Name = Fawad Ahmad

ID = 7783

Section = "A"

(1)

Q.1

A Circular Curve has 300m radius and 60° deflection angle. what its degree by (a) arc definition of standard length 30m. Also calculate (i) length of Curve (ii) tangent length (iii) length of long Chord (iv) mid-ordinate (v) apex distance.

Sol:

$R = 300m \quad . \quad \Delta = 60^\circ$

(a) Arc definition:-

$S = \cancel{300}\ 30m$

$R = \frac{S}{D_a} \times \frac{180}{\pi}$

$\therefore \quad 300 = \frac{30 \times 180}{D_a \pi}$ or $D_a = \boxed{5.730}$

(b) Chord definition:

$R \sin \frac{D_c}{2} = \frac{S}{2}$

$300 \sin \frac{D_c}{2} = \frac{30}{2}$

$\boxed{D_c = 5.732}$

(1) length of the Curve:

$L = R\Delta \frac{\pi}{180} = 300 \times 60 \times \frac{\pi}{180}$

$\boxed{314.16m}$

(ii) Tangent length:-

$$T = R \tan\frac{\Delta}{2} = 300 \tan\frac{60}{2} =$$

$$\boxed{173.21m}$$

(iii) length of long chord:-

$$L = 2R \sin\frac{\Delta}{2} = 2 \times 300 \times \sin\frac{60}{2}$$

$$= \boxed{300m}$$

(iv) Mid-ordinate:-

$$M = R\left(1 - \cos\frac{\Delta}{2}\right) = 300\left(1 - \cos\frac{60}{2}\right)$$

$$= \boxed{40.19m}$$

(v) Apex distance:

$$E = R\left(\sec\frac{\Delta}{2} - 1\right) = 300\left(\sec\frac{60}{2} - 1\right)$$

$$= \boxed{46.41m} \text{ Ans..}$$

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Q 2:-

Two roads having a deviation angle of 45° at apex point V are to be joined by a 200m radius Circular Curve. If the Chainage of apex point is 1839.2m and Peg interval being 10 m. Calculate necessary data to the set the Curve by:

=> Offset from Chords (using Peg Interval 20m if needed).

Solution:-

$R = 200m \quad \Delta = 45°$

$\therefore$ length of tangent $= 200 \tan \frac{45}{2} = 82.84m.$

$\therefore$ Chainage of $T_1 = 1839.2 - 82.84 = 1756.36m$

length of Curve $= R \times 45 \times \frac{\pi}{180} = 157.08m$

Chainage of Forward tangent T_2

$= 1756.36 + 157.08 = 1913.44m$

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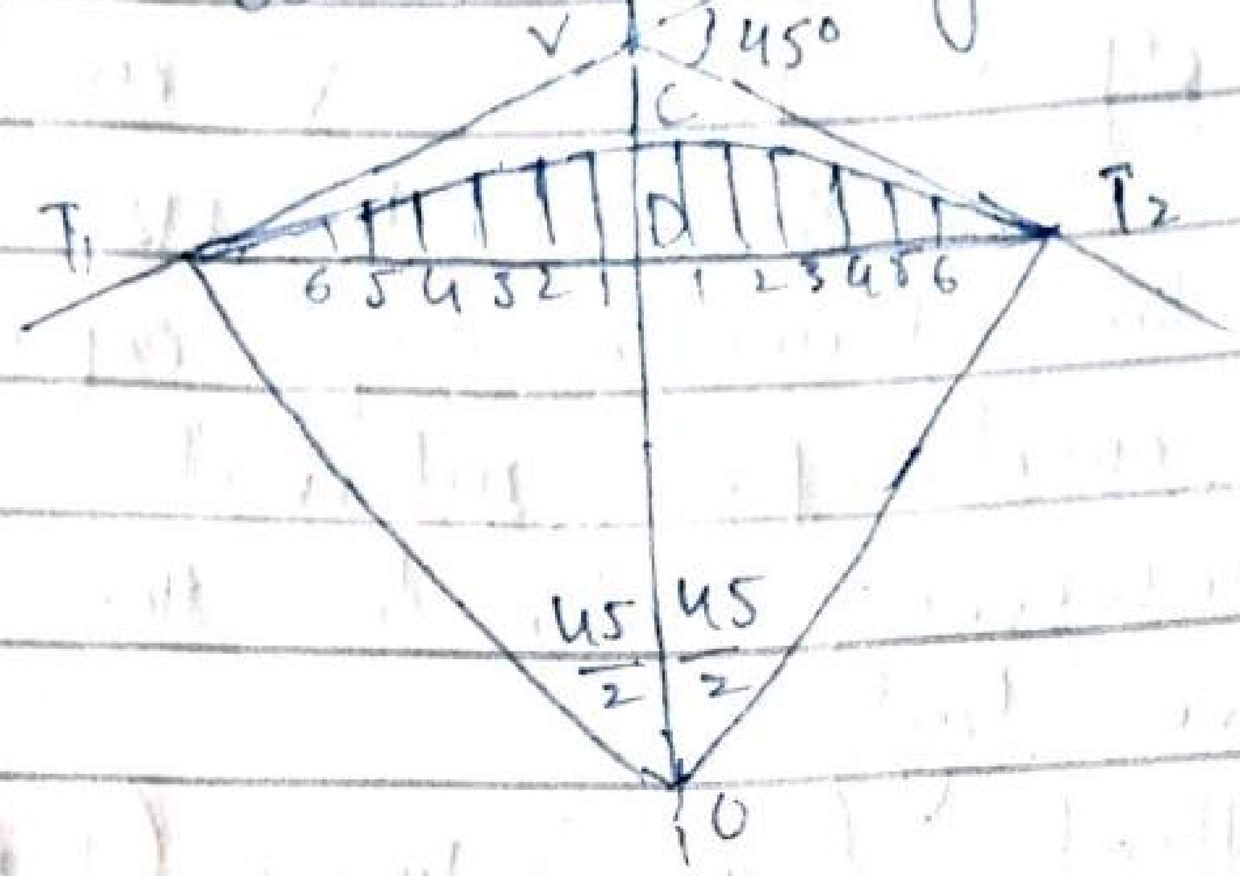
(a) By offset form long Chord:-



Distance of DT $= L/2 = R \sin \Delta/_2 = 200 \sin 45/_2$
$= 76.54$

Measuring "x" form D.

$$Y = \sqrt{R^2 - x^2} - \sqrt{R^2 - (L/2)^2}$$
$$x = 0$$

$O_0 = 200 - \sqrt{200^2 - 76.54^2} = 200 - 184.78$
$= 15.22m$

$O_1 = \sqrt{200^2 - 10^2} - 184.78 = 14.97m$

$O_2 = \sqrt{200^2 - 20^2} - 184.78 = 14.22m.$

$O_3 = \sqrt{200^2 - 30^2} - 184.78 = 12.96m$

$O_4 = \sqrt{200^2 - 40^2} - 184.78 = 11.18m$

$O_5 = \sqrt{200^2 - 50^2} - 184.78 = 8.87m$

$O_6 = \sqrt{200^2 - 60^2} - 184.78 = 6.01m$

$O_7 = \sqrt{200^2 - 70^2} - 184.28 = 2.57m.$

At $T_{1,2}$ $O = 0.00$.

(b)

Method of Bisection.

Central ordinate at $D = R(1-\cos\Delta/2) =$
$200(1-\cos 45/2)$
$= 15.22$

Ordinate at $D_1 = R(1-\cos\Delta/4) = 200(1-\cos 45/4)$
$= 3.84m$

ordinate at $D_2 = R(1-\cos\Delta/8) = 200(1-\cos 45/8)$
$= 0.96m$.

(c) Offsect form tangent.

Radial offset :-

$$O_x = \sqrt{R^2+x^2} - R$$

Chainage of $T_1 = 1756.36m$.
:- For 30m Chain it is at.
$= 58$ chains $+ 16.36m$
$x_1 = 30 - 16.36 = 13.64$
$x_2 = 43.64m$
$x_3 = 73.64m$.
& the last il at x_4 = tangent length $= 82.24m$

$O_1 = \sqrt{200^2+13.64^2} - 200 = 0.46m$.
$O_2 = \sqrt{200^2+43.64^2} - 200 = 4.71m$
$O_3 = \sqrt{200^2+73.64^2} - 200 = 13.13m$
$O_4 = \sqrt{200^2+82.84^2} - 200 = 16.48m$.

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D) Offset form chord produced.

length of first sub-chord $= 13.64m = C_1$
length of normal Chord $= 30m = C_2$

Since length of Chain is $157.08m$, $C_3 = C_4 = C_5 = 30m$.

Chainage of Forward tangent $= 1913.44m$
$= 63$ chain $+ 23.44m$

length of last Chord $= 23.44m = C_n = C_6$

$$O_1 = \frac{C_1^2}{2R} = \frac{13.64^2}{2 \times 200} = 0.47m$$

$$O_2 = \frac{C_2(C_1 + C_2)}{2R} = \frac{30(30 + 13.64)}{2 \times 200} = 3.27m.$$

$$O_3 = \frac{C_2^2}{R} = \frac{30^2}{2 \times 200} = 4.5m = O_4 = O_5$$

$$O_6 = \frac{C_n(C_{n-1} + C_n)}{2R} = \frac{23.44(23.44 + 30)}{2 \times 200}$$

$$= 3.13m$$

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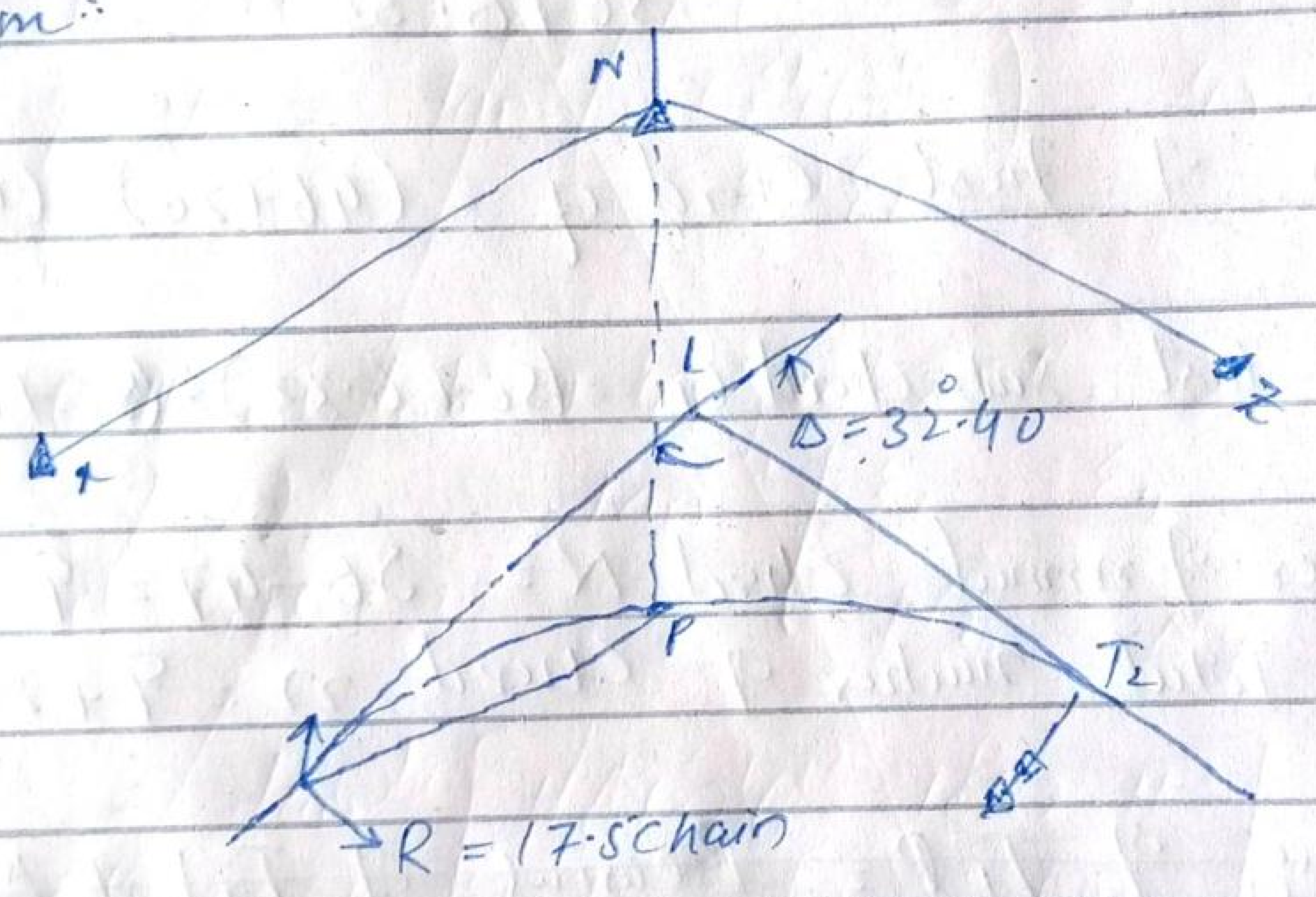
CO3:

A Circular Curve of radius of 17.5 Chain deflecting right Through 32°.40 is to be set out between two straight having Chainage of the Intersection as (51+9.35)
Calculate the necessary data to Set out the curve by the method the deflection angle of the right of one chain 20m.

Solution:



$R = 17.5 \times 20 = 350m$

$\Delta = 32°40' = 32.667°$

$\Delta/2 = 16°20'$

Tangent Length $T = R \tan \Delta/2$

$= 350 \times \tan 16°20' = 102.57m$

length of curve $l = \frac{\pi R \Delta}{180}$

$= \frac{\pi \times 250 \times 32.667}{180} = 199.55m$

(8)

Chainge of T_1 = Cheinage of P.I − T

$= (51 + 9.35) - 102.57$

$= (51 \times 20 + 9.35) - 102.57$

$= 926.78m = 46 + 6.78$

Chainge of T_2 = Chainage of T_1 + l

$= 926.78 + 199.55 = 1126.33m$

$= 56 + 6.33$

length of First-chord $c_1 = (46+20) - (46 + 6.78) = 13.22m$

length of last sub-chord $C_1 = (56 + 6.33) - (56 + 0) = 6.33m$

Number of normal chord $N = 56 - 47 = 9$

Total nuber of chord $n = 9 + 2 = 11$

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Cordinate of T_1 and T_2

$$\text{Bearing of } IT_1 = \alpha = 180^\circ + \text{bearing of } T_1 I$$
$$= 180^\circ + 78^\circ 36' 30''$$

$$\text{Bearing of } IT_2 = \beta = \text{Bearing of } IT_1 - \phi$$
$$= \text{Bearing of } IT_1 - (180^\circ - \Delta)$$
$$= 258^\circ 36' 30'' - (180^\circ - 32^\circ 40')$$
$$= 111^\circ 16' 30''$$

Coordinate T_1

$$\text{Easting of } T_1 = E_{T_1} = \text{Easting of } I + T \sin\alpha$$
$$= 1058.55 + 102.57 \times \sin 258^\circ 36' 30''$$
$$= E = 958.00m$$

$$\text{Northing of } T_1 = N_{T_1} = \text{Northing of } I + T\cos\alpha$$
$$= 1045.04 + 102.57 \times \cos 258^\circ 36' 30''$$
$$= N \quad 1024.78m$$

Coordinate of T_2

$$\text{Easting of } T_2 = E_{T_2} = \text{Easting of } I + T\sin\beta$$

$$= 1058.55 + 102.57 \times \sin 111^\circ 16' \cancel{B} 30''$$
$$E = 1154.18m.$$

$$\text{Northing of } T_2 = N_{T_2} = \text{Northing of } I + T\cos\beta$$

$$= 1045.04 + 102.57 \times \cos 111^\circ 16' 30''$$
$$N = 1007.812m.$$

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Tangential angle

$$\delta = 1718.9 \frac{c}{R} \text{ mint}$$

$$\delta_1 = 1718.9 \frac{13.22}{350} = 64.925'$$

$$\delta_2 \text{ to } \delta_{10} = 1718.9 \frac{20}{350} = 98.223'$$

$$\delta_{11} = 1718.9 \frac{6.33}{350} = 31.088''$$

Deflection angle

$$\Delta_1 = \delta_1 = 64.925' = 1°04'5''$$

$$\Delta_2 = \Delta_1 + \delta_2 = 64.925' + 98.223' = 163.148' = 2°43'04''$$

$$\Delta_3 = \Delta_2 + \delta_3 = 163.148' + 98.223' = 261.371' = 4°21'22''$$

$$\Delta_4 = \Delta_3 + \delta_4 = 261.371' + 98.223' = 359.594' = 5°59'36''$$

$$\Delta_5 = \Delta_4 + \delta_5 = 359.594' + 98.223' = 457.817' = 7°37'39''$$

$$\Delta_6 = \Delta_5 + \delta_6 = 457.817 + 98.223' = 556.040' = 9°16'02''$$

$$\Delta_7 = \Delta_6 + \delta_7 = 556.040' + 98.223' = 654.263' = 10°54'16''$$

$$\Delta_8 = \Delta_7 + \delta_8 = 654.263' + 98.223' = 752.486' = 12°32'29''$$

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$\Delta_9 = \Delta_8 + \delta_9 = 752.486' + 98.223' = 850.709'$
$= 14°10'48''$

$\Delta_{10} = \Delta_9 + \delta_{10} = 850.709' + 98.223' = 15°48'56''$

$948.932'$

$\Delta_{11} = \Delta_{10} + \delta_{11} = 948.932' + 31.088' = 980.020'$
$= 16°20'00''$

Check $= \Delta_{11} = \Delta/2 \; 16°20'$ (okay).