Exp. 1 :

Distance measurements by stepping and pacing

Group B "Mariam Injass"

Date : 25.9.2023

Weather : Sunny

Location : Behind the engineering building

Instruments : 1. Tape
2. Ranging rods
3. Chalk (طبشور)

Sketch

The Data

Segment	Distance (m)
AA_1	12.24 m
A_1A_2	16.27 m
A_2B	15.09 m
Σ	43.60 m

Segment	Distance (m)
BA_3	16.72 m
A_3A_4	12.93 m
A_4A	13.92 m
Σ	43.57 m

- Calculation :

- $AB_{avg} = \frac{sum\ 1 + sum\ 2}{2} = \frac{43.60 + 43.57}{2} = 43.585 m$

- Error (e) = |measured distance - Known distance|

  = |43.585 - 43.574| → Known distance = 43.574

  = 0.011 m

- $RP = \frac{1}{measured\ distance / |e|}$

  $= \frac{1}{43.585/0.011}$

  $= \frac{1}{3962}$ ⇒ It's acceptable

Exp. 2:

Mapping using ties and offsets

Group B "Mariam Injass"

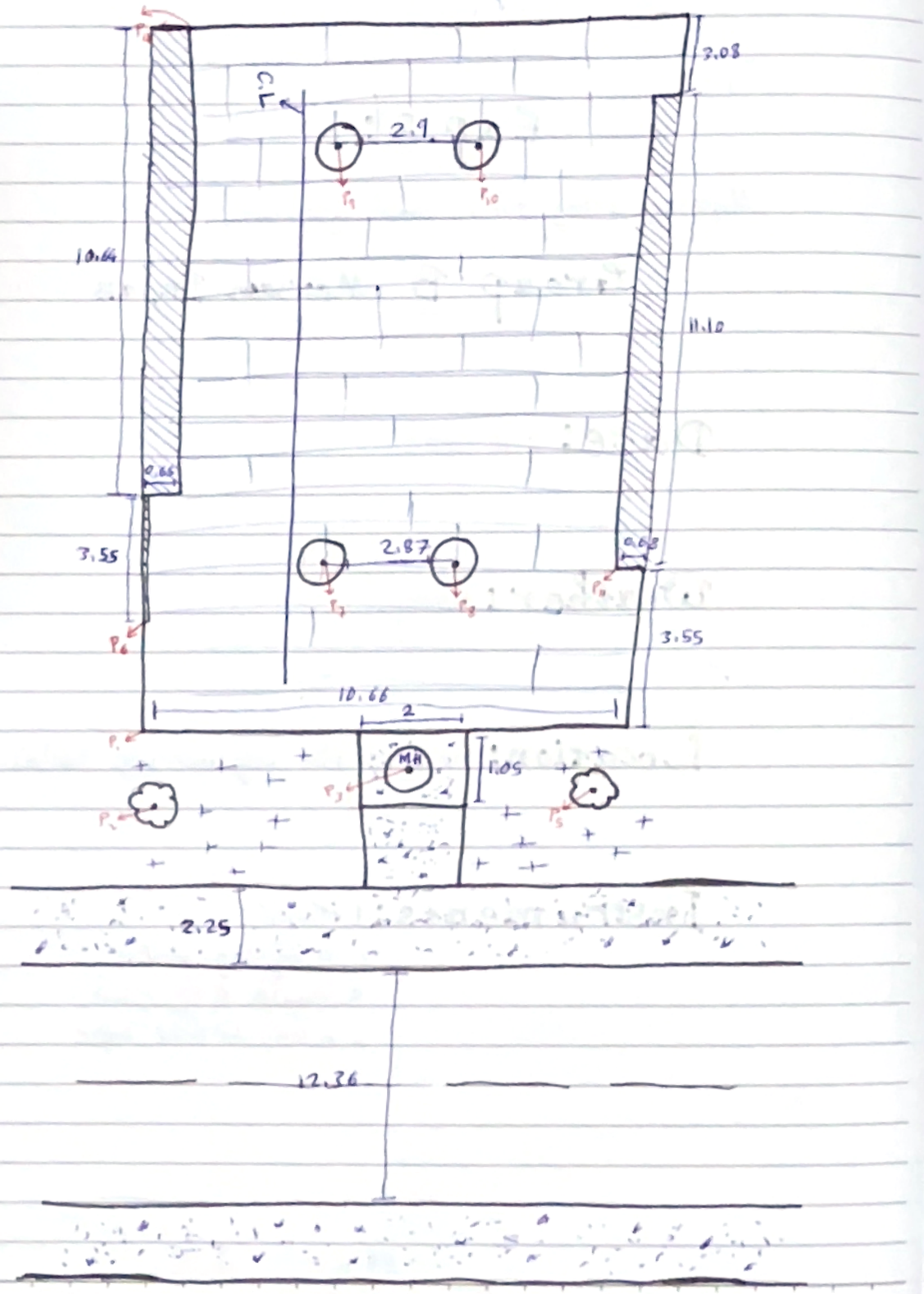
Date: 2.10.2023

Weather: Rainy

Location: Behind the engineering building

Instruments: 1. Tape
2. Ranging rods
3. Chalk ((طبشورة))
4. Rocks to hold tape

SKetch



The Data

	Ties Method				offset Method		
Point	d_1	d_2	d_3	d_4	d_1	d_2	Notes
P_1	15	3.4	12	5.3	---	---	---
P_2	15	4	12	6.27	---	---	---
P_3	15	2.94	12	5.3	---	---	---
P_4	14	3.47	12	5.8	---	---	---
P_5	15	6.57	13	7.72	---	---	---
P_6	---	---	---	---	12.7	3	---
P_7	---	---	---	---	12.59	0.66	---
P_8	---	---	---	---	12.59	3.53	---
P_9	---	---	---	---	1.8	0.56	---
P_{10}	---	---	---	---	1.8	3.46	---
P_{11}	---	---	---	---	12.7	6.54	---

BIRZEIT UNIVERSITY

FACULTY OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT

SURVEYING LAB (ENCE316)

EXP:2 : MAPPING USING TIES AND OFFSET

GROUP B
STUDENT NAME : MARIAM INJASS
STUDENT NO. : 1210934

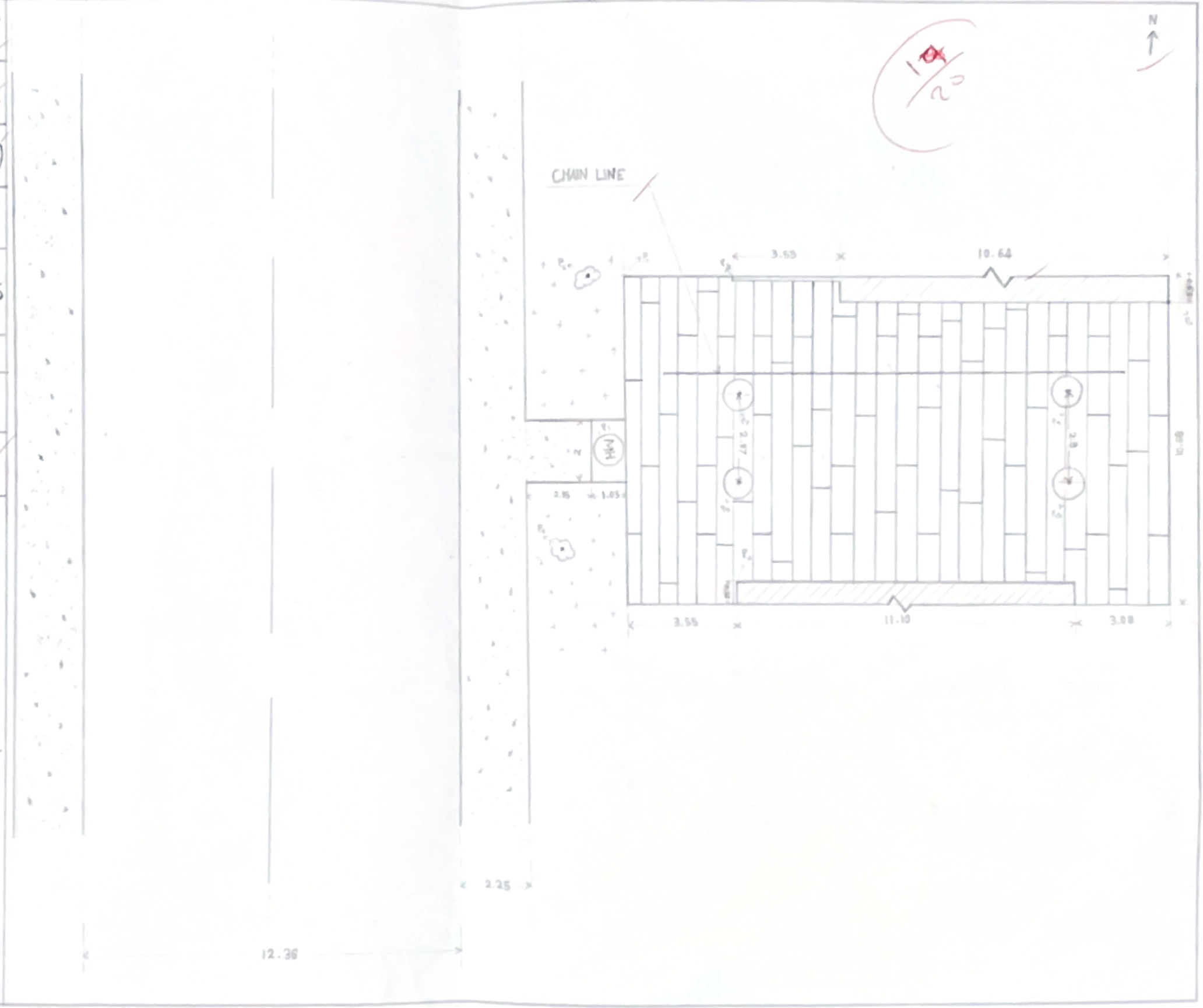
DATE: 2.10.2023

UNIT: CENTIMETRE

SCALE: 1 : 100

LEGEND

- SOIL
- CONCRETE
- BUILDING
- CONCRETE WALL
- STONE WALL
- MH — MANHOLE
- ELECTRIC POLE
- TREE



Exp. 3:

Practicing the use of the level

Group B "Mariam Injass"

Date: 29.11.2023

Weather: Cloudy

Location: In the surveying lab oratory

Instruments: 1. leveling rod
2. level device

sKetch

The Data

Point	r_1	r_2	r_3	HI (m)	h_i (m)	Error
A	1.482	1.422	1.364	101.422	100.000	0.001
B	1.471	1.416	1.361	101.422	100.006	0.000

- $HI = h_A + r_{A2}$
  $= 100 + 1.422$
  $= 101.422\ m$

- $h_B = HI - r_{B2}$
  $= 101.422 - 1.416$
  $= 100.006$

- $Error_{(A)} = \frac{r_1 + r_3}{2} - r_2$

  $= \frac{1.482 + 1.364}{2} - 1.422$

  $= 0.001$ ⇒ It's acceptable

- $Error_{(B)} = \frac{r_1 + r_3}{2} - r_2$

  $= \frac{1.471 + 1.361}{2} - 1.416$

  $= 0.000$ ⇒ It's acceptable

Exp.4:

Closed link leveling

Group B "Mariam Injass"

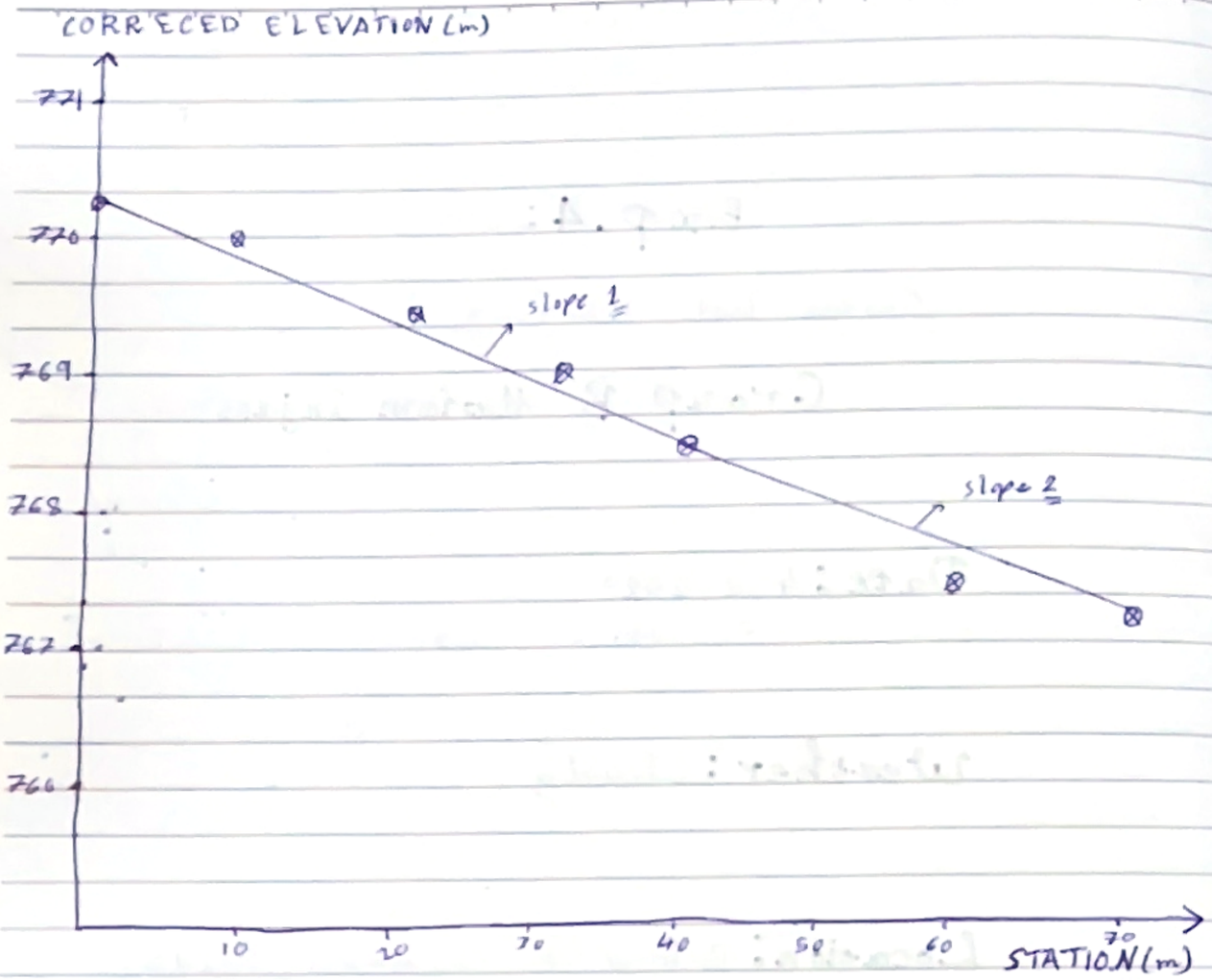
Date: 4.12.2023

Weather: Cloudy

Location: Behind the engineering building

Instruments: 1. leveling rod
2. level device

sKetch



$$\text{slope } \underline{1} = \frac{Y_2 - Y_1}{x_2 - x_1} = \frac{768.349 - 770.288}{40 - 0} = \frac{-1.939}{40} = -0.05\,m$$

$$\text{slope } \underline{\underline{2}} = \frac{Y_2 - Y_1}{x_2 - x_1} = \frac{767.272 - 768.349}{70 - 40} = \frac{-1.077}{30} = -0.04\,m$$

The Data

Point	B.S	I.S	F.S	HI (m)	H (m)	C_f	$H_{corrected}$
BM_1	0.368			770.890	770.522		770.522
P_1		0.609			770.281	0.007	770.288
P_2		0.952			769.938	0.007	769.945
P_3		1.369			769.521	0.007	769.528
P_4		1.908			768.982	0.007	768.989
P_5	0.965		2.548	769.307	768.342	0.007	768.349
P_6		1.842			767.465	0.014	767.479
P_7	1.195		2.049	768.453	767.258	0.014	767.272
BM_2			1.300		767.153	0.021	767.174

- Calculation:

* HI_1 = elevation of BM_1 + BS;
- $HI_1 = 770.522 + 0.368 = 770.890\,m$
- $HI_2 = 768.342 + 0.965 = 769.307\,m$
- $HI_3 = 767.258 + 1.195 = 768.455\,m$

* To check error:

- Error $= \frac{r_1 + r_3}{2} = r_2$

* H (for any point) = $HI_{\text{for the setup}}$ - staff reading at the point

- sample:

$H = HI_1$ - staff reading at the point
$= 770.890 - 0.609$
$= 770.281\,m$

* To check the calculation:

1. No. of setups = No. of T.P + 1

3 = 2 + 1

3 = 3 ✓

2. No. of B.S = No. of F.S

3 = 3 ✓

3. Σ B.S - Σ F.S = Elev. of the last point - Elev. of the first point

2.528 - 5.897 = 767.153 - 770.522

-3.369 = -3.369 ✓

4. Σ Elev. for all points - Elev. of B.M. = [Σ (HI, a (# of IS + # of F.S))] - Σ I.S - Σ F.S

6919.462 - 770.522 = [6161.517] - 6.68 - 5.897

6148.94 = 6148.94 ✓

* Misclosure error (E) = B.M. computed elevation (from leveling) ↓
- Known elevation for B.M.
= 767.153 - 767.174
= -0.021 m

* Tolerance error (mm) = $C\sqrt{K}$

- Misclosure error > Tolerance error

|-0.021| > 0.012 ✓ , not accepted

* To adjust point elevations:

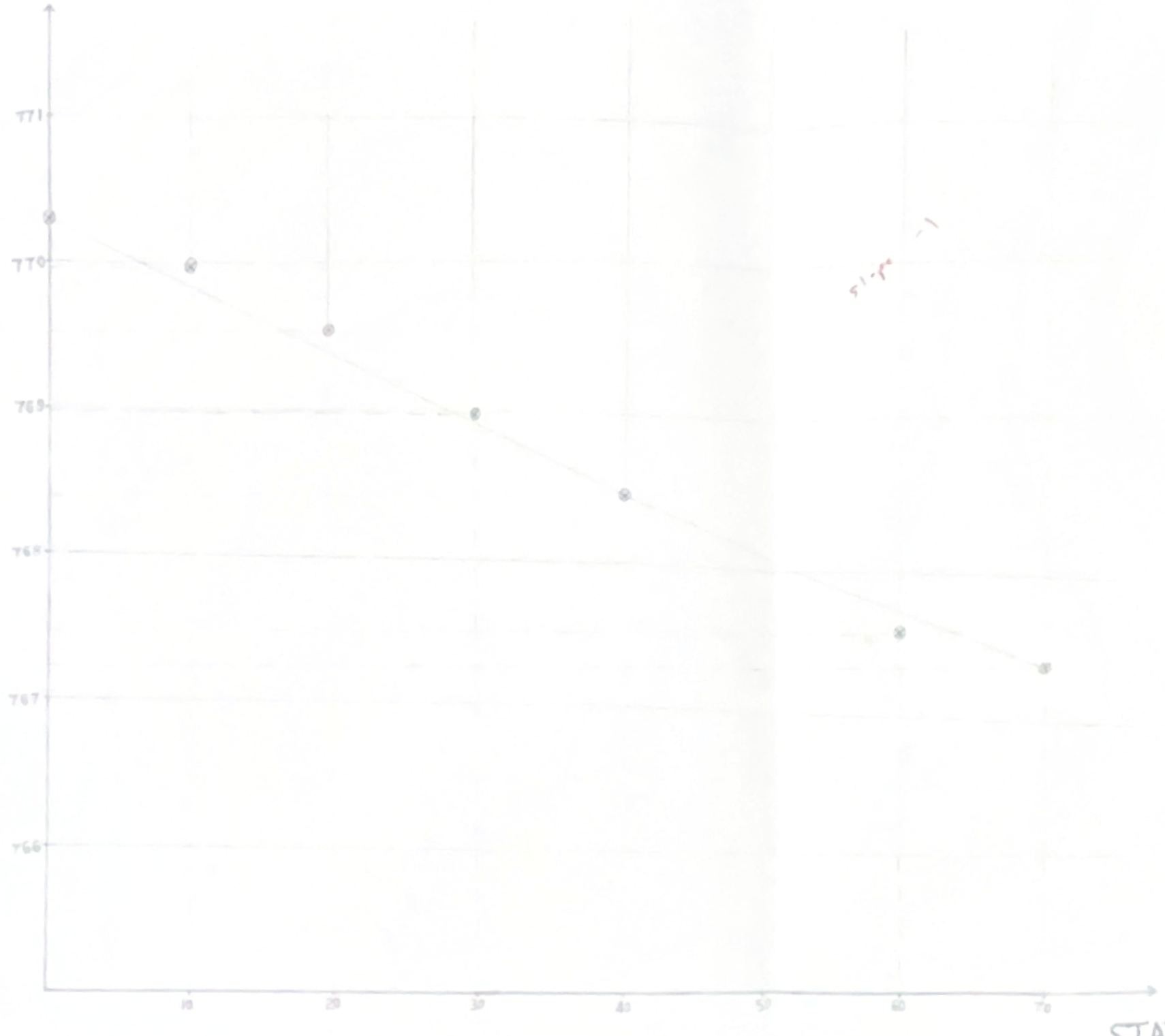
1. Correction (C_i) = $-E \times \frac{\text{No. of level setups up to the point}}{\text{Total No. of setups}}$

- sample: $C_1 = -(-0.021) \times \left(\frac{1}{3}\right)$
$= 0.007$

2. $H_{corrected} = H_{calculated} + C_i$

- sample: $H_{corrected} = 770.281 + 0.007 = 770.288$ m

CORRECED ELEVATION (m)



NORTH: N ↑

BZU

CIVIL DEP

ENCE 316

DONE BY

NAME: MARIAM INJASS

NO.: 1210934

GROUP B

LEGEND

⊗ STATION

△ BENCH MARK

SCALE:

VERTICAL SCALE: 1:25

HORIZONTAL SCALE: 1:250

DATE: 7.1.2024

UNIT: METER

Exp.6:

practicing the use of theodolite

Group B "Mariam Injass"

Date: 27.11.2023

Weather: Rainy and cloudy

Location: In the surveying laboratory

Instruments: 1. leveling rod
2. level device

Sketch

The Data

Set angle	station	Point	F_R	$HA_{1,i}$	F_L	$HA_{2,i}$	HA_i	HA
0°	A	B	0°	53°52'00"	179°53'04"	53°55'21"	53°53'40.5"	53°43'35.5"
		C	53°52'00"		233°48'25"			
90°	A	B	90°00'06"	53°40'26"	270°13'50"	53°26'35"	53°33'30.5"	
		C	143°40'32"		313°40'23"			

- Calculation:

- $HA_{1,i} = FR_{AC} - FR_{AB} = 53°52'00" - 0° = 53°52'00"$
- $HA_{2,i} = FL_{AC} - FL_{AB} = 233°48'25" - 179°53'04" = 53°55'21"$
- $HA_0 = (HA_{1,0} + HA_{2,0})/2 = (53°52'00" + 53°55'21")/2 = 53°53'40.5"$
- $HA_{90} = (HA_{1,90} + HA_{2,90})/2 = (53°40'26" + 53°26'35")/2 = 53°33'30.5"$
- $HA = (HA_0 + HA_{90})/2 = (53°53'40.5" + 53°33'30.5")/2 = 53°43'35.5$

Exp. 7 :

Measuring Height of object using Stadia Method

Group B "Mariam Injass"

Date: 18.12.2023

Weather: cloudy

Location: In the surveying laboratory

Instruments: 1. Thedeolite device
2. Ranging rod
3. tape

sKetch

The Data

station	point	HR	Stadia Meas				HI
			Z	r_1	r_2	r_3	
A_1	B	0°	88° 58' 45"	1.693m	1.654m	1.614m	
	C	57°46'42"	81° 44' 35"	—	—	—	1.520m
B_1	C	0°	———	—	—	—	
	A	74°52'18"	———	—	—	—	

- Calculation:

1. $\frac{D_{AC}}{\sin\hat{b}} = \frac{D_{AB}}{\sin\hat{c}} \Rightarrow \frac{D_{AC}}{\sin(74°52'18")} = \frac{7.897}{\sin(47°21'00")} \Rightarrow D_{AC} = 10.37m$

* $\hat{a} = R_{AC} - 0 = 57°46'42"$
* $\hat{b} = R_{AB} - 0 = 74°52'18"$
* $\hat{C} = 180 - 57°46'42" - 74°52'18" = 47°21'00"$

- $D_{AB} = Kr(\sin Z_{AB})^2$
  $= (100)(0.079)(\sin(88°58'45"))^2$
  $= 7.897m$

2. $h_C = h_A + HI_A + \frac{D_{AC}}{\tan Z_{AC}}$

$= 100 + 1.520 + \frac{10.37}{\tan(81°44'35")}$

$= 103.023\,m$

Exp. 8:

Traverse measurement using Total station

Group B "Mariam Injass"

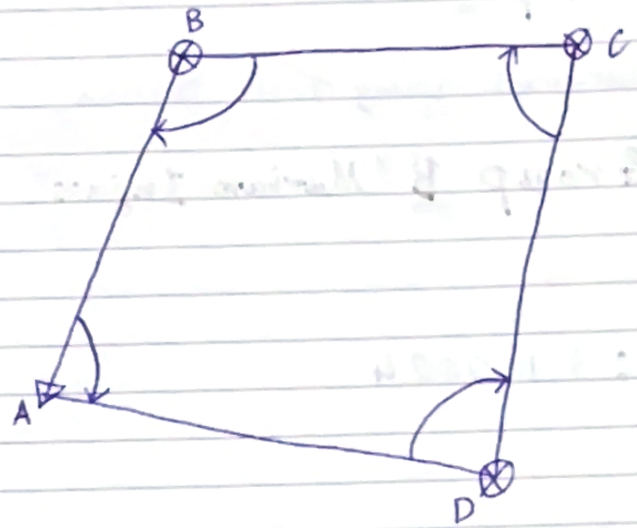
Date: 8.1.2024

Weather: cloudy

Location: In the surveying laboratory

Instruments: 1. Total station device
2. Refloctor
3. Tape

Sketch



The Data

Station	point	HR	HA	Z	VD	HD	SD	HI
A	B	0°	84°52'40"	92°17'10"	0.557	6.190	6.215	1.440
	D	84°52'40"		91°21'18"	0.567	8.447	8.466	
B	C	0°	99°26'23"	85°48'08"	0.565	7.971	7.991	1.420
	A	99°26'23"		95°46'10"	0.431	6.180	6.195	
C	D	0°	89°40'52"	85°35'58"	0.603	7.882	7.905	1.430
	B	89°40'52"		84°48'48"	0.505	7.969	7.985	
D	A	0°	85°29'20"	85°45'26"	0.344	8.447	8.454	1.395
	C	85°29'20"		86°47'32"	0.377	7.881	7.890	

- Calculation :

* Internal angle correction :
  - The sum of internal angle $= 180(n-2) = 180(4-2) = 360$
  - Angular misclosure $= \Sigma$ internal angle $- 180(n-2)$
    $= 359° 29' 15" - 360 = -00° 30' 45"$
  - ε allowable $= c\sqrt{n}$, $c = 90"$
    $= 90" \times \sqrt{4} = 90" \times 2 = 00° 03' 00"$
    $|-00° 30' 45"| > 00° 03' 00"$ ⇒ not accepted
  - Correction $= \frac{-\text{Miscloser error}}{n} = \frac{-(-00° 30' 45")}{4} = 00° 07' 41.25"$
  - Corrected angle = observed angle + correction

$C_A = 85° 00' 21.25"$, $C_B = 99° 34' 4.25"$, $C_C = 89° 48' 33.25"$, $C_D = 85° 37' 1.25"$

Azimuth Calculation :-

$\alpha_{AB} = 15°25'35''$

$\alpha_{BC} = (15°25'35'' + 180°) - 99°34'4.25'' = 95°51'30.75''$

$\alpha_{CD} = (95°51'30.75'' + 180°) - 89°48'33.25'' = 186°02'57.5''$

$\alpha_{DA} = (((186°02'57.5'' + 180°) - 360°) - 85°37'1.25'') + 360° = 280°25'56.2''$

Horizontal distances :-

- $\Delta I_A = (0.0007 \times 6.190) + 0.03 = 0.034m$

$I_{AB} - I_{BA} < \Delta I_A$

$6.190 - 6.180 < 0.034m$

$0.01m < 0.034m$ ✓

$\overline{I_{AB}} = \frac{I_{AB} + I_{BA}}{2} = \frac{12.37}{2} = 6.185m$

- $\Delta I_B = (0.0007 \times 7.971) + 0.03 = 0.036m$

$I_{BC} - I_{CB} < \Delta I_B$

$7.971 - 7.969 < 0.036m$

$0.002m < 0.036m$ ✓

$\overline{I_{BC}} = \frac{I_{BC} + I_{CB}}{2} = \frac{15.94}{2} = 7.97m$

- $\Delta I_C = (0.0007 \times 7.882) + 0.03 = 0.035m$

$I_{CD} - I_{DC} < \Delta I_C$

$7.882 - 7.881 < 0.035m$

$0.001m < 0.035m$ ✓

$\overline{I_{CD}} = \frac{I_{CD} + I_{DC}}{2} = \frac{15.764}{2} = 7.8815m$

- $\Delta I_D = (0.0007 \times 8447) + 0.03 = 0.036m$

$I_{DA} - I_{AD} < \Delta I_D$

$8.447 - 8.447 < 0.036m$

$0 < 0.036m$ ✓

$\overline{I_{DA}} = \frac{I_{DA} + I_{AD}}{2} = \frac{16.894}{2} = 8.447m$

Coordinates and their corrections :-

- $\Delta E_{AB} = I_{AB} \cdot \sin \alpha_{AB}$

$= 6.185 \times \sin(15°25'35'')$

$= 1.645m$

$\Delta N_{AB} = I_{AB} \cdot \cos \alpha_{AB}$

$= 6.185 \times \cos(15°25'35'')$

$= 5.962m$

- $\Delta E_{BC} = I_{BC} \cdot \sin \alpha_{BC}$

$= 7.97 \times \sin(95°51'30.75'')$

$= 7.928m$

$\Delta N_{BC} = I_{BC} \cdot \cos \alpha_{BC}$

$= 7.97 \times \cos(95°51'30.75'')$

$= -0.814m$

- $\Delta E_{CD} = I_{CD} \cdot \sin \alpha_{CD}$

$= 7.8815 \times \sin(186°02'57.5'')$

$= -0.831$

$\Delta N_{CD} = I_{CD} \cdot \cos \alpha_{CD}$

$= 7.8815 \times \cos(186°02'57.5'')$

$= -7.838m$

- $\Delta E_{DA} = I_{DA} \cdot \sin \alpha_{DA}$

$= 8.447 \times \sin(280°25'56.2'')$

$= -8.307m$

$\Delta N_{DA} = I_{DA} \cdot \cos \alpha_{DA}$

$= 8.447 \times \cos(280°25'56.2'')$

$= 1.529m$

- $\delta \Delta E = \Sigma \Delta E = 0.435m$
- $\delta \Delta N = \Sigma \Delta N = -1.161m$
- $\delta = \sqrt{(\Sigma \Delta E)^2 + (\Sigma \Delta N)^2} = 1.240m$
- $\delta allowable = 0.0009(\Sigma \bar{I}) + 0.2 = 0.0009 \cdot (5.685) + 0.2 = 0.205m$

- $\Delta E_{AB} = \frac{-L_{AB\,avg}}{\Sigma L} \times (\delta \Delta E) = \frac{-1.440}{5.685} \times (0.435) = -0.110\,m$

$\Delta N_{AB} = \frac{-L_{AB\,avg}}{\Sigma L} \times (\delta \Delta N) = \frac{-1.440}{5.685} \times (-1.161) = 0.294\,m$

- $\Delta E_{BC} = \frac{-L_{BC\,avg}}{\Sigma L} \times (\delta \Delta E) = \frac{-1.420}{5.685} \times (0.435) = -0.109\,m$

$\Delta N_{BC} = \frac{-L_{BC\,avg}}{\Sigma L} \times (\delta \Delta N) = \frac{-1.420}{5.685} \times (-1.161) = 0.290\,m$

- $\Delta E_{CD} = \frac{-L_{CD\,avg}}{\Sigma L} \times (\delta \Delta E) = \frac{-1.430}{5.685} \times (0.435) = -0.109\,m$

$\Delta N_{CD} = \frac{-L_{CD\,avg}}{\Sigma L} \times (\delta \Delta N) = \frac{-1.430}{5.685} \times (-1.161) = 0.292\,m$

- $\Delta E_{DA} = \frac{-L_{DA\,avg}}{\Sigma L} \times (\delta \Delta E) = \frac{-1.395}{5.685} \times (0.435) = -0.107\,m$

- $\Delta N_{DA} = \frac{-L_{DA\,avg}}{\Sigma L} \times (\delta \Delta N) = \frac{-1.395}{5.685} \times (-1.161) = 0.285\,m$

- To find corrected coordinates :-
  - ΔE corrected = ΔE calculated + ΔE correction
  - ΔN corrected = ΔN calculated + ΔN correction

- $\Delta E_{AB} = 1.645 + -0.110 = 1.535\,m$
- $\Delta N_{AB} = 5.962 + 0.294 = 6.256\,m$

- $\Delta E_{BC} = 7.928 + -0.109 = 7.819\,m$
- $\Delta N_{BC} = -0.814 + 0.290 = -0.524\,m$

- $\Delta E_{CD} = -0.831 + -0.109 = -0.940\,m$
- $\Delta N_{CD} = -7.838 + 0.292 = -7.546\,m$

- $\Delta E_{DA} = -8.307 + -0.107 = -8.414\,m$
- $\Delta N_{DA} = 1.529 + 0.285 = 1.814\,m$

- A(E, N, H) = A(100, 150, 200)
  - $E_B = E_A + \Delta E_{AB} = 100 + 1.535 = 101.535\,m$
  - $N_B = N_A + \Delta N_{AB} = 150 + 6.256 = 156.256\,m$

  - $E_C = E_B + \Delta E_{BC} = 101.535 + 7.819 = 109.354\,m$
  - $N_C = N_B + \Delta N_{BC} = 156.256 + -0.524 = 155.732\,m$

  - $E_D = E_C + \Delta N_{CD} = 109.354 + -0.940 = 108.414\,m$
  - $N_D = N_C + \Delta N_{CD} = 155.732 + -7.546 = 148.186\,m$

*To check :-
- $E_A = E_D + \Delta E_{DA} = 108.414 + -8.414 = 100\,m$ ✓
- $N_A = N_D + \Delta N_{DA} = 148.186 + 1.814 = 150\,m$ ✓

- $\alpha_{AB} = \tan^{-1}\left(\frac{1.535}{6.256}\right) + 0 = 13°47'9.59''$
- $\alpha_{BC} = \tan^{-1}\left(\frac{7.819}{-0.524}\right) + 180 = 93°50'2.45''$
- $\alpha_{CD} = \tan^{-1}\left(\frac{-0.940}{-7.546}\right) + 180 = 187°06'2.58''$
- $\alpha_{DA} = \tan^{-1}\left(\frac{-8.414}{1.814}\right) + 360 = 282°9'58.88''$

* Elevation of traverse point :-

$- H_B = H_A + HI_A + VD_B - RH$

$= 200 + 1.440 + 0.562 - 2$

$= 200.002m$

$- H_C = H_B + HI_B + VD_C - RH$

$= 200.002 + 1.420 + 0.498 - 2$

$= 199.92\ m$

$- H_D = H_C + HI_C + VD_D - RH$

$= 199.92 + 1.430 + 0.554 - 2$

$= 199.904m$

$- H_A = H_D + HI_D + VD_A - RH$

$= 199.904 + 1.395 + 0.3605 - 2$

$= 199.6595m$

* $\varepsilon = H_A - 200$

$= 199.6595 - 200$

$= -0.3405$

* $C_i = -\left(\frac{i}{n}\right)\varepsilon$, $n = 4$ setups

$- C_B = -\left(\frac{1}{4}\right) \times (-0.3405) = 0.085m$

$- C_C = -\left(\frac{2}{4}\right) \times (-0.3405) = 0.170m$

$- C_D = -\left(\frac{3}{4}\right) \times (-0.3405) = 0.255m$

$- C_A = -\left(\frac{4}{4}\right) \times (-0.3405) = 0.3405m$

$- H'_B = H_B + C_B = 200.002 + 0.085 = 200.087m$

$- H'_C = H_C + C_C = 199.92 + 0.170 = 200.09\ m$

$- H'_D = H_D + C_D = 199.904 + 0.255 = 200.159\ m$

$- H'_A = H_A + C_A = 199.6595 + 0.3405 = 200\ m$

, $RH = 2m$

$- VD_B = \left(\frac{0.557 + 0.567}{2}\right)$

$= 0.562$

$- VD_C = \left(\frac{0.565 + 0.431}{2}\right)$

$= 0.498$

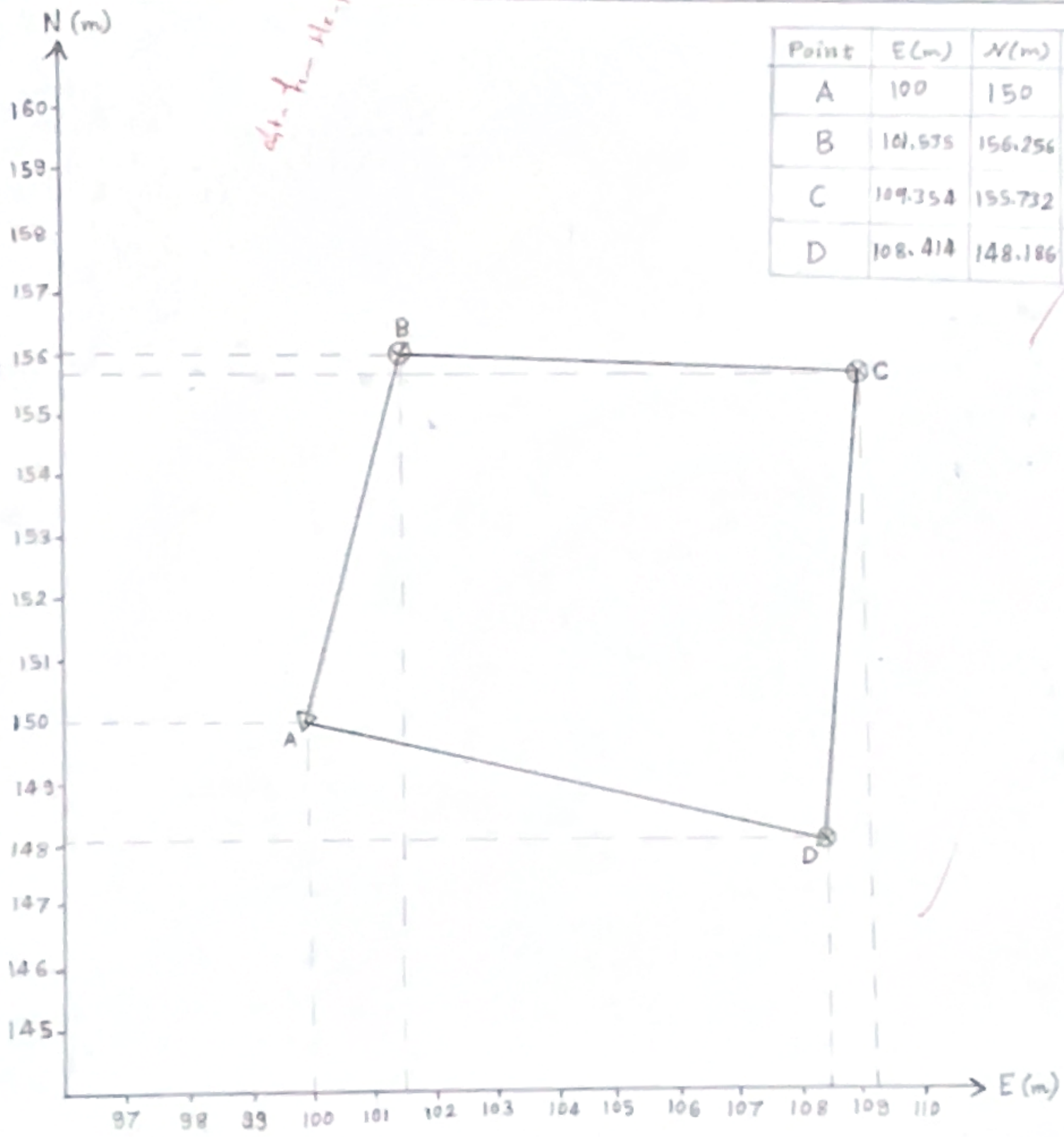
$- VD_D = \left(\frac{0.603 + 0.505}{2}\right)$

$= 0.554$

$- VD_A = \left(\frac{0.344 + 0.377}{2}\right)$

$= 0.3605$

Point	E(m)	N(m)	H(m)
A	100	150	200
B	101.575	156.256	199.997
C	109.354	155.732	199.982
D	108.414	148.186	200.015



NORTH: ↑

BZU

CIVIL DEP

ENCE316

DONE BY:

NAME: MARIAM INJASS

NO.: 1210934

GROUP B

LEGEND

⊗ STATION

△ BENCH MARK

SCALE: 1:100

DATE: 28.1.2024

UNIT: METER

Exp 9:

Mapping using Total station

Group B "Mariam Injass"

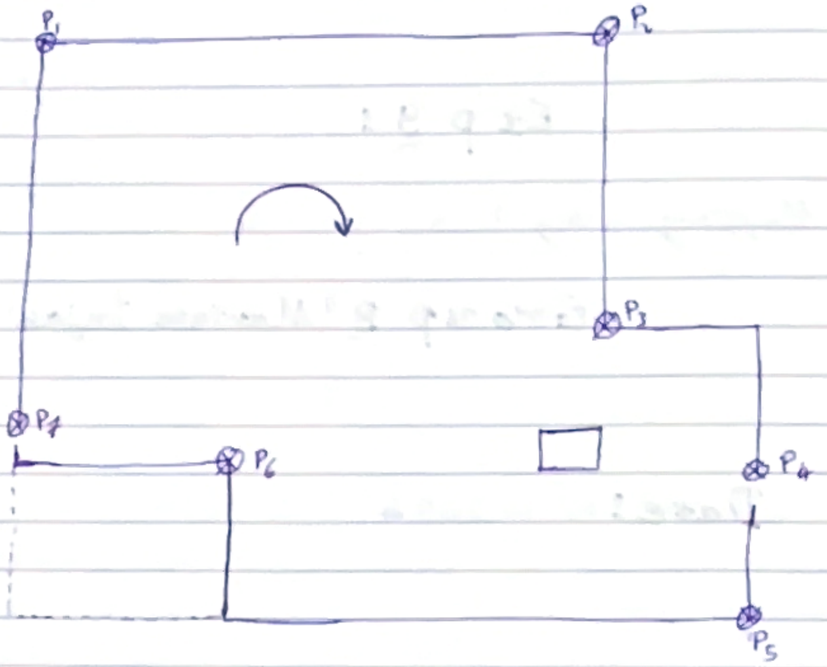
Date: 17.1.2024

Weather: cloudy

Location: In the surveying laboratory

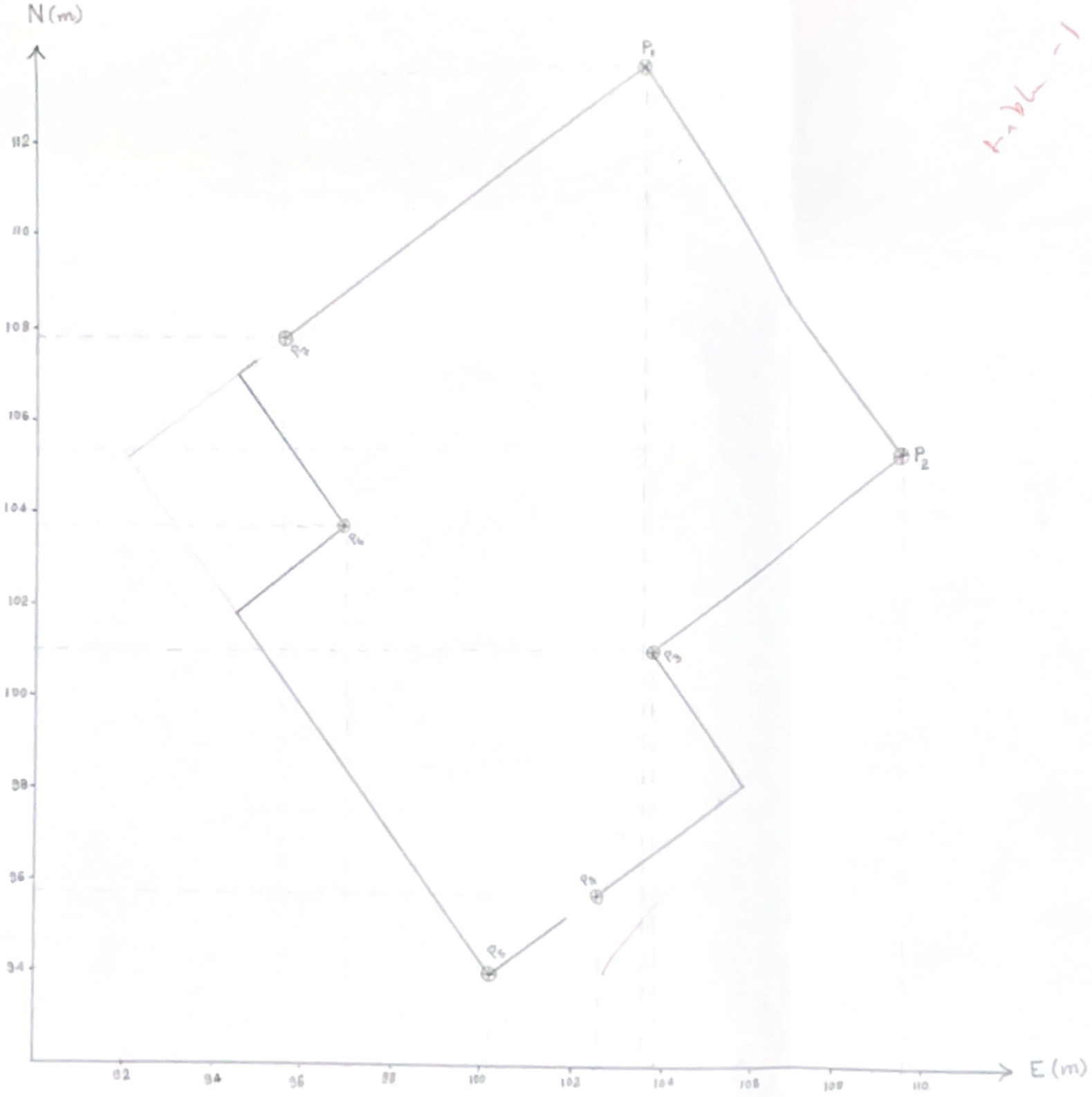
Instruments: 1. Total station device
2. Reflector

Sketch



The Data

Point	E (m)	N (m)
1	103.728	112.513
2	109.624	105.287
3	103.892	101.057
4	102.627	95.722
5	100.226	94.056
6	97.035	103.795
7	95.652	107.806



NORTH: ↑

BZU
CIVIL DEP
ENCE316

DONE BY:
NAME: MARIAM INJASS
NO.: 1210934
GROUP B

LEGEND
⊗ POINT

SCALE:
1:200

DATE: 28.1.2024

UNIT: METER