Name : Jam Murad Ghani

ID : 7440

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Submitted To : Engr. Abdul Farhan

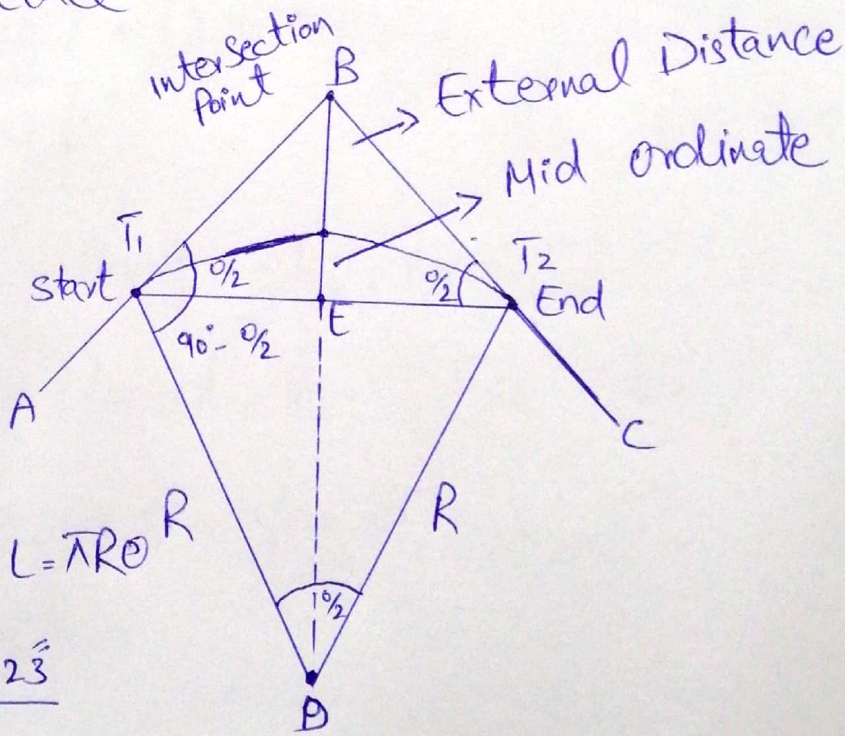
Iqra National University

Q No 1:

(Part a)

Two tangents meet at chainage of (ID = 7440) ft with deflection angle of $14^\circ 13' 23''$. Degree of curve is 5°.

Calculate: 1. Chainage at the begining and end of.
2. Length of long chord.
3. Mid ordinate & External distance.



Sol:- $D = 5^\circ$

$R = 5729.58/D$ (ft)

$R = 5729.58/5^\circ$

$R = 1145.92$ ft

Now:- Length of curve $= L = \pi R \Theta$

So; $L = \dfrac{3.14 \times 1145.92 \times 14^\circ 13' 23''}{180^\circ}$

$L = \dfrac{51177.04}{180}$ ft

$L = 284.32$ ft

① chainage at the begining and End of the curve.

chainage at the begining = T_1 = chainage of intersection Point B.
chainage of length ($B\bar{T}$).

$$T_1 = (74+40) - (1+42.90)$$

$$\boxed{T_1 = 72 + 97.1}$$

Now;

chainage at the end of the curve

$= T_2$ = chainage of T_1 + length of curve

$$\therefore T_2 = (72 + 97.1) + (2 + 84.32)$$

$$\boxed{T_2 = 75 + 81.42}$$

② Length of the long chord.

Length of long chord = $l = 2R\sin(\Delta/2)$

$$l = 2 \times 1145.92 \times \sin\frac{(14^\circ 13' 23'')}{2}$$

$$\boxed{l = 238.73 \text{ ft}}$$

(3) Mid ordinate and External Distance.

=> Mid ordinate:

Mid ordinate = EF = $R\ (1 - \cos(\Theta/2))$

$EF = 1145.92\ (1 - \cos(\frac{14°13'23''}{2}))$

$EF = 1145.92\ (1 - 0.992)$

$\boxed{EF = 9.167 ft}$

External Distance:

$BF = R = (\sec \Theta/2) - 1$

$BF = 1145.92\ (\sec(\frac{14°13'23''}{2}) - 1)$

$BF = 1145.92 \times (\frac{1}{\cos}(\frac{14°13'23''}{2}) - 1)$

$BF = 1145.92 \times (1.008 - 1)$

$BF = 1145.92 \times 0.008$

$\boxed{BF = 9.24 ft}$

Q.No: 1

(Part b)

Chainage (m)	0	30	60	90	120	150
Offset (m)	7.440	7.440+3 = 10.440	7.440+4 = 11.440	7.440-2 = 5.440	7.440-4 = 3.440	7.440-3 = 4.440
	O_1	O_2	O_3	O_4	O_5	O_6

Apply Simpson's Rule to calculate Area b/w 1st and 5th offsets and Then find 6th offset seperatly.

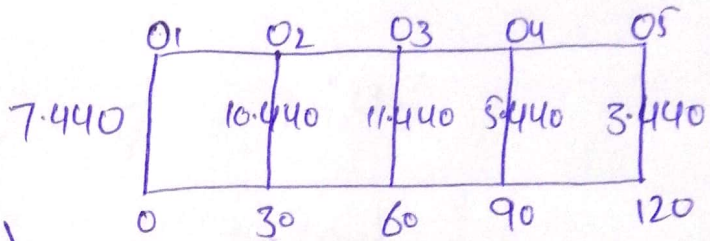
Offset No	offset	Simpsons Multiplier	Product
1	7.440	1	7.440
2	10.440	4	41.76
3	11.440	2	22.880
4	5.440	4	21.76
5	3.440	1	3.440

$\Sigma = 97.28$

$$\text{Area } (h_1 - h_5) = \frac{30}{3} \times (97.28)$$

$$= 10 \ (97.28)$$

$$= 972.8 \ m^2$$

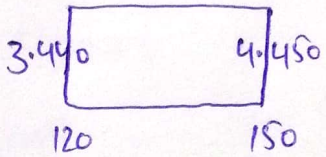


$$\text{Area } (h_5 - h_6)$$

$$= \frac{30}{2} \times (3.440 + 4.440)$$

$$= 15 \times 7.88$$

$$= 118.2 \ m^2$$



Now Total Area $= 972.8 m^2 + 118.2 m^2$

Total Area $= 1091 \ m^2$

In hectares, it is;

As 1 hectares $= 10{,}000 \ m^2$

So;

$$\text{Total Area} = \frac{1091}{10{,}000} \ ha$$

Total Area = 0.109 ha

Q.No 2:

Radius = R = ID - 200m

R = 7440 - 200m

R = 7240m

Deflection angle = ϕ = 20°40′

Chainage of Point of Intersection.

= ID - 400m

= 7440 - 400m

= 7040m

Peg Interval = 20m

Sol:- Required Data.

Calculate All Necessary Data.

Using Deflection Angle Method.

→ Length of tangent = $BT_1 = BT_2 = R\tan(\phi/2)$

$BT_1 = BT_2 = 7240 \tan\left(\frac{20°40'}{2}\right)$

$BT_1 = BT_2 = 7240\ (0.377)$

$\boxed{BT_1 = BT_2 = 2731.44m}$

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

$$L = \frac{3.14 \times 7240 \times 20^\circ 40'}{180^\circ}$$

$$L = \frac{469903.5}{180^\circ}$$

$$\boxed{L = 2610.58\text{m}}$$

→ Chainage of T_1 = Chainage of Point of Tangent

Tangent of intersection - length

$= 7040 - 2731.44$

$= 4308.56\text{m}$

→ Chainage of T_2 = chainage of T_1 + length of curve

$= 4308.56 + 2610.58$

$= 6919.14\text{m}$

→ Length of 1st chord = $C_1 = 4320 - 4308.56$

$$\boxed{C_1 = 11.44\text{m}}$$

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

$C_{11} = C_{12} = C_{13} \ldots\ldots\ldots\ldots C_{130} = 20\text{m}$

and $C_{131} = 6919.14 - 6900$

$$\boxed{C_{131} = 19.14}$$

By Deflection Angle.

$$S_1 = \frac{1718.9\, c_1}{R} \text{ (min)}$$

$$S_1 = \frac{1718.9\, c_1}{60R} \text{ (degree)}$$

$$S_1 = \frac{1718.9 \times 11.44}{60 \times 7240}$$

$$S_1 = 0.0453$$

$$\boxed{S_1 = 0^\circ 2' 42.96''}$$

$$S_2 = \frac{1718.9 \times 20}{60 \times 7240}$$

$$\boxed{S_2 = 0^\circ 4' 44.9''}$$

$$S_2 = S_3 = S_4 = S_5 \text{ ------- } = S_{130} = 0^\circ 4' 44.9''$$

because peg interval is same (i.e 20m)

And;

$$S_{131} = \frac{1781.9 \times 19.14}{60 \times 7240}$$

$$\boxed{S_{131} = 0^\circ 4' 32.65''}$$

Deflection Angle Method.

By Deflection Angle.

Total Deflection (tangential) angle.

for The chords are;

$$\Delta_1 = S_1 = 0^\circ 2' 42.96''$$

$$\Delta_2 = \Delta_1 + S = 0^\circ 2' 42.96'' + 0^\circ 4' 44.9''$$

$$\Delta_2 = 0^\circ 7' 27.86''$$

$$\Delta_3 = \Delta_2 + S_3 = 0^\circ 7' 27.86'' + 0^\circ 4' 44.9''$$

$$\Delta_3 = 0^\circ 12' 12.76''$$

$$\Delta_4 = \Delta_3 + S_4$$

$$\Delta_4 = 0^\circ 16' 57.66''$$

$$\Delta_5 = 0^\circ 21' 27.56''$$

$$\Delta_6 = 0^\circ 26' 42.46''$$

$$\Delta_7 = 0^\circ 31' 12.36''$$

$$\Delta_8 = 0^\circ 35' 57.26''$$

$$\Delta_9 = 0^\circ 40' 42.16''$$

$$\Delta_{10} = 0^\circ 45' 27.06''$$

$\Delta_{11}, \Delta_{12}, \Delta_{13}$ upto so on .....

$$\boxed{\Delta_{130} = 10^\circ 15' 15.06''}$$

and $\Delta_{131} = \Delta_{130} + S_{131}$

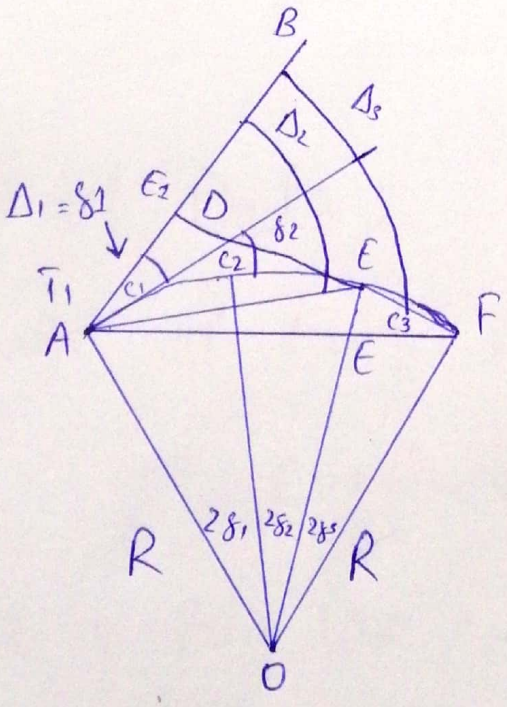
$\Delta_{131} = 10^\circ 15' 15.06'' + 0^\circ 4' 32.65''$

$$\boxed{\Delta_{131} = 10^\circ 19' 47.71''}$$

Check :- $\Delta_{131} = \phi/2 = 20^\circ 40'/2 = 10^\circ 20'$

and we have calculated $\Delta_{131} = 10^\circ 19' 47.71''$

So calculation is OK.



Q.No: 3

Given Data:

$\angle AKM = 130^\circ$

$\angle KMC = 140^\circ$

Radius of first Arc = ID - 300m

= 7440 - 300m

= 7140m

Radius of 2nd Arc = ID - 200m

= 7440 - 200m

= 7240m

Chainage of Intersection Point = ID - 400m

= 7440 - 400m

= 7040m

Required Data:

-> Chainage of tangent Points = ?

-> Point of Compound Curve = ?

Sol: $\alpha = 180^\circ - 130^\circ = 50^\circ$ so $\alpha = 50^\circ$

$B = 180^\circ - 140^\circ = 40^\circ$ so $B = 40^\circ$

$$\phi = \alpha + B = 50^\circ + 40^\circ$$

$$\phi = 90^\circ$$

Now;

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

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

$$I = 90^\circ$$

Now;

$$KT_1 = KN = R_L \tan(\alpha/2)$$

$$KT_1 = KN = 7140 \times \tan(50^\circ/2)$$

$$KT_1 = KN = 3329.44m$$

Similarly;

$$MT_2 = MN = R_S \times \tan(B/2)$$

$$\text{''} = MN = 7240 \times \tan(40^\circ/2)$$

$$MT_2 = MN = 2635.14m$$

Now;

$$KM = MT_2 + KT_1$$

$$KM = 2635.14 + 3329.44$$

$$KM = 5964.58m$$

Find ΔBKM By Sin Rule.

$$\frac{BK}{K \sin B} = \frac{M}{\sin(I)}$$

$$BK = \frac{MK \sin B}{\sin(I)}$$

$$BK = \frac{5964.58 \times \sin(40^\circ)}{\sin(90^\circ)}$$

$$BK = \frac{3833.96}{1}$$

$$\boxed{BK = 3833.96m}$$

Now;

$$BM = \frac{MK \sin \alpha}{\sin(I)}$$

$$BM = \frac{59.64.58 \times \sin(50^\circ)}{\sin(90^\circ)}$$

$$BM = \frac{4569.13}{1}$$

$$\boxed{BM = 4569.13m}$$

Now;

$$TL = KT_1 + BK$$

$$TL = 3329.44 + 3833.96$$

$$TL = 7163.4m$$

and;

$$T_S = MT_2 + BM$$

$$T_S = 2635.14 + 4569.13$$

$$T_S = 7204.27m$$

Now;

$$L_L = \frac{\pi R_L \alpha}{180^\circ}$$

$$L_L = \frac{3.14 \times 7140 \times 50^\circ}{180^\circ}$$

$$\boxed{L_L = 6227.67m}$$

and;

$$L_S = \frac{\pi R_S B}{180^\circ}$$

$$L_S = \frac{3.14 \times 7240 \times 40^\circ}{180^\circ}$$

$$\boxed{L_S = 5051.91m}$$

Now;

Chainage of T_1 = Chainage of intersection Point $- T_L$

$= 7040 - 7163.4$

$= -123.4$ which is impossible.

In The Paper we have give That chainage of Point of Intersection =ID - 400m which is equal to 7040m in my case But when i am calculating The chainage of tangent Point, I am getting negative value which is Impossible.

So i want to change The Assumption for chainage of Point of Intersection.

as;

chainage of Point Intersection

= ID - 100m

= 7440 - 100

= 7340m

Now;

Chainage of T_1 = chainage of intersection Point − TL

= 7340 − 7163.4

= 176.6m

and;

Chainage of T_2 = chainag of compound curvature (N)+L_s

chainge of T_2 = (Chainage of T_1 + L_L) + L_s

= (176.6 + 6227.67) + 5051.91

= (6404.27) + 5051.91

= 11456.18m