by Sin Rule.

$$\frac{BK}{\sin\beta} = \frac{M}{\sin(I)}.$$

$$BK = \frac{MK \sin\beta}{\sin I} = \frac{5859.13 \times \sin 40^\circ}{\sin(90^\circ)} = 3766.17\ m.$$

$$BM = \frac{MK \sin a}{\sin I} = \frac{5859.13 \times \sin 50^\circ}{\sin(90^\circ)} = 4488.35\ m$$

$T_L = KT_1 + BK = 2588.92 + 3766.17 = 6355.09m$

$T_s = MT_2 + BM = 3270.21 + 4488.35 = 7758.56\ m.$

$$L_L = \frac{\pi R_L \beta}{180^\circ} = \frac{3.14 \times 7113 \times 40^\circ}{180^\circ} = 4963.29\ m.$$

$$L_s = \frac{\pi R_s a}{180^\circ} = \frac{3.14 \times 7013 \times 50^\circ}{180^\circ} = 6116.89\ m.$$

Chainage of intersection point $= 7313 - 400 = 6913m$

Minus Ts $= 6913 - 7758.66 = 854.56m$

Chainage of T_1 $= 854.56m$

Plus $Ls = 854.56 + 6116.89 = 6971.45\ m$

Chainage of Compound curvature $N = 6971.45m$.

Pluse L_L $= 6971.45 + 4963.29$

Chainage of T_2 $= 11934.74.m.$