

بسم الله الرحمن الرحيم



Hashemite University
Faculty of Engineering
Civil Engineering Department

Surveying Laboratory

Experiment No. 2

Part1: Horizontal Tapping Over Uneven Or Sloping Ground

Part2 : Measuring The Sides & The Diagonals Of A Quadrilateral

Name : Osama Mohammad Salhab

No. : 1438561

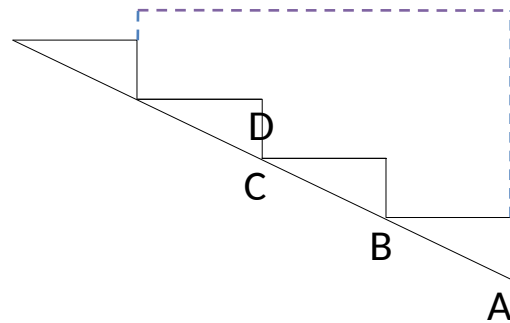
Sunday 7/2/2016

Group 5

Part1: Horizontal Tapping Over Uneven Or Sloping Ground

Data (In Meter)

	FWD	BWD
AB	0.59	0.57
BC	0.56	0.58
CD	0.58	0.57



Total Horizontal Distance

- FWD = 1.73 m
- BWD = 1.72 m

Average Horizontal Distance = $(\text{FWD} + \text{BWD}) / 2 = (1.73 + 1.72) / 2 = 1.725 \text{ m}$

Error = $|AD - DA| = 1.73 - 1.72 = 0.01$

Accuracy Relative To AD = $\text{error} / AD = 0.01 / 1.73 = 1/173$

Accuracy Relative To DA = $\text{error} / DA = 0.01 / 1.72 = 1/172$

- Complete these sentences ...

1- The maximum horizontal distance between any two consecutive station for taking horizontal distance over sloping ground is

- 10 m

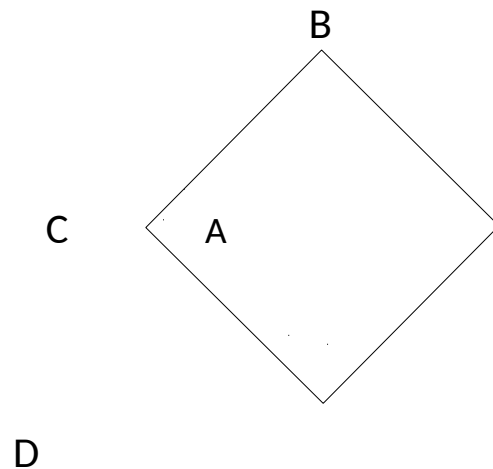
2- The maximum vertical distance between any two consecutive station for taking horizontal distance over sloping ground is

- 1.5 m

Part2 : Measuring The Sides & The Diagonals Of A Quadrilateral

Data (In Meter)

	FWD	BWD	Avg.
AB	1.90	1.90	1.90
BC	1.80	1.80	1.80
CD	1.40	1.40	1.40
DA	1.75	1.74	1.745
BD	2.30	2.29	2.295
AC	2.50	2.51	2.505



$$(CB)^2 = (CD)^2 + (BD)^2 - 2(CD)(BD)$$

$$(1.80)^2 = (1.40)^2 + (2.295)^2 - 2(1.40)(2.295) \quad 51.65084$$

$$(AB)^2 = (AD)^2 + (BD)^2 - 2(AD)(BD) \quad 54.05166$$

$$(AB)^2 = (AC)^2 + (BC)^2 - 2(AC)(BC) \quad 49.09518$$

$$(AD)^2 = (AC)^2 + (DC)^2 - 2(AC)(DC) \quad 42.27295$$

Diagonals length ...

$$(AC)^2 = (CD)^2 + (AD)^2 - 2(CD)(AD)$$

$$(AC)^2 = (1.4)^2 + (1.745)^2 - 2(1.4)(1.745) \quad AC = 2.515 \text{ m}$$

$$(BD)^2 = (DC)^2 + (BC)^2 - 2(DC)(BC) \quad BD = 2.306 \text{ m}$$

Diagonals Error ...

$$\text{error BD} = |\text{BD}_{\text{exp.}} - \text{BD}_{\text{calc.}}| = |2.295 - 2.306| = 0.011$$

$$\text{error AC} = |\text{AC}_{\text{exp.}} - \text{AC}_{\text{calc.}}| = |2.505 - 2.515| = 0.01$$

Diagonals Accuracy ...

$$\text{accuracy BD} = \text{error} / \text{BD}_{\text{calc.}} = 0.011 / 2.306 = 0.0047$$

$$\text{accuracy AC} = \text{error} / \text{AC}_{\text{calc.}} = 0.01 / 2.515 = 0.0039$$

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Experiment No. 3

Horizontal Control For Mapping By Linear Measurements

Name : Osama Mohammad Salhab

No. : 1438561

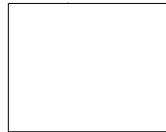
Sunday 14/2/2016

Group 5

- Data (In Meter) ...

	BWD	FWD	Avg.
AB	15.0	15.0	15.0
BC	15.0	15.0	15.0
CD	15.0	15.0	15.0
DA	13.56	13.52	13.54
a_1a_2	0.625	0.622	0.6235
b_1b_2	0.77	0.76	0.765
c_1c_2	0.60	0.59	0.595
d_1d_2	0.828	0.8275	0.82775

$$Aa_1 = Aa_2 = 0.5 \text{ m}$$



$$(a_1a_2)^2 = (Aa_1)^2 + (Aa_2)^2 - 2(Aa_1)(Aa_2)$$

$$(0.765)^2 = (0.5)^2 + (0.5)^2 - 2(0.5)(0.5)$$

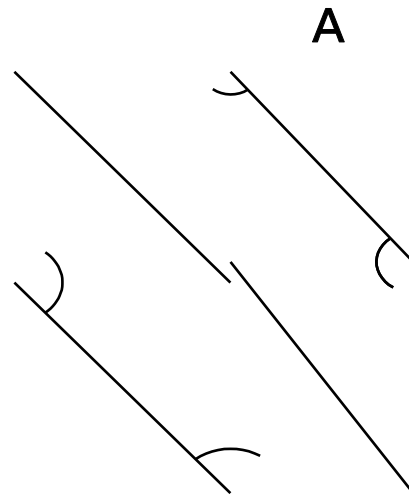
$$(b_1b_2)^2 = (Bb_1)^2 + (Bb_2)^2 - 2(Bb_1)(Bb_2)$$

$$(c_1c_2)^2 = (Cc_1)^2 + (Cc_2)^2 - 2(Cc_1)(Cc_2)$$

$$(d_1d_2)^2 = (Dd_1)^2 + (Dd_2)^2 - 2(Dd_1)(Dd_2)$$

$$\text{Angular Error} = (n - 2) * 180 -$$

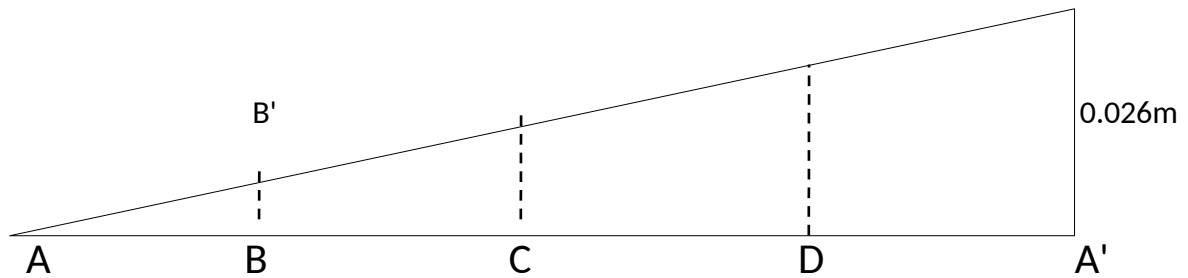
$$= 1.7199$$



a1

a2

-The Linear Closing Error is : $0.004_{(\text{at scale } 1:200)} = 0.8 \text{ m}$



$$AA'/0.026 = AB/BB'$$

$$14.5/0.026 = 3.7/BB'$$

$$BB' = 0.0066_{(\text{at scale } 1:30)} = 0.198 \text{ m}$$

$$AA'/0.026 = AC/CC'$$

$$CC' = 0.013_{(\text{at scale } 1:30)} = 0.39 \text{ m}$$

$$AA'/0.026 = AD/DD'$$

$$DD' = 0.019_{(\text{at scale } 1:30)} = 0.57 \text{ m}$$

$$\text{Relative error} = \text{error}/\text{true perimeter} = 0.0136$$

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Experiment No. 5

Test the level

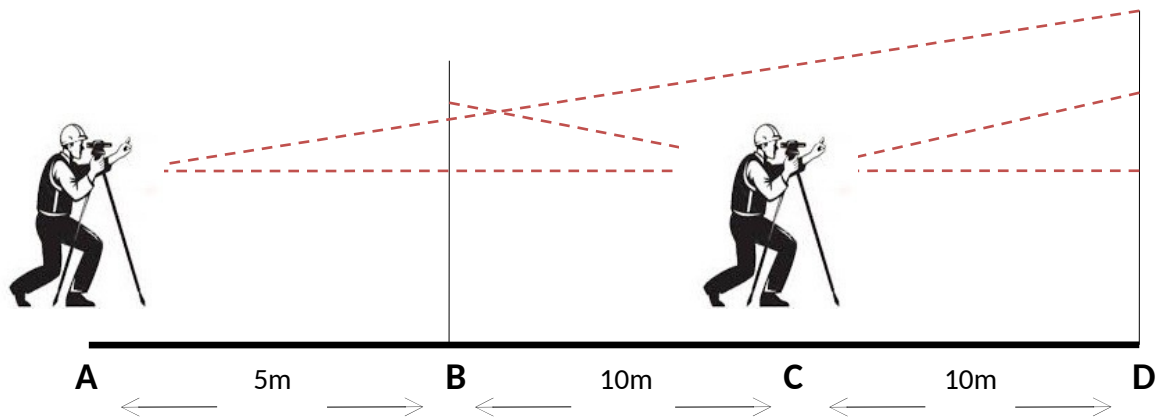
Name : Osama Mohammad Salhab

No. : 1438561

Sunday 28/2/2016

Group 5

- Data (In Meter) ...



$$R_{CD} = 1.455 \text{ m}$$

$$R_{AB} = 1.423 \text{ m}$$

$$R_{CB} = 1.347 \text{ m}$$

$$R_{AD} = 1.66 \text{ m}$$

$$true = R_{CD} - R_{CB} = 1.455 - 1.347 = 0.108$$

$$true = R'_{AD} - R'_{AB}$$

$$R_{CD} - R_{CB} = (R_{AD} - 25) - (R_{AB} - 5)$$

$$0.108 = (1.66 - 25) - (1.423 - 5)$$

m/m

$$R'_{CD} = R_{CD} - 10 = 1.455 - 10 = 1.3905 \text{ m}$$

$$R'_{CB} = R_{CB} - 10 = 1.347 - 10 = 1.2825 \text{ m}$$

$$R'_{AB} = R_{AB} - 5 = 1.423 - 5 = 1.39075 \text{ m}$$

$$R'_{AD} = R_{AD} - 25 = 1.66 - 25 = 1.499875 \text{ m}$$

$$\text{Check ... } R_{CD} - R_{CB} = R'_{CD} - R'_{CB} = R'_{AD} - R'_{AB} = 0.108$$

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Experiment No. 6

Differential leveling

Name : Osama Mohammad Salhab

No. : 1438561

Sunday 6/3/2016

Group 5

- Data (In Meter) ...

$$\text{Elev. BM(A)} = 8561/100 = 85.61 \text{ m}$$

point		B.S	F.S	Cumulative distance	HI	Elev.
A	upper	1.460	-	-	87.043	85.61
	main	1.435				
	lower	1.403				
	Avg.	1.433				
B	upper	1.490	1.503	10	87.03	85.565
	main	1.465	1.477			
	lower	1.440	1.453			
	Avg.	1.465	1.478			
C	upper	1.435	1.430	20	87.038	85.623
	main	1.415	1.403			
	lower	1.395	1.387			
	Avg.	1.415	1.407			
A	upper	-	1.455	27.57	-	85.603
	main		1.435			
	lower		1.415			
	Avg.		1.435			
.		4.313	4.32			

$$AB = BC = 10 \text{ m} \text{ , , } CA = 7.57 \text{ m}$$

$$HI_1 = \text{elev. @A} + RR@B.S_A = 85.61 + 1.433$$

$$= 87.043$$

$$\text{Elev. @B} = HI_1 - RR@F.S_B = 87.043 - 1.478 = 85.565 \text{ m}$$

$$HI_2 = \text{elev. @B} + RR@B.S_B = 87.030$$

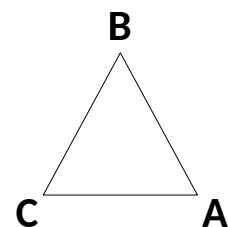
$$\text{Elev. @C} = HI_2 - RR@F.S_C = 85.623 \text{ m}$$

$$HI_3 = \text{elev. @C} + RR@B.S_C = 87.038$$

$$\text{Elev. @A} = HI_3 - RR@F.S_A = 85.603 \text{ m}$$

- **Check**

$$- = \text{Last elev.} - \text{First elev.}$$



$$.313 - 4.32 = 85.603 - 85.61 = - 0.007$$

check is correct

- Error in A = Last elev. - First elev.
= $85.603 - 85.61 = - 0.007$

- Allowable error =
=
= 0.00199

$$*K = 27.57 / 1000 = 0.02757 \text{ Km}$$

- Is the error A within allowable error ?
** NO
- Accuracy = error / total distance
= $- 0.007 / 27.57 = - 0.00045$

- Correction when we use Cumulative distance & corrected elevation ...

$$\begin{aligned} \text{Correction for point A} &= \\ &= 0 \end{aligned}$$

$$\begin{aligned} \text{Correction elevation for point A} &= \text{Correction} + \text{elevation} \\ &= 0 + 85.61 = 85.61 \end{aligned}$$

point	Elev.	Cumulative distance	correction	Corrected Elev.
A	85.61	0	-	85.610
B	85.56 5	10	= = 0.0025	85.567
C	85.62 3	20	= = 0.0051	85.628
A	85.60 3	27.57	= = 0.007	85.610

- Correction when we use # of setup & corrected elevation ...

$$\text{Correction for point A} =$$

$$= = 0$$

Correction elevation for point A = Correction + elevation
 $= 0 + 85.61 = 85.61$

point	Elev.	# of setup		correction	Corrected Elev.
A	85.61	1	-	-	85.610
B	85.56 5		2	= = 0.0023	85.567
C	85.62 3	3		= = 0.0046	85.627
A	85.60 3		-	= = 0.007	85.610

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Experiment No. 7

Contouring from grid (spot) elevation

Name : Osama Mohammad Salhab

No. : 1438561

Sunday 13/3/2016

Group 5

- Data (In Meter) ...

Elev. BM(A) = $8561/100 = 85.61$ m

B.S reading = 2.333 m

point	B.S	*HI	F.S	Elev.
BM	2.333	87.943	-	85.610
H8	-		2.853	85.090

point	IS	elevation	point	IS	elevation
A1	3.225	84.718	D1	2.913	85.030
A2	3.123	84.820	D2	2.755	85.188
A3	3.105	84.838	D3	2.320	85.623
A4	2.977	84.966	D4	2.200	85.743
A5	3.017	84.926	D5	2.220	85.723
A6	3.197	84.746	D6	2.343	85.600
A7	3.255	84.688	D7	2.855	85.088
A8	3.345	84.598	D8	3.015	84.928
B1	3.015	84.928	E1	2.853	85.090
B2	2.975	84.968	E2	2.703	85.240
B3	2.965	84.978	E3	2.300	85.643
B4	2.853	85.090	E4	2.223	85.720
B5	2.795	85.148	E5	2.215	85.728
B6	2.777	85.166	E6	2.330	85.613
B7	2.870	85.073	E7	2.575	85.368
B8	3.227	84.716	E8	3.000	84.943
C1	2.957	84.986	F1	2.755	85.188
C2	2.805	85.138	F2	2.665	85.278
C3	2.577	85.366	F3	2.563	85.380
C4	2.347	85.596	F4	2.300	85.643
C5	2.353	85.590	F5	2.315	85.628
C6	2.597	85.346	F6	2.523	85.420
C7	2.923	85.020	F7	2.695	85.248
C8	3.103	84.840	F8	2.985	84.958

point	IS	elevation	point	IS	Elevation
G1	2.710	85.233	H1	2.693	85.250
G2	2.705	85.238	H2	2.777	85.166
G3	2.585	85.358	H3	2.695	85.248
G4	2.550	85.393	H4	2.713	85.230
G5	2.560	85.383	H5	2.755	85.188
G6	2.623	85.320	H6	2.783	85.160
G7	2.873	85.070	H7	2.793	85.150
G8	2.955	84.988	H8	-	85.090

$$\begin{aligned}
 * \text{HI} &= \text{elev. @BM} + \text{RR@B.S} = 85.61 + 2.333 \\
 &= 87.943 \text{ m}
 \end{aligned}$$

- Check

- = Last elev. - First elev.

$$- 2.853 = 85.090 - 85.61 = - 0.52$$

check is correct

Contour interval =

=

$$= 0.1145$$

** = 9

$$\text{C.C}_1 = \text{min.} + \text{CI} = 84.598 + 0.1145 = 84.7125$$

*

$$\text{C.C}_2 = \text{C.C}_1 + \text{CI} = 84.7120 + 0.1145 = 84.8270$$

•

$$\text{C.C}_3 = \text{C.C}_2 + \text{CI} = 84.8270 + 0.1145 = 84.9415$$

△

$$\text{C.C}_4 = \text{C.C}_3 + \text{CI} = 84.9415 + 0.1145 = 85.0560$$

■

$$\text{C.C}_5 = \text{C.C}_4 + \text{CI} = 85.0560 + 0.1145 = 85.1705$$

◦

$$\text{C.C}_6 = \text{C.C}_5 + \text{CI} = 85.1705 + 0.1145 = 85.2850$$

□

$$\text{C.C}_7 = \text{C.C}_6 + \text{CI} = 85.2850 + 0.1145 = 85.3995$$

▤

$$\text{C.C}_8 = \text{C.C}_7 + \text{CI} = 85.3995 + 0.1145 = 85.5140$$

@

$$\text{C.C}_9 = \text{C.C}_8 + \text{CI} = 85.5140 + 0.1145 = 85.6285$$

-

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Experiment No. 8

Measurement Of Horizontal & Vertical Angle

Name : Osama Mohammad Salhab

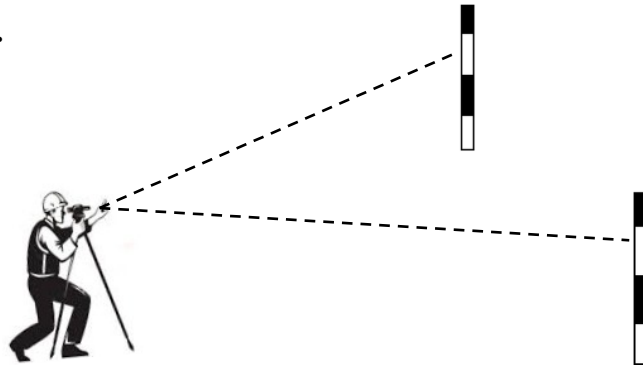
No. : 1438561

Thursday 24/3/2016

Group 3

- Horizontal Angle :

- Data ...



S.T	P.T	I (F.L)	II (F.R)
O	A	204°46'41''	25°01'23''
	B	227°11'47''	47°12'53''

- Difference method

$$\begin{aligned} * \{ I_{(F.L)} . B \} - \{ I_{(F.L)} . A \} &= 227^{\circ}11'47'' - 204^{\circ}46'41'' \\ &= 22^{\circ}25'6'' \end{aligned}$$

$$\begin{aligned} ** \text{Avg.} &= \\ &= 22^{\circ}18'18'' \end{aligned}$$

S.T	P.T	I (F.L)	II (F.R)	mean	Angle
O	A	204°46'41''	25°01'23''	204°24'2''	22°48'18''
	B	227°11'47''	47°12'53''	227°12'20''	

Δ	*22°25'6''	22°11'30''
Avg.	**22°18'18''	

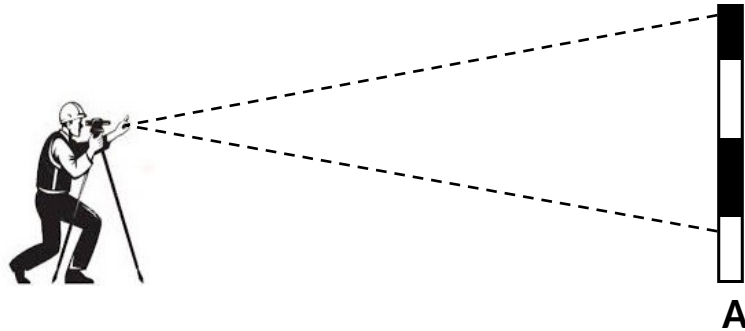
- Means method

$$\text{mean A} = 204^{\circ}0'0'' + (0^{\circ}46'41'' + 0^{\circ}01'23'') / 2 = 204^{\circ}24'2''$$

$$\text{mean B} = 227^{\circ}0'0'' + (0^{\circ}11'47'' + 0^{\circ}12'53'') / 2 = 227^{\circ}12'20''$$

- Vertical Angle :

- Data ...



S.T	P.T	I (F.L)	II (F.R)
O	A	3°48'52''	176°26'45''

*

- index error = =
- Correct the **I (F.L)** = 3°48'52'' = 3°41'3.5''
- Correct the **II (F.R)** = = 176°18'56.5''

S.T	P.T	I (F.L)	II (F.R)	*	index error
O	A	3°48'52''	176°26'45''		
	A'	3°41'3.5''	176°18'56.5''		-

- Angle of elevation = 3°41'3.5''

- zenithal angle = 90 - Angle of elevation

$$= 90 - 3^{\circ}41'3.5''$$

$$= 86^{\circ}18'56.5''$$

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Experiment No. 9

Repetition & error of closure

Name : Osama Mohammad Salhab

No. : 1438561

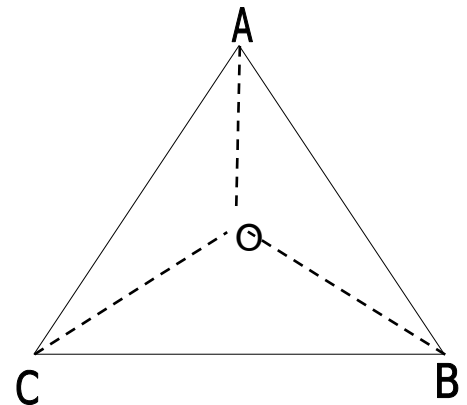
Thursday 31/3/2016

Group 1

- Data ...

L0	0	103°11'40''	276°33'30''
L1	115°58'30'' (F.L)	237°19'50''	27°19'00''
L2	231°30'40''(F.L)	10°28'20''	137°19'50''
L3	347°14'00''(F.R)	143°24'20''	246°25'50''
L4	103°11'40''(F.R)	276°33'30''	357°40'50''

Mean	159°32'58''	154°11'32''	209°3'48''
-------------	-------------	-------------	------------



Mean angle =

=

= - 3°11'42.5'' + 90

= 86°48'17.5''

*

Mean angle = 90

= 99°48'25''

Mean angle = 90

= 172°35'27.5''

= 87°48'17.5'' + 100°48'25'' + 169°35'27.5''

= 358°12'10''

Error = 360 -

= 360 - 358°12'10'' = 1°47'50''

Check error =

=

= - 0°34'47.5''

