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 Subject: Advance Engineering Survey.  
 Semester: 10th  
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Q19 Two tangent meet at a chainage of 7547 ft with the  $\Delta$  deflection angle of ~~14°13'23"~~ 14°13'23". Degree of curve 5°. Calculate i) Chainage at the beginning and end of the curve.

(ii) Length of long chord.

(iii) Mid ordinate & External distance.

Solution.

Tangent meet at chainage = 7547 ft  
 Deflection angle = 14°13'23"  
 Degree of curve = 5°

Solution

$$D = 5^\circ$$

$$R = 5729.58 / D$$

$$= \frac{5729.58}{5^\circ} = 1145.91 \text{ ft.}$$

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

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

$$BT_1 = BT_2 = 142.96 \text{ ft}$$

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

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

$$L = 284.45 \text{ ft}$$

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$$\begin{aligned} \text{Chainage of intersection point} &= 7547 \\ \text{Minus tangent length} &= 142.96 \text{ ft} \\ \text{Chainage of } T_1 &= 7404.04 \text{ ft} \\ \text{Plus } L &= 284.45 \text{ ft} \\ \text{Chainage of } T_2 &= 7688.49 \text{ ft} \end{aligned}$$

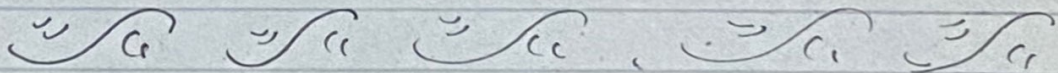
$$\begin{aligned} \text{length of chord} &= 2R \sin(\phi/2) \\ &= 2 \times 1145.91 \times \sin\left(\frac{14^\circ 13' 23''}{2}\right) \\ &= 283.72 \text{ ft} \end{aligned}$$

$$\begin{aligned} \text{Mid ordinate} &= R(1 - \cos(\phi/2)) \\ &= 1145.91 \left(1 - \cos\left(\frac{14^\circ 13' 23''}{2}\right)\right) \\ &= 8.81 \text{ ft} \end{aligned}$$

$$\text{External Distance} = R(\sec(\phi/2) - 1)$$

$$\begin{aligned} &= 1145.91 \left(\sec\left(\frac{14^\circ 13' 23''}{2}\right) - 1\right) \end{aligned}$$

$$= 8.88 \text{ ft}$$



Q1B Find the area from the data obtained from chain survey as shown in table below

Chainage (m)	0	30	60	90	120	150
offset (m)	7.547	10.547	11.547	5.547	3.547	4.347

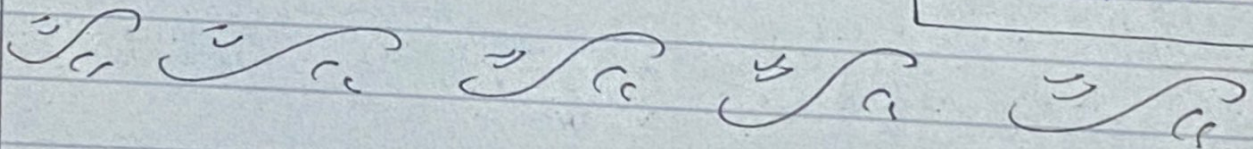
$$\begin{aligned} \text{offset} &= 6 \\ \text{intercept} &= 5 \\ \text{interval} &= 30 \end{aligned}$$

offset No	offset	Simpson Multiplier	Product.
1	7.547	1	7.547
2	10.547	4	42.188
3	11.547	2	23.094
4	5.547	4	22.184
5	3.547	1	3.547
			$\Sigma = 98.564$

$$\text{Area } (h_1 - h_5) = 30/3 \times 98.564 = 985.64$$

$$\text{Area } (h_5 - h_0) = 30/2 (3.547 + 4.547) = 121.41$$

$$\text{Total area} = 985.64 + 121.41 = 1107.05 \text{ m}^2$$



Q2 A circular curve of radius  $(10 = 7250) \text{ m}$  deflecting right through  $20^\circ 41'$  is to be set out b/w two straight lines having chainage of the point of intersection as  $(10 = 400) \text{ m}$ . Calculate all the data necessary for setting out the curve using deflection angle method, with peg interval being  $20 \text{ m}$ .

Q2. Solution. Given data.

$$\text{Circular radius} = 7547 - 7260 \\ = 287 \text{ m}$$

$$\text{Deflection angle} = 20^\circ 40'$$

Point of intersection

$$7547 - 5000 = 2547$$

$$\text{Interval} = 20 \text{ m}$$

Solution

$$R = 284 \times 2 = 568 \text{ m}$$

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

$$BT_1 = BT_2 = 568 \tan \frac{20^\circ 40'}{2}$$

$$BT_1 = BT_2 = 103.56 \text{ m}$$

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

$$= \frac{\pi \times 568 \times 20^\circ 40'}{180}$$

$$= 204.87 \text{ m}$$

$$\text{Chainage of point of intersection} = 2547 \text{ m}$$

$$\text{Minus tangent} = -103.56$$

$$\text{Chainage of } T_1 = 2443.44$$

$$\text{Plus } L = +204.87$$

$$\text{Chainage of } T_2 = 2648.31 \text{ m}$$

$$\text{Length of curve of 1st chord} = C_1 =$$

$$C_1 = 2460 - 2443.44$$

$$= 16.56 \text{ m}$$

$$C_2 = C_3 = C_4 = C_5 = C_6 = C_7 = C_8 = C_9 = C_{10} =$$

$$2648.40 - 2630$$

$$= 18.40 \text{ m}$$

By deflection method.

$$\delta_1 = \frac{1718.9 \times C_1}{60R} \text{ (degree)}$$

$$\delta_1 = \frac{1718.9 \times 16.56}{60 \times 568}$$

$$\delta_1 = 0^\circ 50' 6.86''$$

$$\delta_2 = \frac{1718.9 \times 20}{60 \times 568} \Rightarrow 1^\circ 0' 31.48''$$

$$\delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = \delta_{10}$$

$$\delta_{11} = \frac{1718.9 \times 18.40}{60 \times 568} \Rightarrow \delta_{11} = 0^\circ 55' 40.96''$$

Total deflection (tangential) angle for the chord is,

$$\Delta_1 = \delta_1 = 0^\circ 50' 6.86''$$

$$\Delta_2 = \delta_1 + \delta_2 = 0^\circ 50' 6.86'' + 1^\circ 0' 31.48''$$

$$\Delta_3 = 1^\circ 50' 38.34''$$

$$\Delta_4 = 2^\circ 51' 9.82''$$

$$\Delta_5 = 3^\circ 51' 41.3''$$

$$\Delta_6 = 4^\circ 52' 12.78''$$

$$\Delta_7 = 5^\circ 52' 44.26''$$

$$\Delta_8 = 6^\circ 53' 15.74''$$

$$\Delta_9 = 7^\circ 53' 47.22''$$

$$\Delta_{10} = 8^\circ 54' 18.7''$$

$$\Delta_{11} = 9^\circ 54' 50.18''$$

$$\Delta_{11} = 10^\circ 50' 31.34''$$

$$\text{check } \phi/2 = \frac{20^\circ 40'}{2}$$

$$\Rightarrow 10^\circ 20'$$

Q3 Two tangents AB & BC are intersecting by KM.

Solution

\* Given Data.

$$\Delta AKM = 130^\circ$$

$$\Delta KMC = 140^\circ$$

$$\text{1st arc radius} = 7547 - 300 = 7247 \text{ m}$$

$$\text{2nd arc radius} = 7547 - 200 = 7347 \text{ m}$$

$$\begin{aligned} \text{Chainage of intersection point} &= 7547 - 400 \\ &= 7147 \text{ m} \end{aligned}$$

\* Required.

Tangents Points = ?

Compound Curvature = ?

\* Solution.

$$\alpha = 180^\circ - 130^\circ = 50^\circ$$

$$\beta = 180^\circ - 140^\circ = 40^\circ$$

$$\phi = \alpha + \beta = 90^\circ$$

$$I = 180^\circ - \phi = 180^\circ - 90^\circ = 90^\circ$$

$$\begin{aligned} KT_1 = KN &= R_1 \tan(\alpha/2) \\ &= 7247 \tan(50^\circ/2) \end{aligned}$$

$$KT_1 = KN = 3379.33 \text{ m}$$

$$\begin{aligned} MN = MT_2 &= R_2 \tan(\beta/2) \\ &= 7347 \tan(40^\circ/2) \end{aligned}$$

$$MN = MT_2 = 2674.08 \text{ m}$$

$$KM = MT_2 + KT_1 = 3379.33 + 2674.08$$

$$KM = 6053.41 \text{ m}$$

Now

$$\frac{BK}{MK \sin \beta} = \frac{1}{\sin I}$$

$$BK = \frac{MK \sin \beta}{\sin I} = \frac{6053.41 \times \sin 40^\circ}{\sin 90^\circ} = 3891.05 \text{ m}$$

$$BM = \frac{MK \sin \alpha}{\sin I} = \frac{6053.41 \times \sin 50^\circ}{\sin 90^\circ} = 4637.18 \text{ m}$$

$$T_L = KT_1 + BK = 3379.33 + 3891.05 = 7270.38 \text{ m}$$

$$T_s = MT_2 + BM = 2674.08 + 4637.18 = 7311.26 \text{ m}$$

$$L_L = \frac{\pi R_L \alpha}{180} = \frac{\pi \times 7247 \times 50}{180} = 6324.20 \text{ m}$$

$$L_s = \frac{\pi R_s \beta}{180} = \frac{\pi \times 7347 \times 40}{180} = 5129.17 \text{ m}$$

Chainage of intersection point  
= 7147 m

Chainage of intersection point  $-T_L = -7270.38 \text{ m}$

Chainage of  $T_1 = -123.38 \text{ m}$

Plus  $L = +6324.26 \text{ m}$   
= 6200.88 m

Chainage of compound curvature (N)

Plus  $L_s = 5129.17 \text{ m}$

Chainage of  $T_2 = 11330.05 \text{ m}$

