Exp. 1

Taping & Pacing

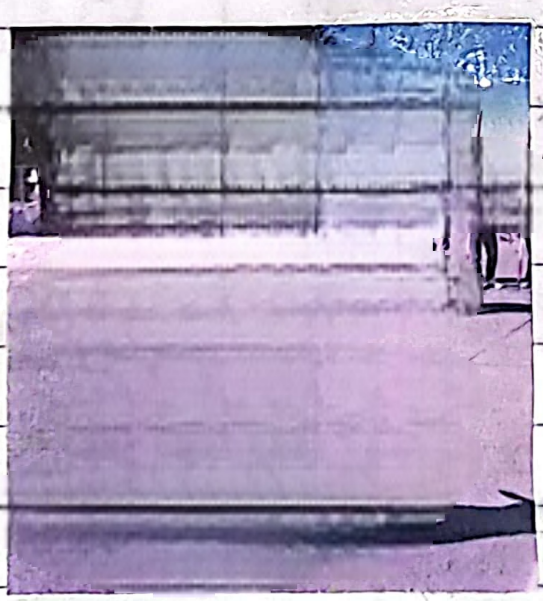
Group "A"

Date: 25-9-2023

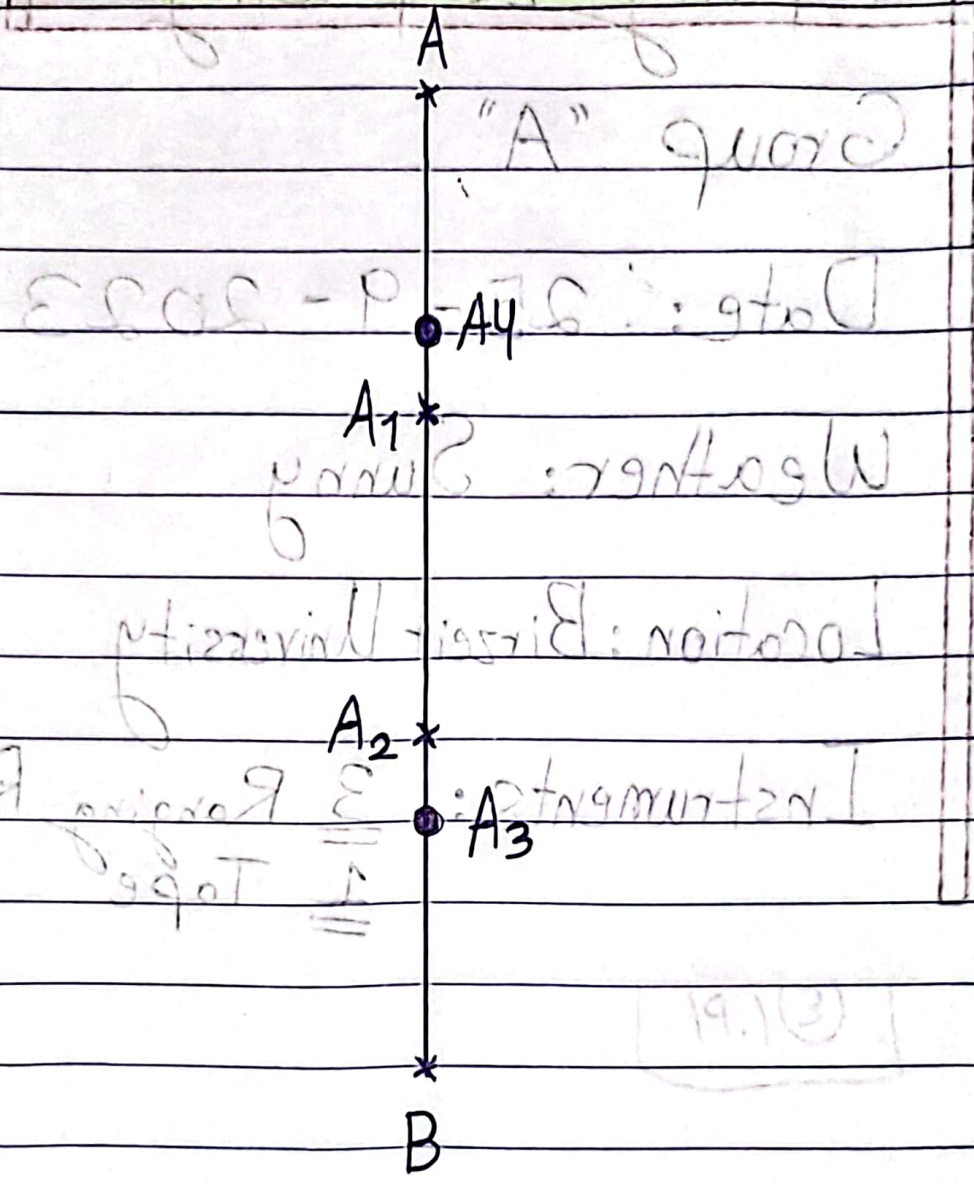
Weather: Sunny

Location: Birzeit University

Instruments: 3 Ranging Rods
1 Tape



SKetch:-



Data:-

True value = 43.574 m

Forward :-

Segment	Distance (m)
AA_1	15.77
A_1A_2	15.32
A_2B	12.43

$L_f = 15.77 + 15.32 + 12.43$

$= 43.52$ m

Backward :-

Segment	Distance (m)
A_3B	19.34
A_4A_3	12.95
AA_4	11.28

$L_b = 19.34 + 12.95 + 11.28$

$= 43.57$ m

* $L_{avg} = \frac{L_f + L_b}{2} = \frac{43.52 + 43.57}{2} = 43.545$ m

* $Error = |L_{avg} - L_{True}| = +0.029$ m

* $RP = \frac{1}{\frac{L_{avg}}{|e|}} = \frac{1}{\frac{43.545}{0.029}} = \frac{1}{1501.6}$

Exp. 2

Mapping Using Ties & Offsets

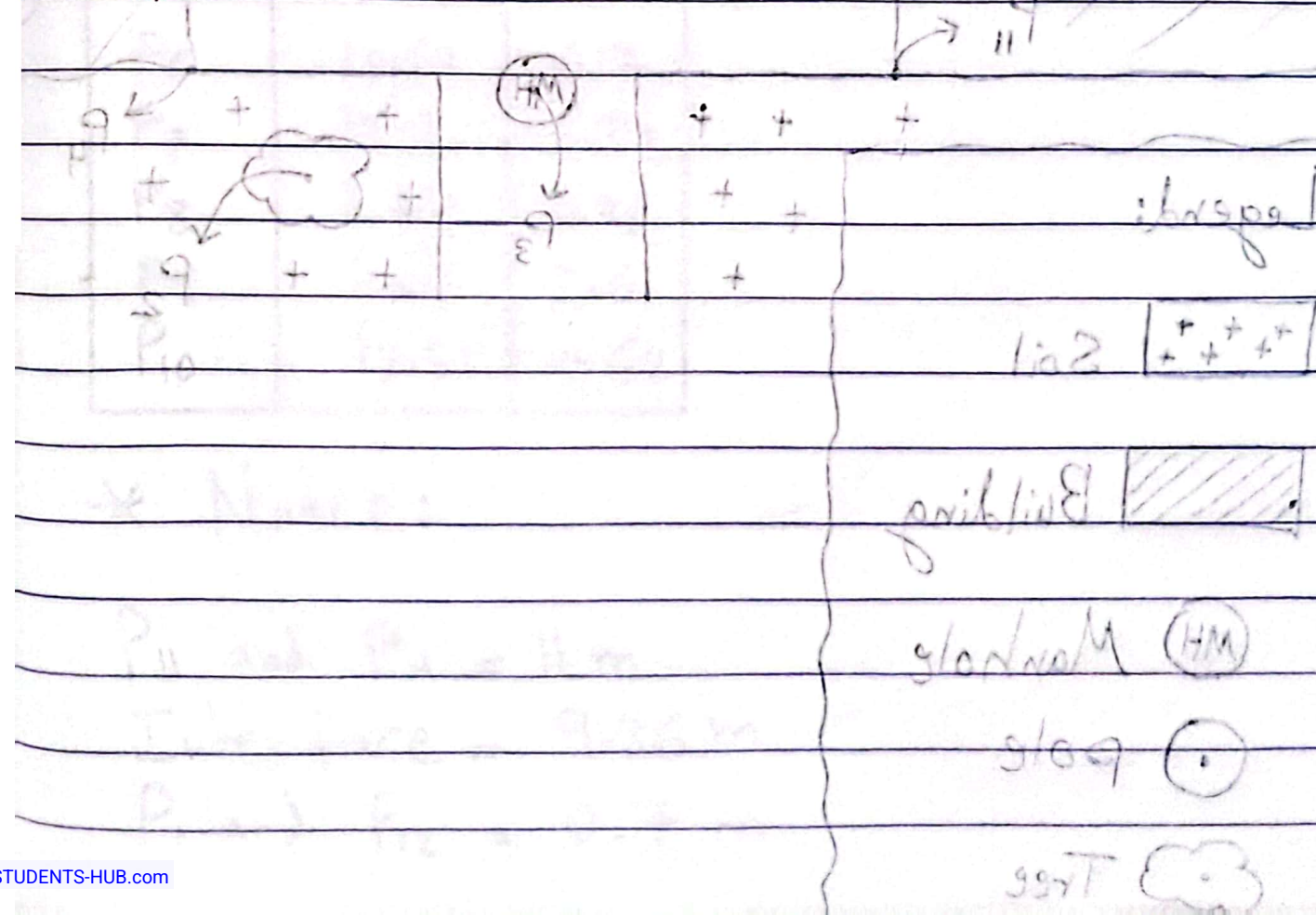
Group "A"

Date: 2 - 10 - 2023

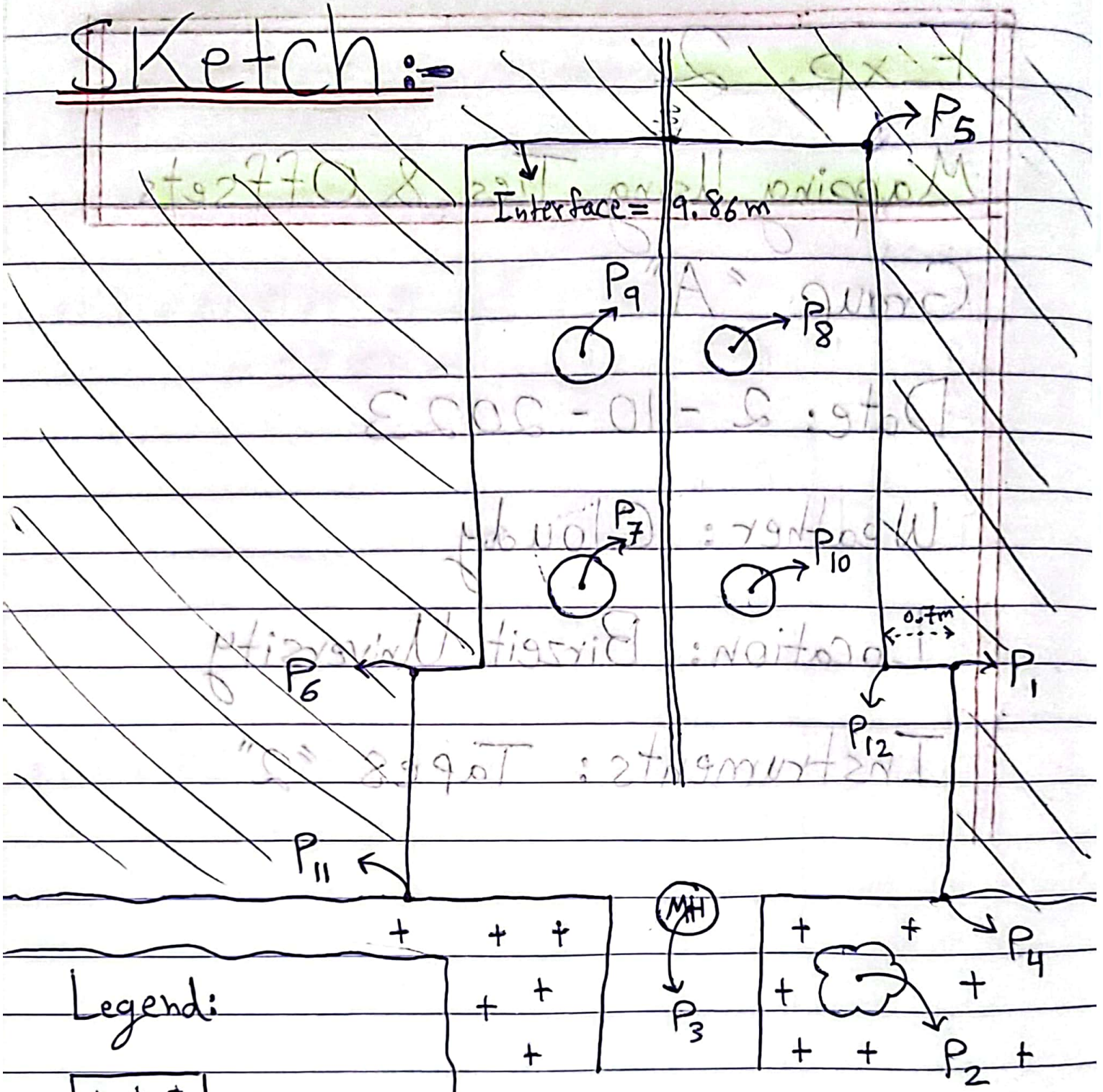
Weather: Cloudy

Location: Birzeit University

Instruments: Tapes "2"



Sketch :-



Legend:

- Soil
- Building
- MH Manhole
- pole
- Tree

Data :-

* Ties Method :

Point	d_1	d_2	d_3	d_4
P_2	15	4.95	12	7.75
P_3	14	2.8	12	4.75
P_4	15	5.75	13	6.95
P_5	1	4.93	3	6.21

* Offset Method :

Point	d_1	d_2
P_1	12.67	4.91
P_6	12.64	6.17
P_7	12.51	2.39
P_8	1.68	0.46
P9	1.68	2.6
P_{10}	12.51	0.62

* Notes :

P_{11} and P_4 = 11 m

Interface = 9.86 m

P_1 and P_{12} = 0.7 m

Exp.3

Practicing the use of the Level:

Khalil Al-Qawasmi & Lama Kurd

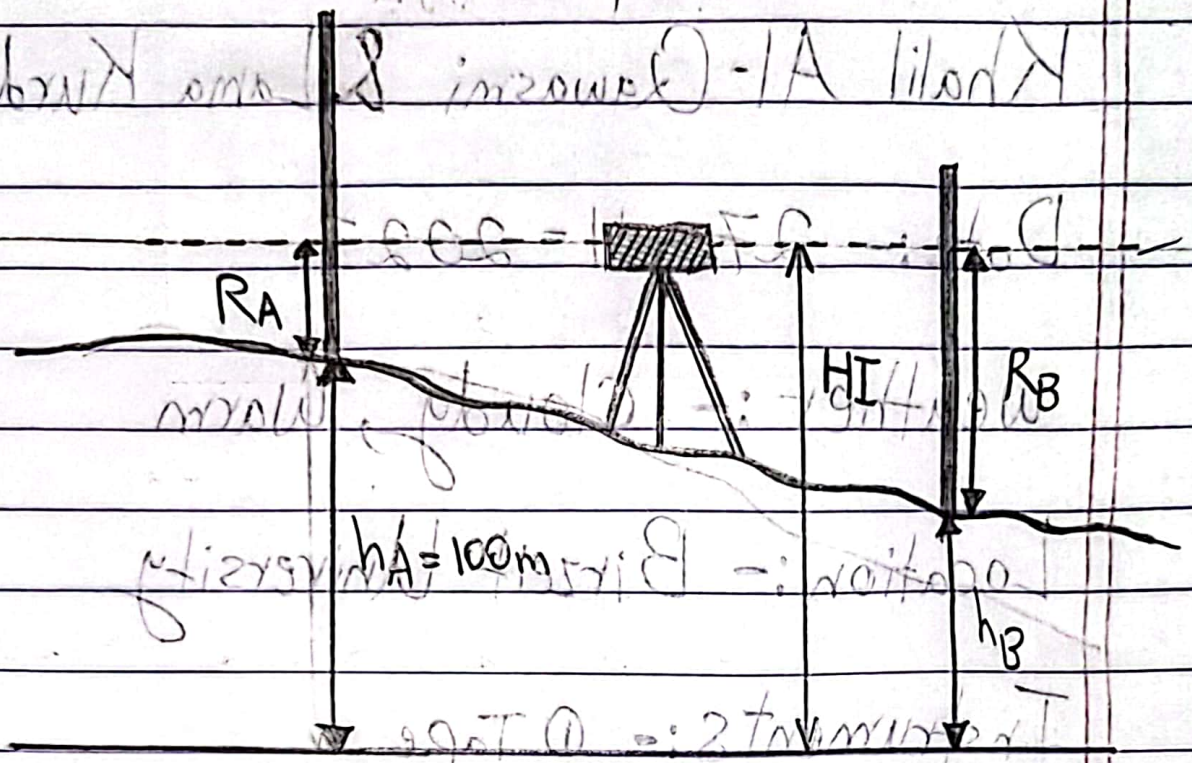
Date:- 27-11-2023

Weather:- Cloudy, warm

Location:- Birzeit University

Instruments:- ① Tape
② 1 Staff
③ Leveling Device

Sketch :-



Data:-

Point	r_1 (m)	r_2 (m)	r_3 (m)	HI (m)	h (m)	Error
A	1.14	1.09	1.045	101.09	100	0.0025
B	0.38	0.345	0.305	101.09	100.745	-0.0025

* $HI = h_A + r_{2A} = 100 + 1.09 = 101.09$ m

* $h_B = HI - r_{2B} = 101.09 - 0.345 = 100.745$ m

* $\text{Error } A = \left[\frac{r_{1A} + r_{3A}}{2}\right] - r_{2A} = \left(\frac{1.14 + 1.045}{2}\right) - 1.09$

$= 1/400 = 0.0025$

* $\text{Error } B = \left[\frac{r_{1B} + r_{3B}}{2}\right] - r_{2B} = \left(\frac{0.38 + 0.305}{2}\right) - 0.345$

$= -1/400 = -0.0025$

Exp. 4
Closed Link Leveling

Group :- Khalil Al-Qawasmi
Mohammad Shtaya
Lama Kurd
Dana Arafat

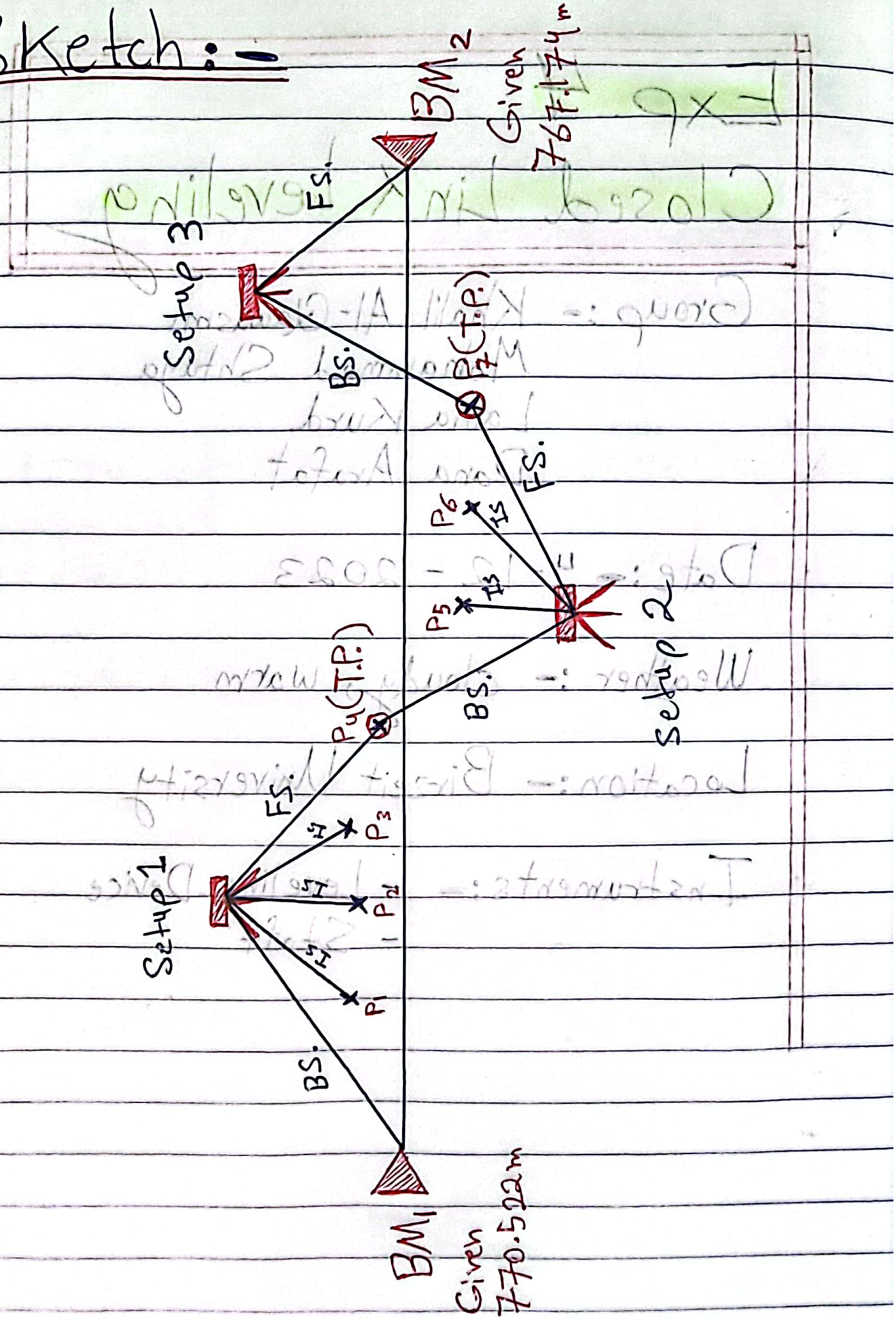
Date :- 4 - 12 - 2023

Weather :- cloudy, warm

Location :- Birzeit University

Instruments :- - Leveling Device
- Staff

Sketch :-



Data:-

(All Units are Cm)

Point	BS	IS	FS	HI	H	check $r_2 \approx \frac{r_1+r_3}{2}$
BM_1	0.46			770.982	770.522	$r_1=0.6$, $r_3=0.32$
P_1		0.705			770.277	$r_2 \approx 0.46$
P_2		1.045			769.937	
P_3		1.465			769.517	
P_4	0.1		2.0	769.082	768.982	→ T.P.
P_5		0.74			768.342	
P_6		1.62			767.462	
P_7	1.095		1.825	768.352	767.257	→ T.P.
BM_2			0.175		768.177	True = 767.174
SUM	1.655	5.575	4		6920.478	

Table Calculations:-

$HI_1 = H(BM_1) + BS$

$HI_2 = H(P_4) + BS$

$HI_3 = H(P_7) + BS$

$H_{(any)} = HI - \text{Staff reading}$

Computational Checks:-

① 3 setups = 2 T.P. + 1 ✓

② 3 BS = 3 FS ✓

③ $\Sigma BS - \Sigma FS = H(BM_1) - H(BM_2) = -2.345$ ✓

④ $[6920.478 - 770.5222] = 770.982(4) + 769.082(3) + 768.352 - 5.575 - 4 = 6149.951$ ✓

$= 6149.951$ ↵

Error:-

$\varepsilon = BM_{2\,Comp.} - BM_{2\,True}$

$768.177 - 767.174 = 1.003\,m > 12\,mm$

$T = C\sqrt{K}$ (3°, $\frac{160}{1000}$)

Not OK!

* Adjusting Elevations :-

P1	IH	27	2I	28

* $C_i = -\varepsilon * \frac{\text{No. setups up to the point}}{\text{Total Setups}}$

for $P_1 \Rightarrow -1.003 * \frac{1}{3} = -0.3343$

P_2, P_3, P_4

for $P_5, P_6, P_7 \Rightarrow -1.003 * \frac{2}{3} = -0.6687$

for $BM_2 \Rightarrow -1.003 * \frac{3}{3} = -1.003$

* Corrected Values :- $H_{corrected} = H_{calc.} + C_i$

- $P_1' = 770.277 - 0.3343 = 769.9427$ m
- $P_2' = 769.937 - 0.3343 = 769.6027$ m
- $P_3' = 769.517 - 0.3343 = 769.1827$ m
- $P_4' = 768.982 - 0.3343 = 768.6477$ m

- $P_5' = 768.342 - 0.6687 = 767.6733$ m
- $P_6' = 767.462 - 0.6687 = 766.7933$ m
- $P_7' = 767.257 - 0.6687 = 766.5883$ m
- $BM_2' = 768.177 - 1.003 = 767.174$ m

Exp. 7 Stadia Method By Theodlite

Khalil Al-Qawasmi
Mohammad Shtayeh
Lama Kurd
Dana Arafat

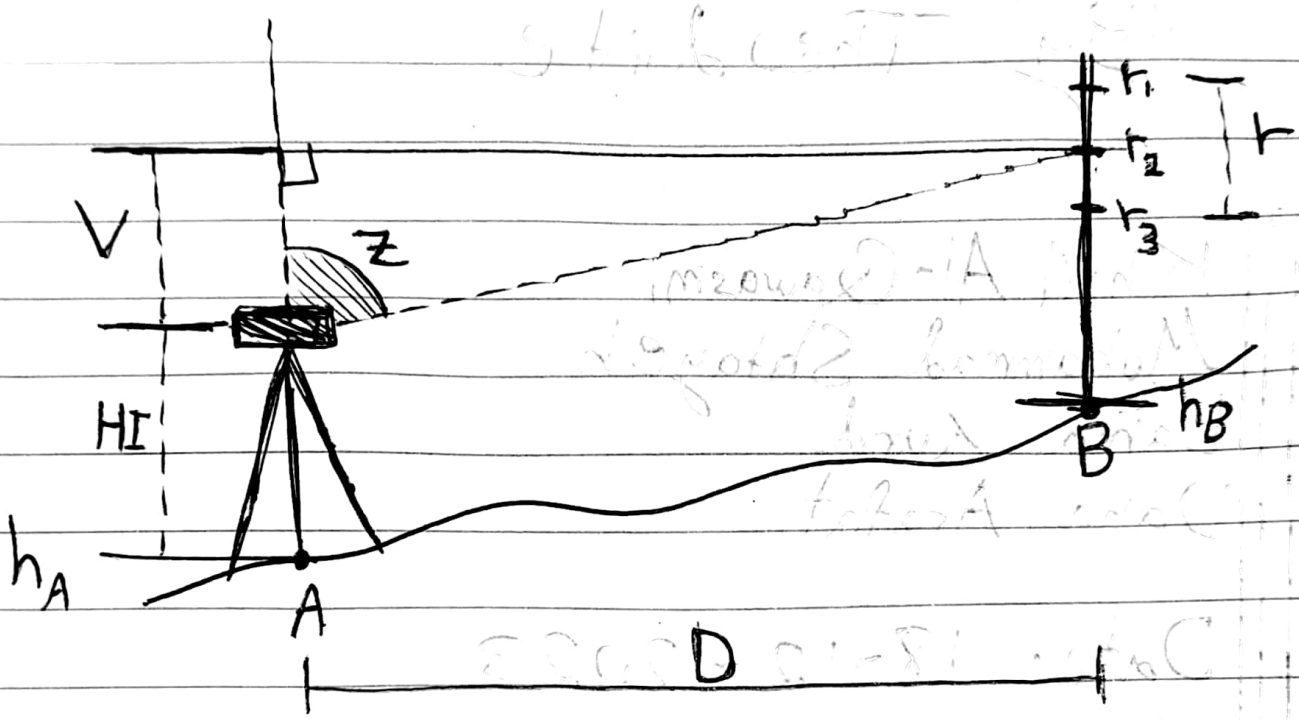
Date: 18-12-2023

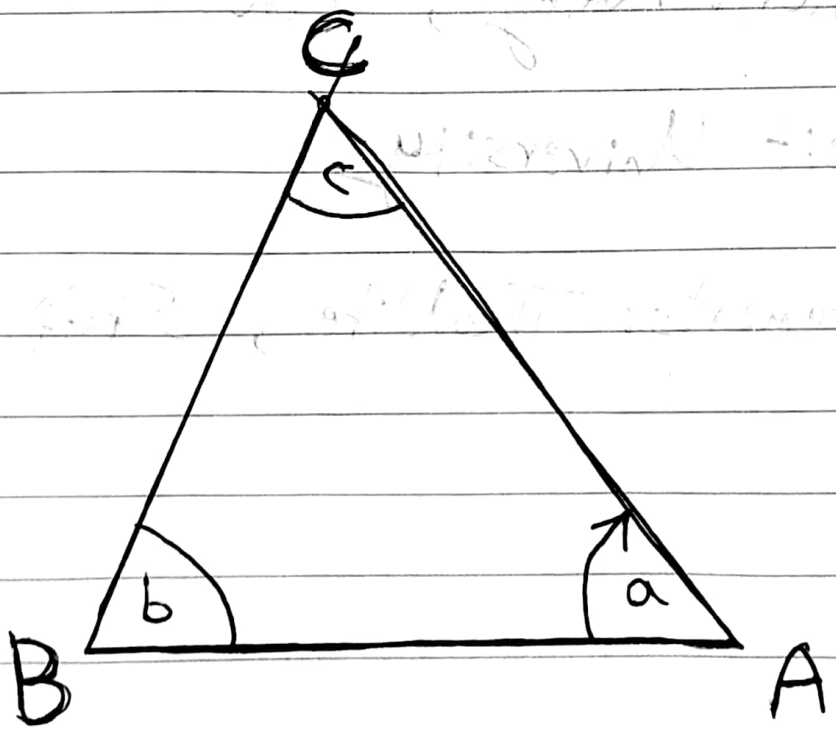
Weather: Rainy, Cold

Birzeit University

Instruments: Theodlite, Staff

Sketch:-





Data:-

Sta.	Point	HR	Z	r_1	r_2	r_3	HI
A	B	0°	81° 13' 14"	2.635	2.60	2.565	1.45
	C	54° 51' 45"	82° 52' 25"	–	–	–	–
B	C	0°	–	–	–	–	–
	A	88° 06' 53"	–	–	–	–	–

Calculations:-

[1] $\frac{D_{AC}}{\sin b} = \frac{D_{AB}}{\sin c}$

* $\hat{a} = R_{AC} - 0° = 54° 51' 45"$
* $\hat{b} = R_{BA} - 0° = 88° 06' 53"$
* $\hat{c} = 180° - \hat{a} - \hat{b} = 37° 1' 22"$
* $D_{AB} = K_t (\sin Z_{AB})^2$
  $= 100 (2.635 - 2.565) (\sin 81° 13' 14")$
  $= 6.84 \text{ m}$

* $D_{AC} = \frac{D_{AB}}{\sin \hat{c}} (\sin \hat{b}) = \frac{6.84 * \sin(88° 06' 53")}{\sin(37° 1' 22")}$

$D_{AC} = 11.35 \text{ m}$

[2] $h_c = h_A + HI_A + \frac{D_{AC}}{\tan Z_{AC}}$

$= 100 + 1.45 + \frac{11.35}{\tan(82° 52' 25")}$

$h_c = 102.87 \text{ m}$ #

EXP. 8

Traverse By Total Station

Khalil Al-Qawasmi
Mohamad Shtayeh
Sanabel Eweis
Naddeen Hammad

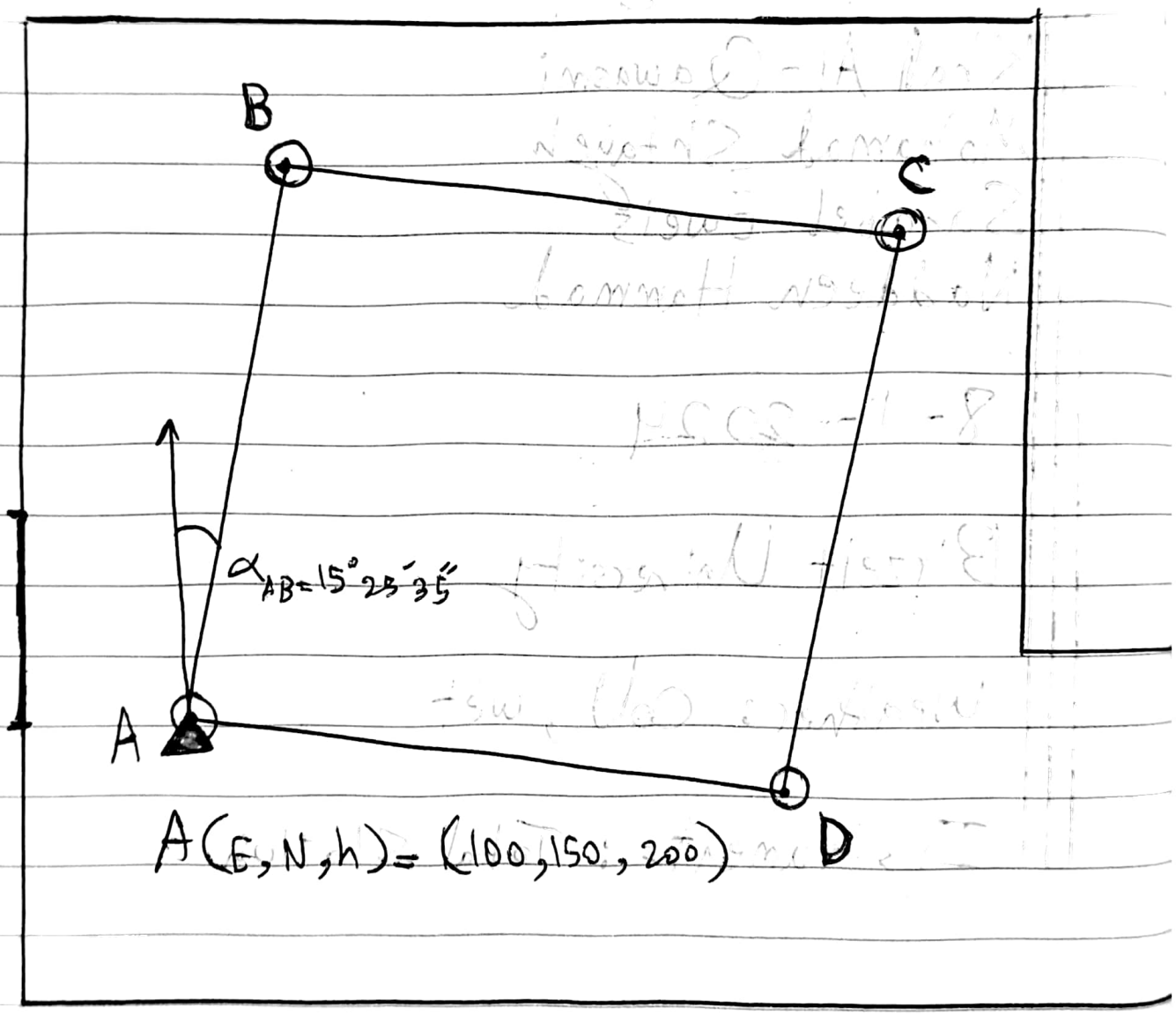
8-1-2024

Birzeit University

Weather: Cold, wet

Instruments: Total Station

SKetch :-



Data & Calculations :-

Sta.	Point	HR	HA	Z	HD	VD	SD	HI
	B	0°		86° 58' 50"	8.76	0.43	8.77	
A			97° 29' 29"					1.54
	D	a		85° 24' 18"	5.81	0.44	5.83	
	C	0°		86° 52' 45"	6.62	0.44	6.63	
B			74° 34' 12"					1.53
	A	b		86° 54' 00"	8.76	0.44	8.78	
	D	0°		86° 30' 55"	7.80	0.45	7.81	
C			101° 08' 31"					1.54
	B	c		85° 58' 58"	6.58	0.43	6.60	
	A	0°		85° 28' 01"	5.82	0.43	5.84	
D			86° 24' 37"					1.53
	C	d		86° 31' 55"	7.80	0.44	7.82	

* Interior Angle Correction → h

- The sum of Interior Angles = $180(4-2) = 360°$
- Angular misclosure = Σ I. Angles $- 360$
  $= 359° 36' 49" - 360°$
  $= - 0° 23' 11"$
- $\Sigma_{allowable} = C\sqrt{n} = 90"\sqrt{4} = 0° 3' 0"$

$0^\circ 23' 11''$ ↑ $0^\circ 3' 0''$ ↑

$\Rightarrow$ Angular misclosure $(23') > \varepsilon_{allow}(3')$

Error not Accepted.

- Correction $= -\frac{\text{misclosure Error}}{n} = -\frac{(-0^\circ 23' 11'')}{4}$

$= 0^\circ 5' 48''$

- Corrected angle = Observed + Correction

$a'_{corrected} = 97^\circ 29' 29'' + 0^\circ 5' 48'' = 97^\circ 35' 17''$

$b' = 74^\circ 40' 0''$

$c' = 101^\circ 14' 19''$

$d' = 86^\circ 30' 25''$

$\rightarrow$ Sum $= 360^\circ 0' 1''$ OK ✓

بسبب التقريب

* Azimuth Calculation:-

Given $\alpha_{AB} = 15^\circ 25' 35''$

- $\alpha_{BA} = \alpha_{AB} + 180^\circ = 195^\circ 25' 35''$
- $\alpha_{BC} = \alpha_{BA} - b'$

$= 195^\circ 25' 35'' - 74^\circ 40' 0''$

$= 120^\circ 45' 35.2''$

- $\alpha_{CB} = \alpha_{BC} + 180^\circ = 300^\circ 45' 35.2''$
- $\alpha_{CD} = \alpha_{CB} - c' = 300^\circ 45' 35.2'' - 101^\circ 14' 19''$

$\Rightarrow \alpha_{CD} = 199^\circ\ 31'\ 16.5''$

- $\alpha_{DC} = \alpha_{CD} + 180^\circ = 379^\circ\ 31'\ 16'' - 360^\circ$
$= 19^\circ\ 31'\ 16.5''$

- $\alpha_{DA} = 360^\circ - (\alpha - \alpha_{DC})$
$= 360^\circ - (86^\circ\ 30'\ 25'' - 19^\circ\ 31'\ 16.5'')$
$= 293^\circ\ 0'\ 51.5''$

* Horizontal Distances :-

- $L_{AB} = \frac{AB + BA}{2} = \frac{8.76 + 8.76}{2} = 8.76\ m$

- $L_{AD} = \frac{AD + DA}{2} = \frac{5.81 + 5.82}{2} = 5.815\ m$

- $L_{BC} = \frac{BC + CB}{2} = \frac{6.62 + 6.58}{2} = 6.60\ m$

- $L_{CD} = \frac{CD + DC}{2} = \frac{7.80 + 7.80}{2} = 7.80\ m$

$\Rightarrow \Sigma L = 28.975\ m$

✱ Coordinates and their Corrections :-

AB → $\Delta E_{AB} = L_{AB} \sin \alpha_{AB} = 2.33\ m$

$\Delta N_{AB} = L_{AB} \cos \alpha_{AB} = 8.44\ m$

BC → $\Delta E_{BC} = L_{BC} \sin \alpha_{BC}$

$= (6.6) \sin(120^\circ 45' 35.2'')$

$= 5.67\ m$

$\Delta N_{BC} = L_{BC} \cos \alpha_{BC} = -3.38\ m$

CD → $\Delta E_{CD} = L_{CD} \sin \alpha_{CD} = -2.61\ m$

$\Delta N_{CD} = L_{CD} \cos \alpha_{CD} = -7.35\ m$

DA → $\Delta E_{DA} = L_{DA} \sin \alpha_{DA} = -5.35\ m$

$\Delta N_{DA} = L_{DA} \cos \alpha_{DA} = 2.27\ m$

✱ Departure Error : $\delta E = \Sigma \Delta E = 0.04\ m$

Latitude Error : $\delta N = \Sigma \Delta N = -0.02\ m$

✱ Total closing Error $\delta = \sqrt{(\Sigma \Delta E)^2 + (\Sigma \Delta N)^2} = 0.045m$

✱ $\delta_{allowable} = 0.0009(\Sigma L) + 0.2$

$= 0.0009(28.975) + 0.2 = 0.226$

Total $\delta < \delta_{allowable}$ ✓

* Departure Correction:- $\left(\frac{-L_i}{\Sigma L} * \delta E\right)$

AB $\longrightarrow \left(\frac{-8.76}{28.975}\right)(0.04) = -0.012$ m

BC $\longrightarrow \left(\frac{-6.60}{28.975}\right)(0.04) = -0.0091$ m

CD $\longrightarrow \left(\frac{-7.80}{28.975}\right)(0.04) = -0.011$ m

DA $\longrightarrow \left(\frac{-5.815}{28.975}\right)(0.04) = -0.008$ m

* Latitude Correction:- $\left(\frac{-L_i}{\Sigma L} * \delta N\right)$

AB $\longrightarrow \left(\frac{-8.76}{28.975}\right)(-0.02) = 0.006$ m

BC $\longrightarrow \left(\frac{-6.60}{28.975}\right)(-0.02) = 0.0046$ m

CD $\longrightarrow \left(\frac{-7.80}{28.975}\right)(-0.02) = 0.0054$ m

DA $\longrightarrow \left(\frac{-5.815}{28.975}\right)(-0.02) = 0.004$ m

$\Delta E'_{(corrected)} = \Delta E + Correction$

$\Delta N'(corrected) = \Delta N + Correction$

AB $\longrightarrow$ $\Delta E' = 2.33 - 0.012 = 2.318 m$

$\Delta N' = 8.44 + 0.006 = 8.446 m$

BC $\longrightarrow$ $\Delta E' = 5.67 - 0.0091 = 5.6609 m$

$\Delta N' = -3.38 + 0.0046 = -3.3754 m$

CD $\longrightarrow$ $\Delta E' = -2.61 + -0.011 = -2.621 m$

$\Delta N' = -7.35 + 0.0054 = -7.3446 m$

DA $\longrightarrow$ $\Delta E' = -5.35 - 0.008 = -5.358 m$

$\Delta N' = 2.27 + 0.004 = 2.274 m$

*Now Points Correction :-

Pt. A (100, 150, 200) Given.

- Pt. B $\longrightarrow$ $E_B = E_A + \Delta E_{AB} = 2.318 + 100 = 102.318 m$

$N_B = N_A + \Delta N_{AB} = 8.446 + 150 = 158.446 m$

- Pt. C $\longrightarrow$ $E_C = E_B + \Delta E_{BC} = 107.98 m$

$N_C = N_B + \Delta N_{BC} = 155.07 m$

- Pt. D → $E_D = E_C + \Delta E_{CD} = 105.36\ m$

$N_D = N_C + \Delta N_{CD} = 147.72\ m$

check (A) → $E_A = E_D + \Delta E_{DA}$

$= 105.36 - 5.358 = 100\ m$ ✓

$N_A = N_D + \Delta N_{DA}$

$= 147.72 + 2.274 = 149.99$

≈ 150 ✓

* Azimuth Correction :-

$$\alpha_{12} = \tan^{-1}\frac{\Delta E}{\Delta N} + C$$

C = 360	C = 0
C = 180	C = 180

- $\alpha_{AB} = 15^\circ\ 20'\ 48.9''$

$$\alpha_{BC} = \tan^{-1}\left(\frac{5.6609}{-3.3754}\right) + 180$$

- $\alpha_{BC} = 120^\circ\ 48'\ 22.2''$

- $\alpha_{CD} = \tan^{-1}\left(\frac{-2.621}{-7.3446}\right) + 180 \rightarrow \alpha_{CD} = 199^\circ\ 38'\ 22''$

- $\alpha_{DA} = \tan^{-1}\left(\frac{-5.358}{2.274}\right) + 360 \rightarrow \alpha_{DA} = 292^\circ\ 59'\ 49''$

* Elevation of traverse Point.

- Given $h_A = 200\ m$, $RH = 2\ m$

- $h_B = h_A + HI \mp VD - RH$
  $= 200 + 1.54 + 0.43 - 2 = 199.97\ m$

- $h_C = h_B + HI \mp VD - RH$
  $= 199.97 + 1.53 + 0.44 - 2 = 199.94\ m$

- $h_D = h_C + HI \mp VD - RH$
  $= 199.94 + 1.54 + 0.45 - 2 = 199.93\ m$

- $h_A = h_D + HI \mp VD - RH$
  $= 199.93 + 1.53 + 0.43 - 2 = 199.89\ m$

- $Error = h_{A\ calc.} - h_{A\ known} = 199.89 - 200$
  $= -0.11\ m$

* **Correction :-** $C_i = -Error * \frac{No.\ of\ point}{No.\ of\ total\ points}$

- $C_B = (*\frac{1}{4}) * -(-0.11) = 0.0275$
- $C_C = (\frac{2}{4}) * -(-0.11) = 0.055$
- $C_D = (\frac{3}{4}) * -(-0.11) = 0.0825$

- $h'_B = h_B + C_B$

$= 199.97 + 0.0275 = 199.9975$

- $h'_C = h_C + C_C$

$= 199.94 + 0.055 = 199.995$

- $h'_D = h_D + C_D$

$= 199.93 + 0.0825 = 200.0125\ m$

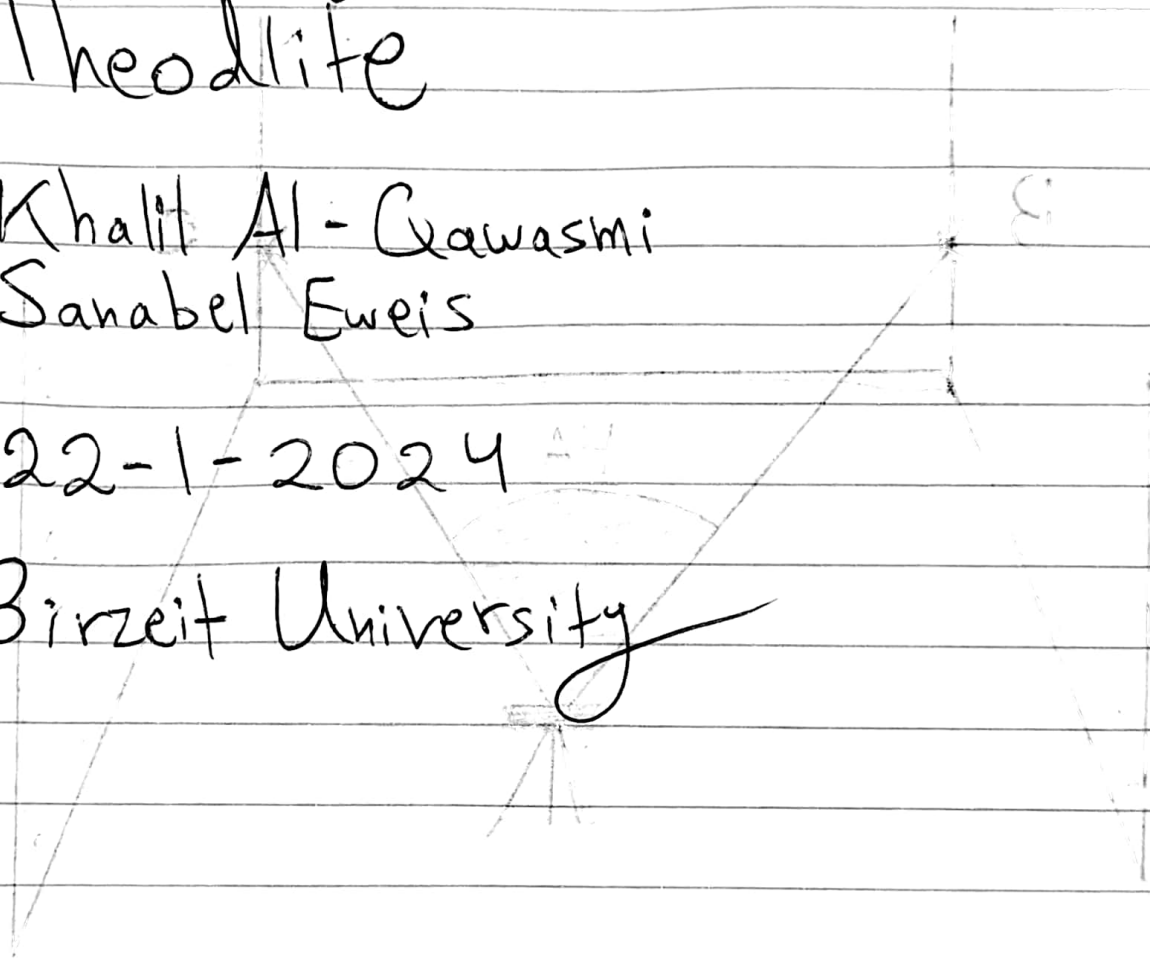
Exp.6

Practising the use of Theodlite

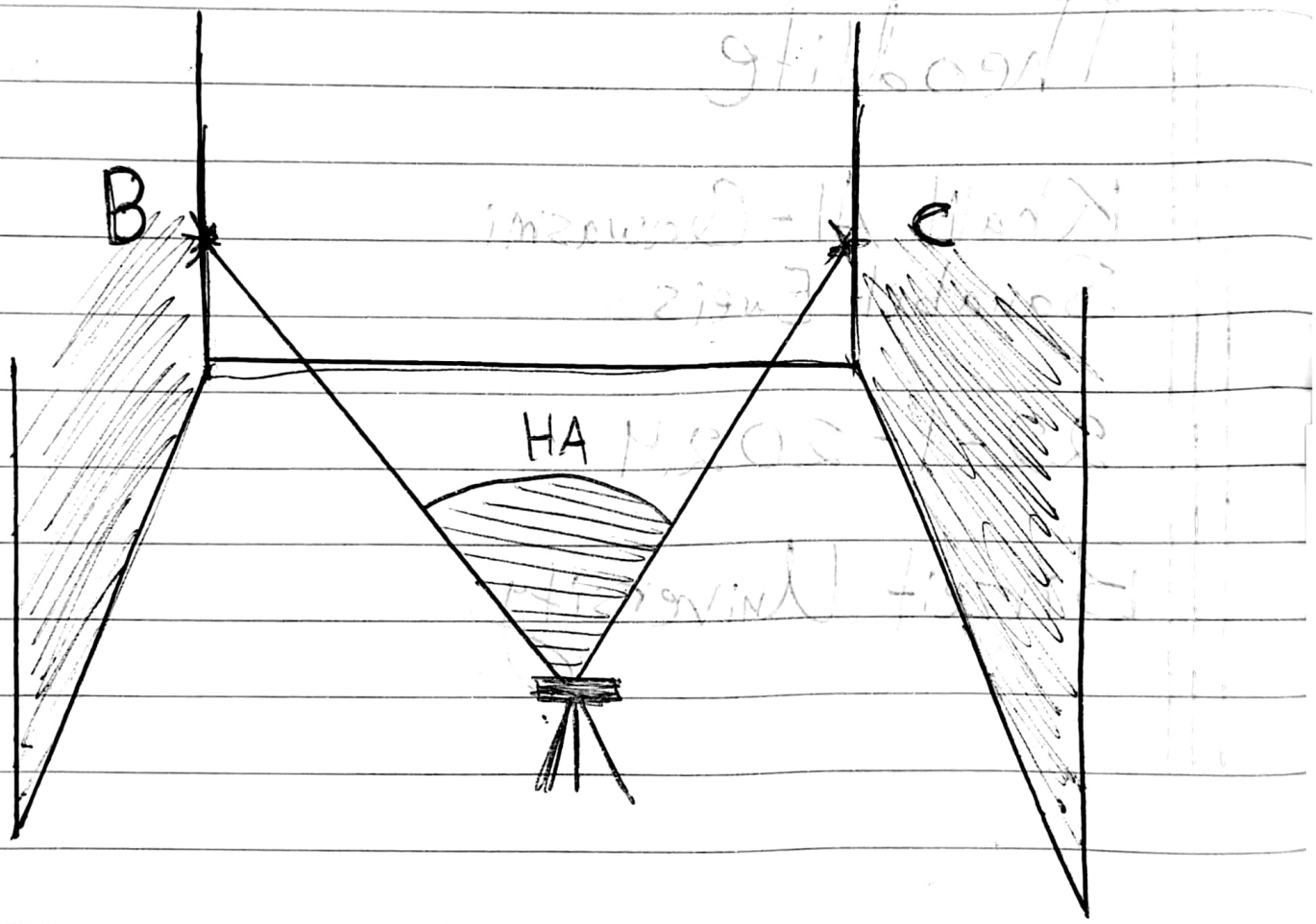
Khalil Al-Qawasmi
Sanabel Eweis

22-1-2024

Birzeit University



Sketch:-



Data & Calculations:-

Set Angle	Sta.	Pt.	FR	HA_R	FL	HA_L	$(H_{AR}+H_{AL})/2$
0	A	B	0	$45^\circ 35' 06''$	$180^\circ 0' 6''$	$45^\circ 19' 47''$	$45^\circ 27' 26.5''$
		C	$45^\circ 35' 06''$		$225^\circ 19' 47''$		
90	A	B	90	$45^\circ 20' 31''$	$269^\circ 59' 20''$	$45^\circ 13' 41''$	45° [illegible] $6''$ 17′
		C	$135^\circ 20' 31''$		$315^\circ 13' 01''$		

$135^\circ 20' 31'' - 90^\circ 0' 0''$

$225^\circ 19' 47'' - 180^\circ 0' 6''$

$315^\circ 13' 1'' - 269^\circ 59' 20''$

$$\text{Final HA} = \frac{HA_0 + HA_{90}}{2}$$

$$= \frac{45^\circ 27' 26.5'' + 45^\circ \text{ [illegible] } 17' \text{ } 6''}{2}$$

$$= 45^\circ 22' 16.25''$$

EX.9

Mapping Total Station

Khalil Al-Qawasmi
Mohamad Shtayeh
Qais Samara
Hala Qadi
Mohamad Kiswani
Yazeed Jabari
Mohamad Abu Khdeir

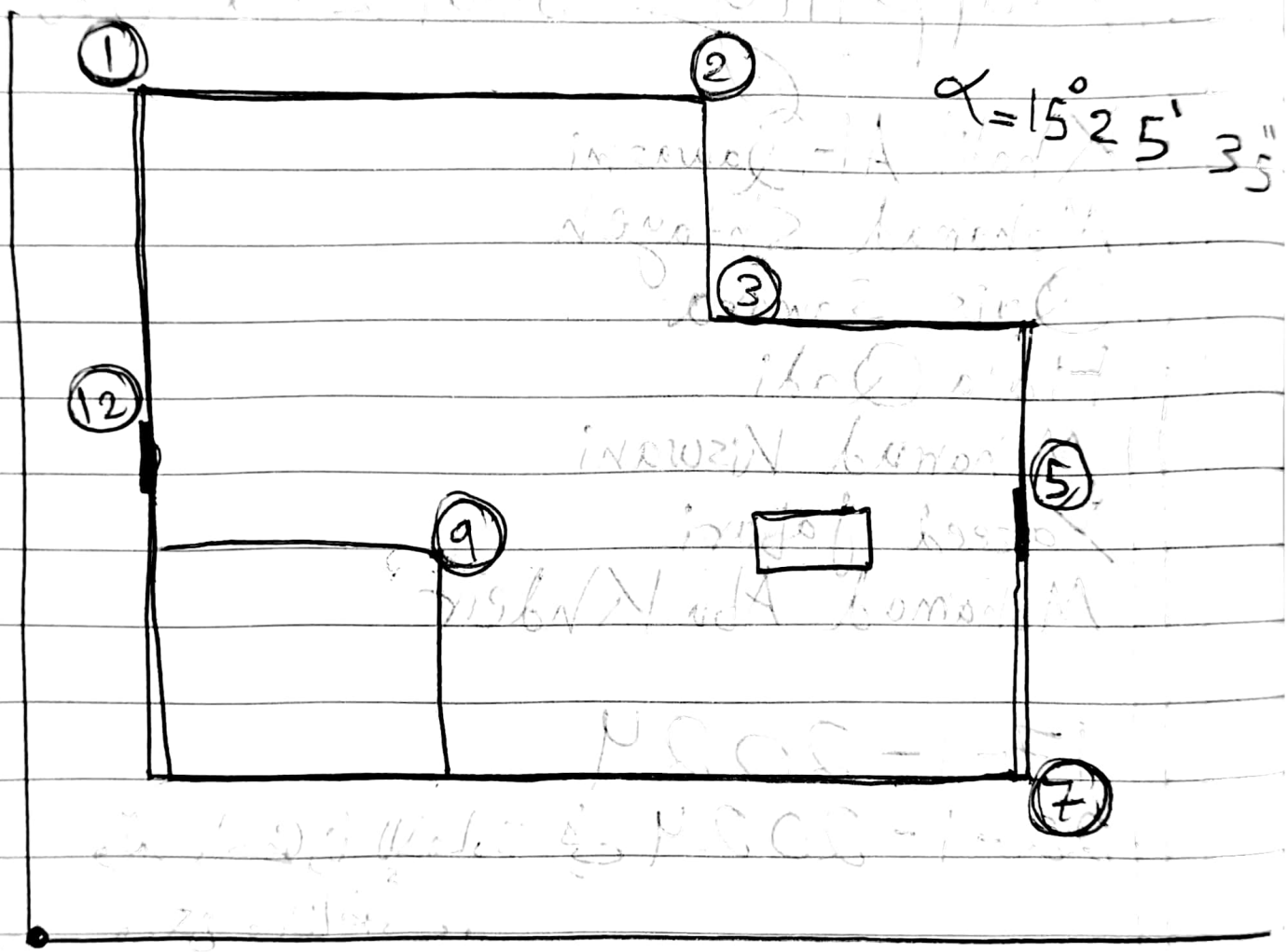
17-1-2024

22-1-2024 وتم احضارنا للإعادة في

ولكم عالفاضي.

Birzeit University

SKetch :-



Data :-

Point	E	N
1	102.634	109.544
2	105.935	100.006
3	99.285	97.658
5	96.589	92.845
6	95.757	92.546
7	93.879	91.904
9	93.489	102.059
12	93.287	106.33