Birzeit University

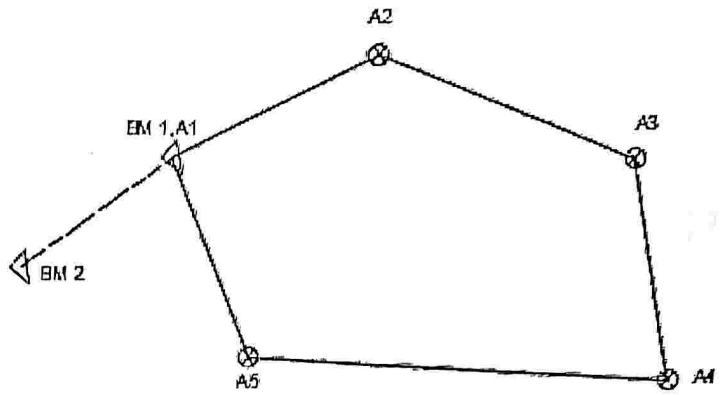
Faculty of Engineering and Technology

Civil Engineering Department

SURVEYING Lab ENCE316

Experiment no.8: Traverse measurement using Total station

Prepared by: Eng. Shuroq Jamal



- Points A1, A2, A3, A4 and A5 are traverse points
- BM1 and BM2 are bench mark points

The aim of this experiment:

- Determine the coordinate of each traverse point (E, N)
- Determine the elevation of each traverse point (Z)

The following table must be filled in the field where,

HCR: Horizontal circle reading

Z.A: Zenith angle

SD: Slope distance

HD: Horizontal distance

VD: Vertical distance

HI: Height of instrument

RH: Reflector height

Station	Point	HCR	Z.A	SD	HD	VD	HI	RH
A1	BM2	0°0' 0''						
	A2	√ 55° 04' 11''						
A1	A2	0°0' 0''	√ 92° 32' 53''	√ 69.546	√ 69.477	√ -3.214	√ 1.49	√ 1.53
30° 34' 24.8''	A5	√ 13[illegible]36'00''	√ 84° 53' 37''	√ 93.606	√ 93.234	√ 8.211	√ 1.49	√ 1.80
A2	A3	0°0' 0''	√ 83° 28' 56''	√ 86.427	√ 85.869	√ 9.692	√ 1.42	√ 3.5
	A1	√ 56° 30' 43''	√ 87° 17' 53''	√ 69.518	√ 69.441	√ 3.157	√ 1.42	√ 3.5
A3	A4	0°0' 0''	√ 89° 16' 21''	√ 44.53	√ 44.525	√ 0.575	√ 1.39	√ 1.53
	A2	√ 172° 13' 29''	√ 93° 29' 29''	√ 86.007	√ 85.847	√ -5.36	√ 1.39	√ 3.88
A4	A5	0°0' 0''	√ 87° 23' 46''	√ 66.77	√ 66.708	√ 2.914	√ 1.40	√ 1.53
	A3	√ 98° 22' 30''	√ 89° 52' 14''	√ 44.485	√ 44.485	√ -0.019	√ 1.40	√ 1.53
								2.6
A5	A1	0°0' 0''	√ 44° 49' 15''	√ 93.660	√ 93.529	√ -7.989	√ 1.37	√ 1.53
	A4	√ 82° 20' 14''	√ 92° 29' 00''	√ 66.770	√ 66.714	√ -2.854	√ 1.37	√ 1.53

Calculations:

Internal angle correction

- The sum of internal angle = 180 (n-2) , where n: # of traverse points
- Angular misclosure = $\sum$ internal angle - 180 (n-2)
- ε allowable = $c\sqrt{n}$, c = 90 "

  If Angular misclosure < ε allowable then you error is accepted.
- You have to correct all of the internal angle using the following equation:

  Correction = $-\frac{\text{Miscloset error}}{n}$ (Note: all internal angle have the same correction)

  Corrected angle = observed angle + correction

201.246
3 21.25

Azimuth calculation

- $\alpha_{A1-BM2} = \tan^{-1}\frac{EBM2-EA1}{NBM2-NA1}$
- Find the azimuth for each traverse leg. (α_{A1-A2} , α_{A2-A3}, ...etc)

Horizontal distances

- The accepted difference between any two reading : $\Delta\ell = (0.0007\,\ell + 0.03)$

  Then find the average value for length of each traverse leg (Horizontal distances)

  For example, $\ell_{A1\,A2} - \ell_{A2\,A1} < \Delta\ell$

  $$\ell_{\overline{A1\,A2}} = (\ell_{A1\,A2} + \ell_{A2\,A1})/2$$

Coordinates and their corrections

- $\Delta E = \ell_{AVE} \sin\alpha$
- $\Delta N = \ell_{AVE} \cos\alpha$

  Find the for all traverse leg: $(\Delta E_{12}, \Delta N_{12})$, $(\Delta E_{23}, \Delta N_{23})$, $(\Delta E_{34}, \Delta N_{34})$,.....

- For Departure error $(\delta\,\Delta E) = \sum\Delta E$
- For Latitude error $(\delta\,\Delta N) = \sum\Delta N$
- *Total closing error* $\delta = \sqrt{(\sum\Delta E)^2 + (\sum\Delta N)^2}$
- δallowable = $0.0009\,(\sum L) + 0.2$

- Dept. correction for traverse leg = - $\frac{Leg\ length}{Sum\ of\ length}$ * Total Dept. error
- Lat. correction for traverse leg = - $\frac{Leg\ length}{Sum\ of\ length}$ * Total Lat. error

For example, ΔE_{12} correction = - $\frac{L12\ avg}{\Sigma L}$ * (δ ΔE)

ΔN_{12} correction = - $\frac{L12\ avg}{\Sigma L}$ * (δ ΔN)

- Then find corrected coordinates

For example, ΔE_{12} corrected= ΔE_{12} calculated+ΔE_{12} correction

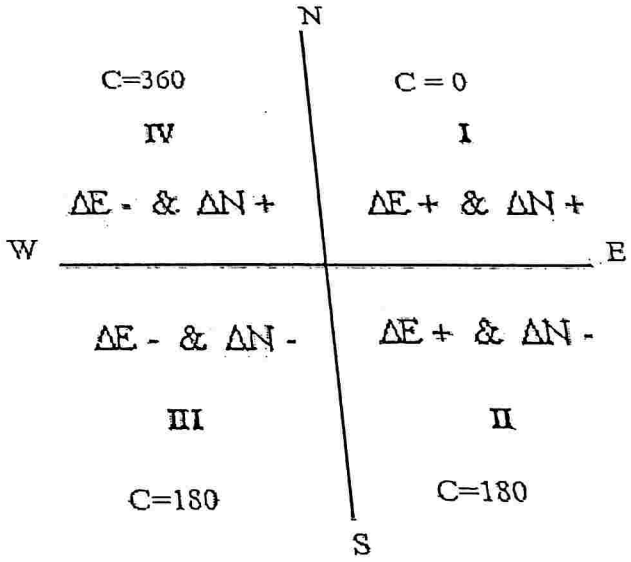
ΔN_{12} corrected= ΔN_{12} calculated+ΔN_{12} correction

$E_2=E_1+\Delta E_{12}$ corrected

$N_2=N_1+\Delta N_{12}$ corrected

- Based on the corrected coordinates find the value of the azimuth of each traverse leg.

$\alpha = \tan^{-1} \frac{\Delta E\ corrected}{\Delta N\ corrected} + c$



Elevation of traverse point

$H_2 = H_1 + HI_1 + VD_{12} - RH_2$

$H_3 = H_2 + HI_2 + VD_{23} - RH_3$

Find the calculated elevation for all points **then correct them.**

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Experiment name: Mapping using Total station

Prepared by: Eng. Shuroq Jamal

Note : The coordinate for traverse points near University theatre.

Group A

Point	Easting (m)	Northing (m)	Elevation (m)
A4	167572.206	152150.081	781.059
A5	167582.648	152084.777	784.146

Azimuth A4-A5 =

Group B

Point	Easting (m)	Northing (m)	Elevation (m)
B4	167571.167	152151.186	781.069
B5	167580.866	152085.214	783.959

Azimuth B4 – B5 =

Group C

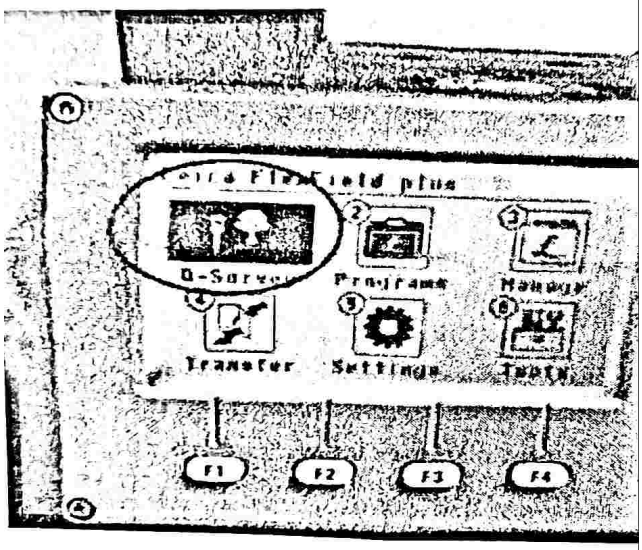
Point	
C4	Easting

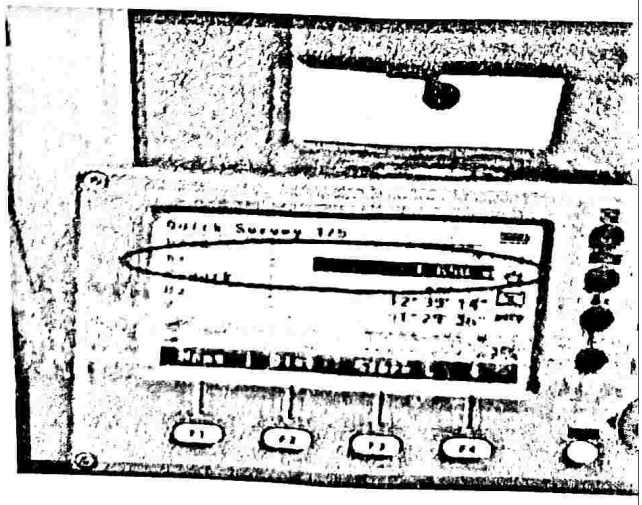
	Easting (m)	No
	167569.739	15
	167566.707	15

pping?

rt the following Data in the total stati

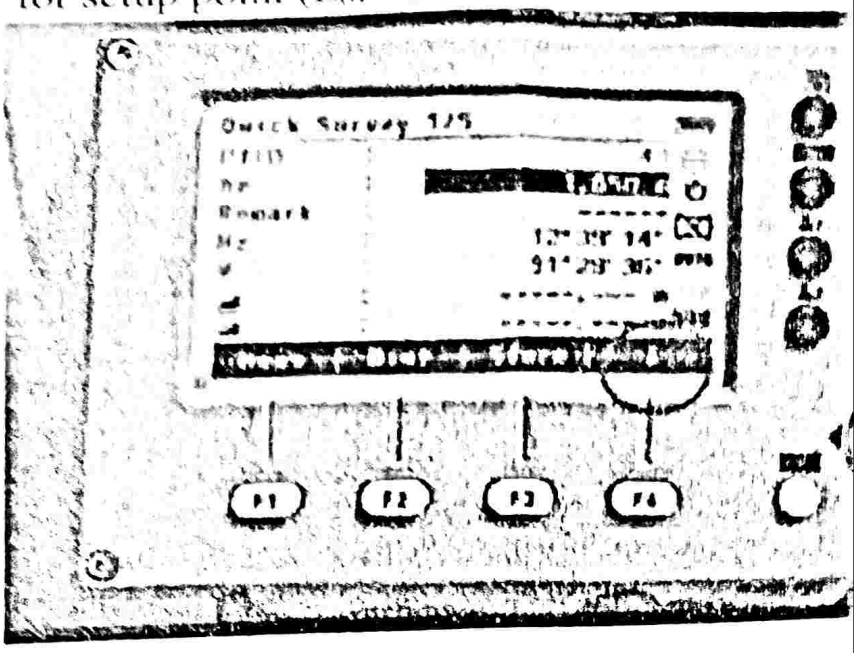
ector (hr) : from the main screen (Q-S

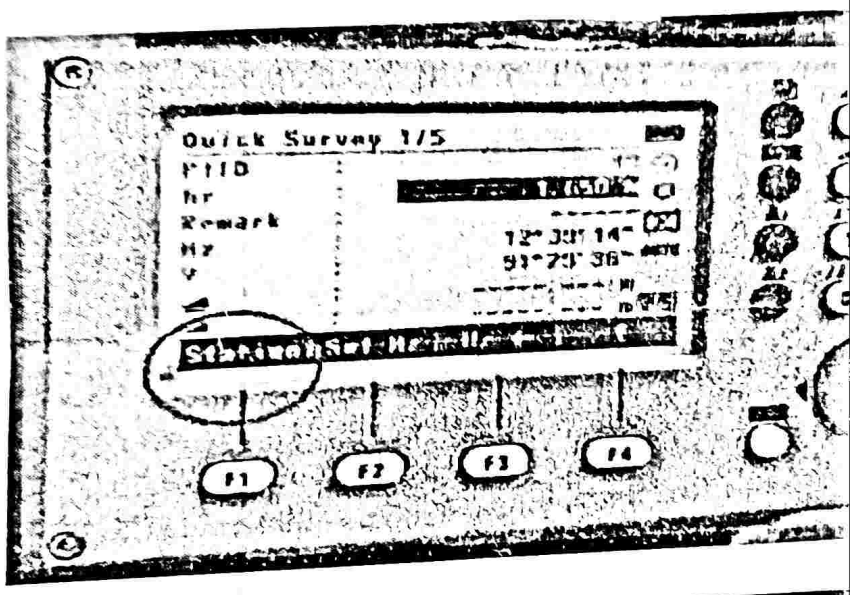


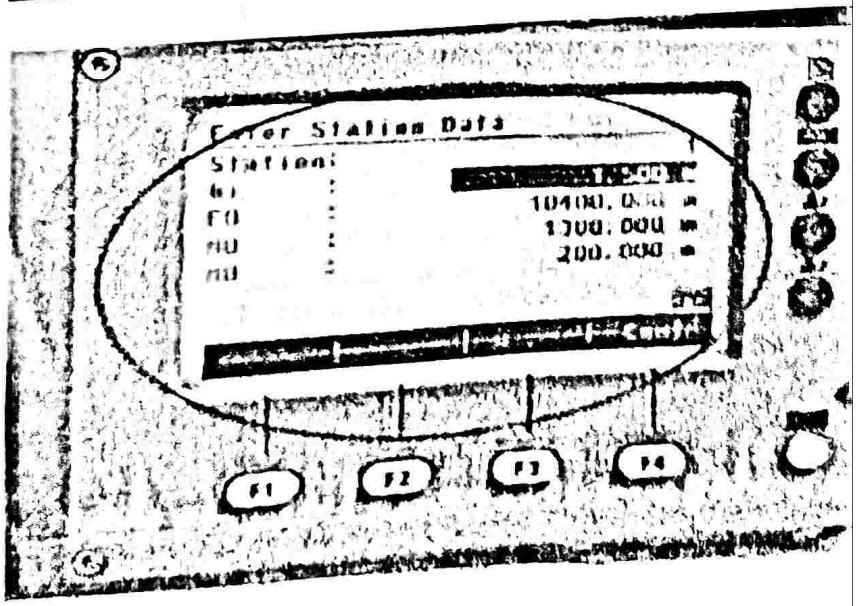


strument (hi) : station → insert hi

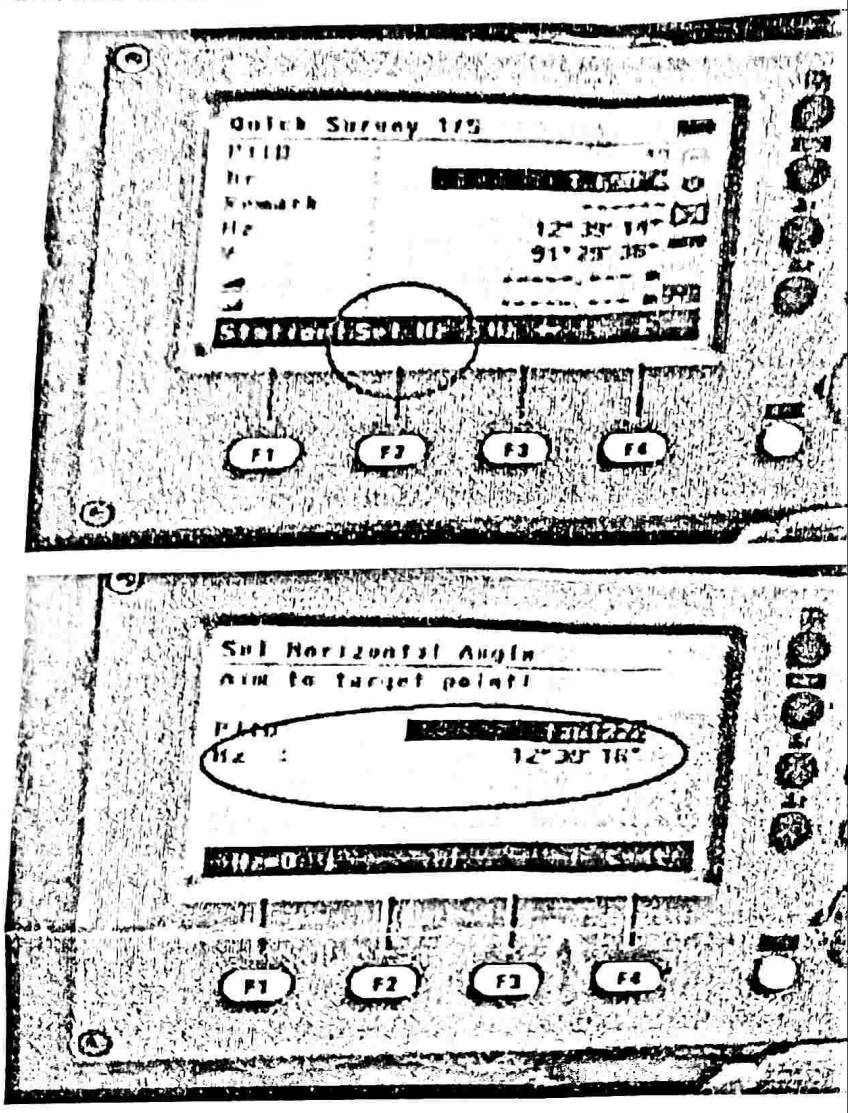
for setup point (E_0, N_0, H_0) : station → insert







e total station toward the targeting point (Point w
: set Hz then insert the calculated azimuth



d check the coordinate of targeted point

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ata and sketch
orking area (A3 Paper)

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Experiment name: Setting out simple circular curve

Prepared by: Eng. Shuroq Jamal

Where:

PI : Point of intersection

PC: Point of curvature

PT: Point of tangency

Δ: Intersection angle or central angle

R: Curve radius

L: Length of tangent

T: Tangent

Lcurve: Curve length

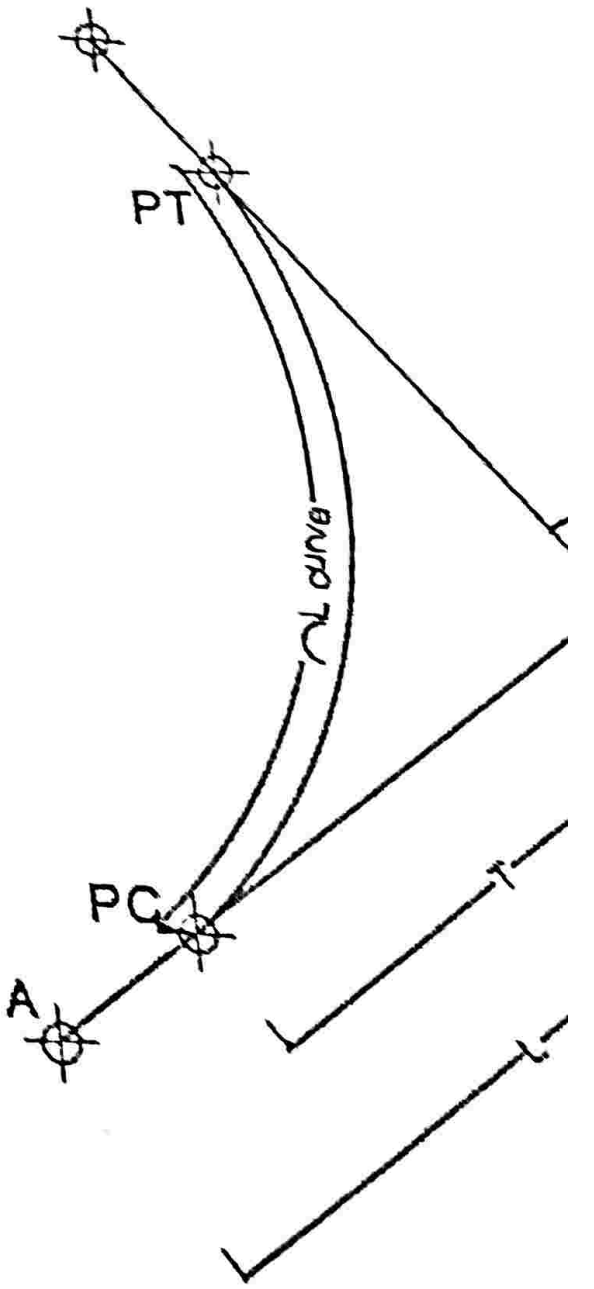
Lc: Chord Length

For this experiment:

R= 200 m

$\Delta = 16°$

$C \leq \frac{R}{20}$



$L = \sqrt{\Delta E^2 + \Delta N^2}$

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

Sta Pc = L - T

$L_{curve} = \frac{\Delta}{180} \pi R$

Sta PT = StaPc +Lcurve

To find intermediate points:

Sta P1= Sta Pc + (C=10) then approximate Sta P1 to nearest 5 (Smaller number)

C1 = StaP1 – Sta Pc

Sta Pn= Sta PT - (C=10) then approximate Sta Pn to nearest 5 (Larger number)

C2 = StaPT – Sta Pn

$n = \frac{L\,curve - C1 - C2}{C}$

Number of required points = n+1

Calculate , α_{A-BM}

$$\delta i = \frac{\Delta\, Li}{2\, Lcurve}$$

$$\alpha = \alpha_{A-BM} - \delta i$$

$L_c = 2R \sin \delta i$

$E_{PC} = E_A + (L\text{-}T) \sin \alpha_{A-BM}$

$N_{PC} = N_A + (L\text{-}T) \cos \alpha_{A-BM}$

$E_{P1} = E_{PC} + L_{c1} \sin \alpha_1$

$N_{P1} = N_{PC} + L_{c1} \cos \alpha_1$

$E_{P2} = E_{PC} + L$.

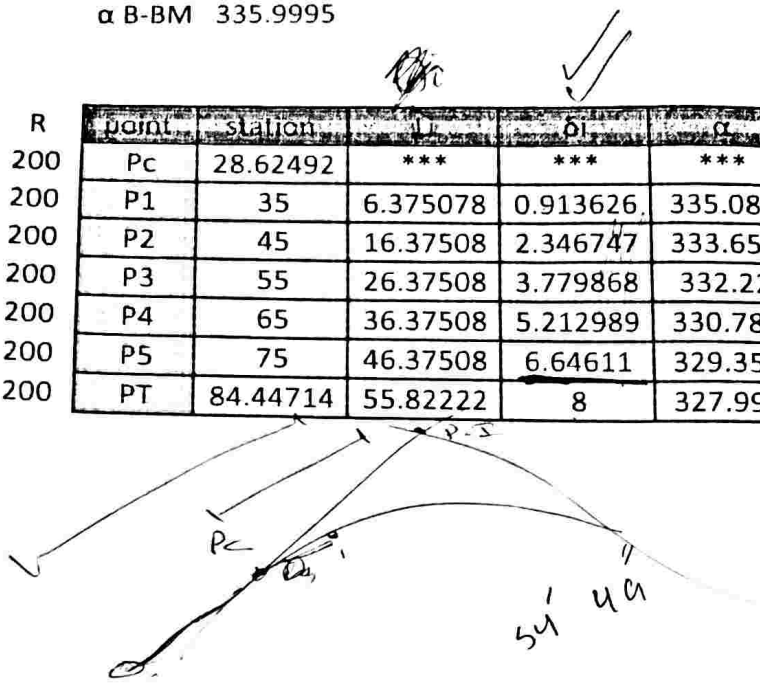
Diameter

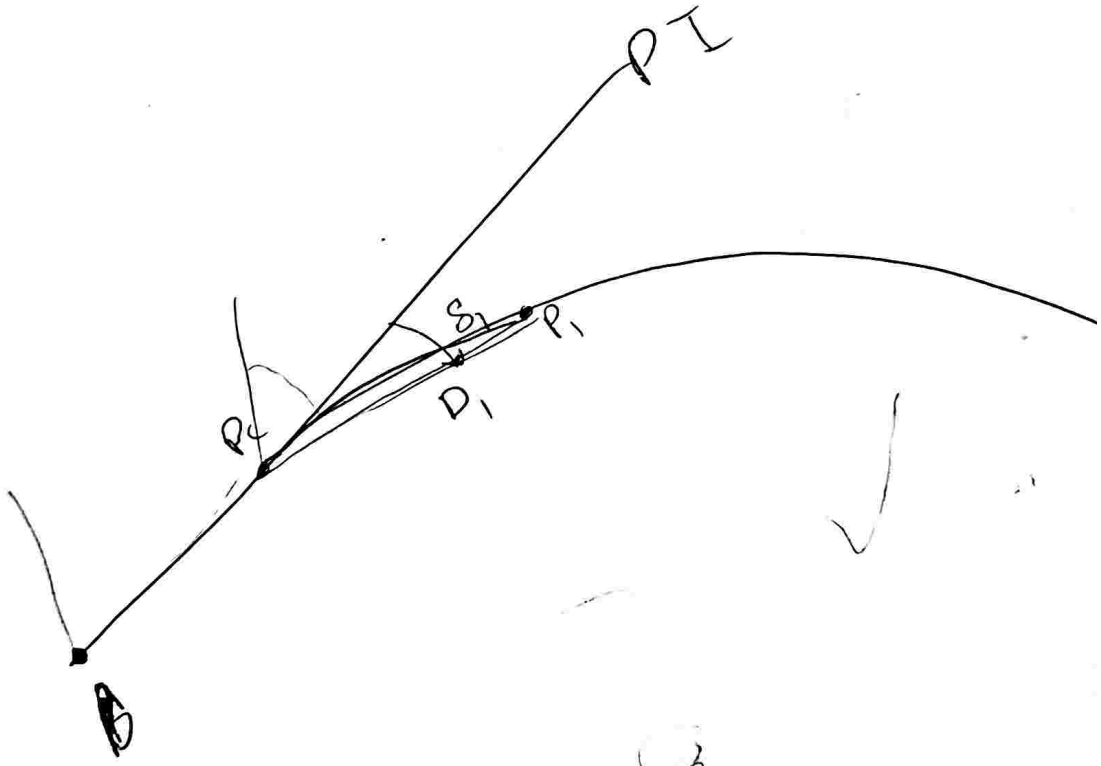
Point	Station	~~Ki~~	δi	α	Lc	E	N
Pc	StaPc	—	—	—	—	√	√
P_1	StaPc + C1	C1	√	√	√	√	√
P_2	$StaP_1$ + C	C1+C	√	√	√	√	√
P_3	$StaP_2$ + C	C1+2C				√	√
.							
.							
.							
Pn	$StaP_{n-1}$ + C	C1+nC	√	√	√	√	√
PT	StaPn + C2	C1+nC+C2 = Lcurve	$\frac{\Delta}{2}$	√	√	√	√

Δ E/Δ N -0.44524

α B-BM 335.9995

R	point	station	U	δi	α	L	E	N
200	Pc	28.62492	***	***	***	***	167264.7189	151929.6551
200	P1	35	6.375078	0.913626	335.086	6.378	167262.0321	151935.4396
200	P2	45	16.37508	2.346747	333.653	16.379	167257.4499	151944.3324
200	P3	55	26.37508	3.779868	332.22	26.369	167252.4286	151952.9851
200	P4	65	36.37508	5.212989	330.786	36.343	167246.981	151961.3758
200	P5	75	46.37508	6.64611	329.353	46.295	167241.1206	151969.4836
200	PT	84.44714	55.82222	8	327.999	55.669	167235.2183	151976.865





16.39

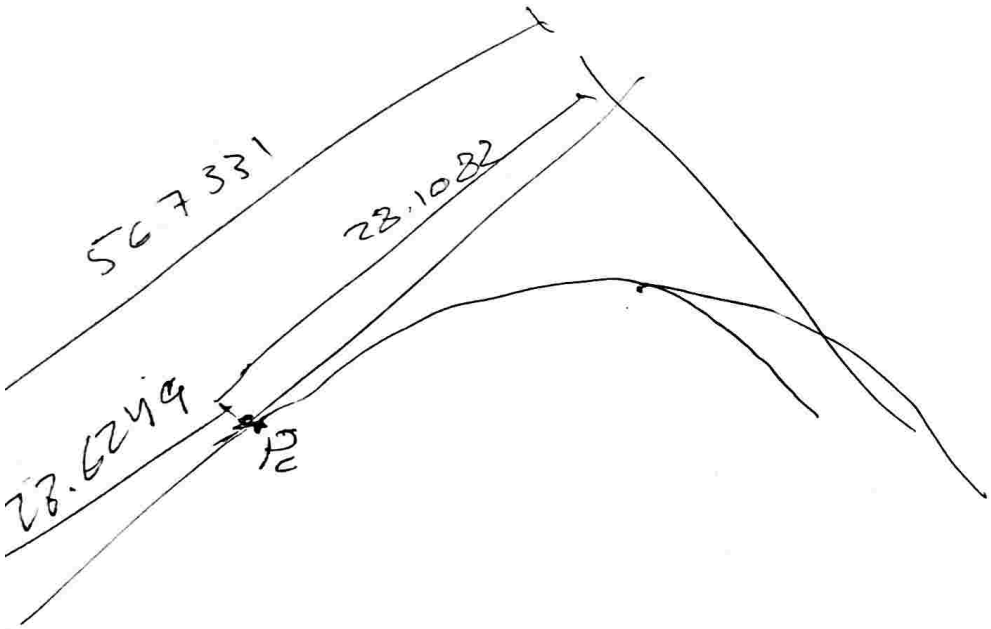
26.386

36.327

46.315

given informations:								
R	200			B	PI			
Δ	16		E	167276.362	167253.286		Δ E	-23.
C< R/20	10		N	151903.505	151955.333		Δ N	51.

Calculations:								
L	56.7331	m			Sta Pc	28.6249		
T	28.1082	m			Sta PT	84.4471		
L curve	55.8222	m						
Sta p1	38.6249	m	35					
C1	6.37508	m						
Sta P last	74.4471	m	75					
C2	9.44714	m						
n	4							
#of points	5		5	points				



c = 28.64 4