



Civilittee

اللجنة الأكاديمية لقسم الهندسة المدنية

www.Civilittee.com

تقارير

لاب مساحة

إعداد: ليان سليمان

 www.civilittee.com

 CivilitteeHashemite

 Civilittee HU | لجنة المدني

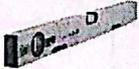
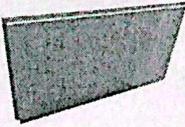
Experiment 1

Model for Field Setting a 0.5 m × 0.75 m Building Grid

Required + objective: make a set out for a rectangular grid (0.5m x 0.75m) by use a basic tools.

Printed report + simple Theory: field preparation of the required plan includes marking points on the ground based on the required plan using strings, pegs and measuring tape.

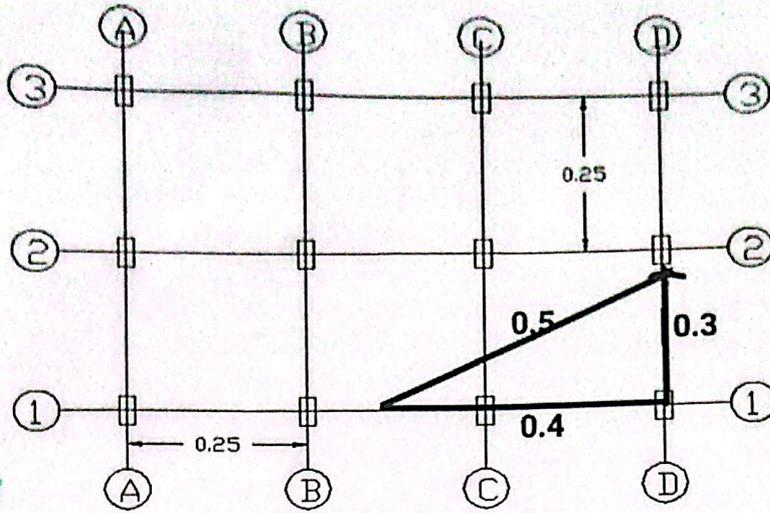
- Objective
- Simple Theory
- Write the Apparatus name in this table

					
Tape	Hand level	pegs or chaining pins	string	square polystyrene board	pencil

- Simple procedure (make it as a point)

1. First, create the indentation on the polystyrene square, measuring 20 by 30 centimeters.
2. After creating the indentation, place the first peg at point A1 .
3. Next, measure 0.25 meters from point A1 and place peg B1.
4. Then, measure 0.25 meters from peg B1 and place peg C1.
5. After that, measure 0.25 meters from C1 and place peg D1.
6. Connect A1 and D1 with a string.
7. Apply Pythagorean theorem to the ends D1 to D3 and A1 to A3 by forming a 3/4/5 triangle so that the angle is 90.
8. Position A2, 0.25 away from A1 and the same distance from D1 to D2.
9. connect A1 and A3 with string, connect too D1 and D3.
10. position B3, 0.25 away from A3, and position C3, 0.25 away from B3.
11. connect A2&D2 with string, then connect B3&B1, then C1&C3. Finally, put pegs in cross region for trings.

• DATA SHEET

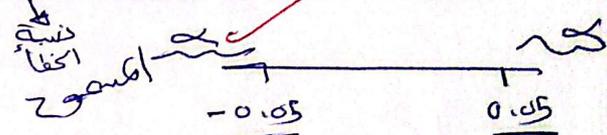


Length	Actual	Measured	Error	Accuracy
A1-A3	0.50	0.55	0.05	1/10
3A-3D	0.75	0.76	0.01	1/75
2A-2C	0.50	0.52	0.02	1/25
Diagonal A1-D3	0.9013	0.9381	0.0368	1/24.5

- Show your calculation for actual diagonal. $Actual = \sqrt{(A1D1)^2 + (D1aD3)^2}$
 $A1 D3 = \sqrt{(0.75)^2 + (0.50)^2} = 0.9013$
- Is the grid acceptable if the tolerance is ± 0.05 m? - Yes, all vales are acceptable.

Hint: Accuracy = Error / True value ; (make the numerator equal one)

Error = Absolute value (Actual - measured)



- You need to set a right angle at the first corner using the 3-4-5 method.
 If you increase the scale by a factor of 10, what are the new lengths to measure?
 * 30/40/50

Offset → حتى تكون الحدود دقيقة ونتجنب أي عوائق ~~في~~ لأننا نفضل نصف أبعاد صيانة [↑] نزل مساحة أمان لأي أعمال صيانة
 m₁

Experiment 2

Field setting a 15m x 10m Building Grid with Basic Tools Required

Printed report (No writing by hand)

- Draw sketch for the grid (show the axes).
- Hatch the axis C-C/2-3.
- Fill the table below .

	Actual	Measured	Error	Accuracy(1/x)
Total area	150	142.37	7.63	1/20
Length A-A/1-3	10	9.87	0.13	1/77
Length A-D/3-3	15	14.77	0.23	1/65
Length D-D/1-3	10	9.5	0.5	1/20
Length A-D/1-1	15	14.63	0.37	1/41
Perimeter	50	48.77	1.23	1/41
Diagonal A1-D3	18.028	18.2	0.172	1/100
Diagonal A3-D1	18.028	19.1	1.072	1/17

● Show your calculation for area & daigonals.

● Write three obstacles during work.

*Actual area = $(15 \times 10) = 150 \text{ m}^2$

*Measured area = $\left(\frac{14.77+14.63}{2}\right) \times \left(\frac{9.87+9.5}{2}\right) = 142.37 \text{ m}^2$

*Actual daigonals(A1-D3) or (A3-D1) = $\sqrt{(15)^2 + (10)^2} = \sqrt{325} = 18.028 \text{ m}$.

*Measured daigonals: It was calculated in the laboratory using the tape.

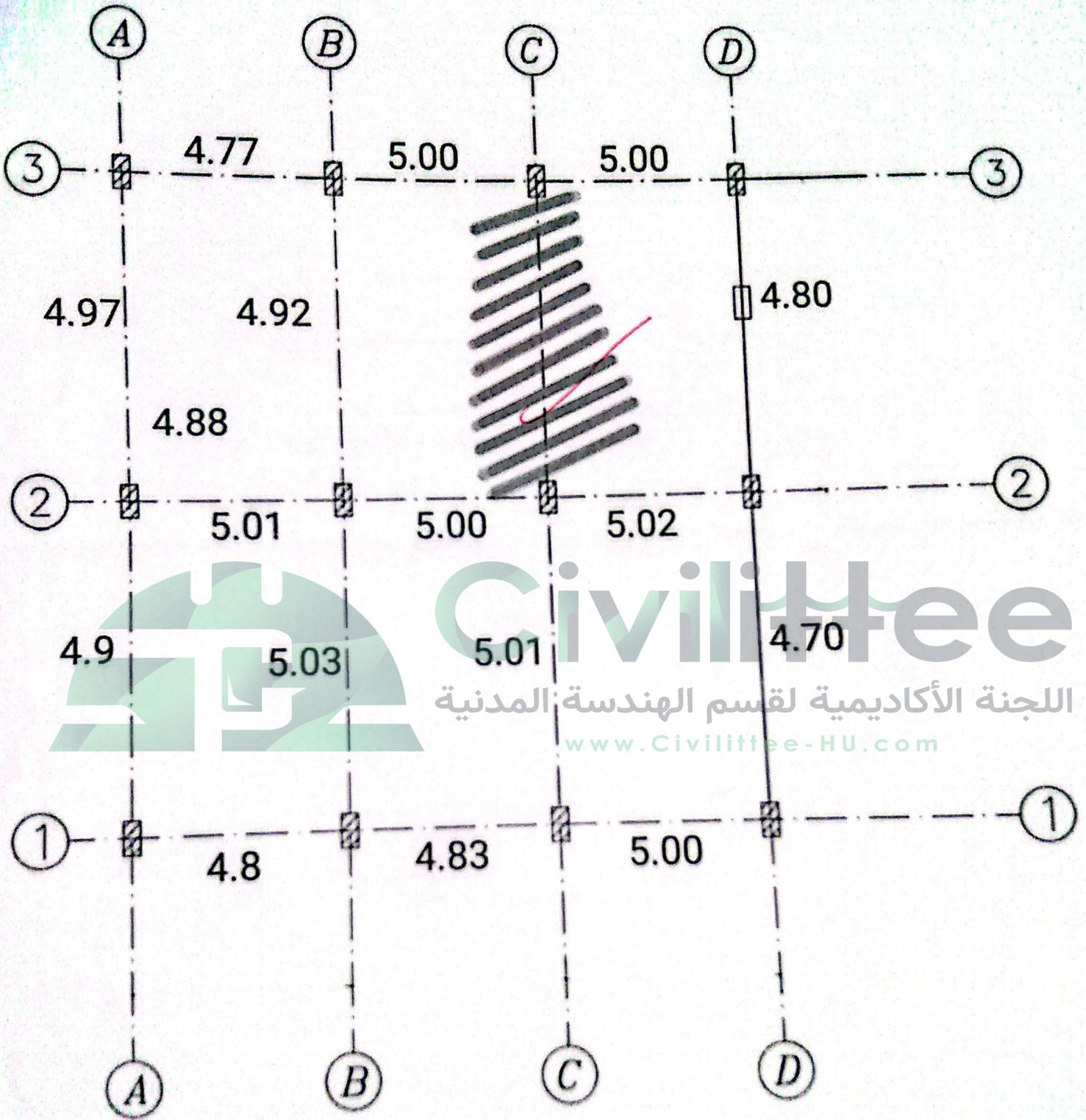
*Calculation daigonals:

Diagonal A1-D3: $\sqrt{(14.63)^2 + (9.5)^2} = 17.444 \text{ m}$.

Diagonal A3-D1: $\sqrt{((14.63)^2 + (9.87)^2)} = 17.648 \text{ m}$.

*The Obstacles during work:

1. The ground is uneven, it contains large rocks, rod can't be installed. *tape is it*
2. tape measure slack, and it's deviation from the horizontal line. *-> not fully supported*
3. Personal error in reading the measuring tape.

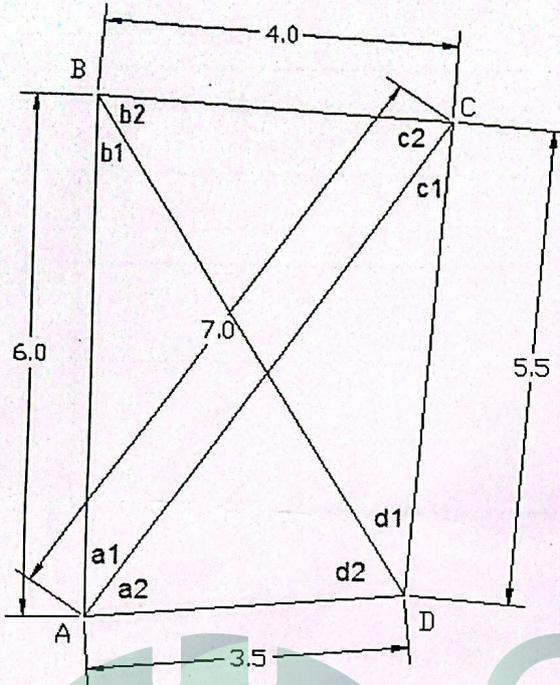


Civilittee
 اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilittee-HU.com

Experiment 3

Precise Boundary Layout using Trigonometric Principles and Taping

Printed report (No writing by hand)



Side	Actual length (m)	Measured lengths (m)	ERROR	Accuracy
A-B	6	6	0	$\frac{0}{6}$
B-C	4	4.1	0.1	$\frac{0.1}{4}$
C-D	5.5	5.48	0.02	$\frac{0.02}{5.5}$
DA	3.5	3.49	0.01	$\frac{0.01}{3.5}$
AC	7	6.8	0.2	$\frac{0.2}{7}$
BD	6.7	6.7	0	$\frac{0}{6.7}$

Find the following twice, once in actual dimensions and once in measured dimensions.

- Calculate Angle ABC (at Point B), Using Law of Cosines.....(Angle(b_1+b_2))
- Calculate Angle BCA (at Point C), Using Law of Sines.....(Angle(c_2))
- Calculate Angle CAB (at Point A), Using Law of Cosines(Angle(a_1))
- Calculate Angle ADC (at Point D) , Using Law of Cosines.....(Angle(d_1+d_2))
- Calculate Angle ACD (at Point C) , Using Law of Sines.....(Angle(c_1))
- Calculate Angle CAD (at Point A) , Using Law of Cosines.....(Angle(a_2))

- Calculate Verification Diagonal BD , Using Law of Cosines
- Calculate Verification Diagonal AC , Using Law of Cosines

	Actual angle	Measured angle	Error	Accuracy
A	85.52581108	89.95782611	4.43201503	1/19
B	86.4166783	82.32599378	4.09068452	1/21
C	88.33764292	91.66911878	3.33147586	1/27
D	99.7198677	96.04706133	3.67280637	1/27
SUM	360	360	0	1

Measure Direct Miss closure (linear error) at Known Point A Using AutoCAD Program and measuring data (length and angle)

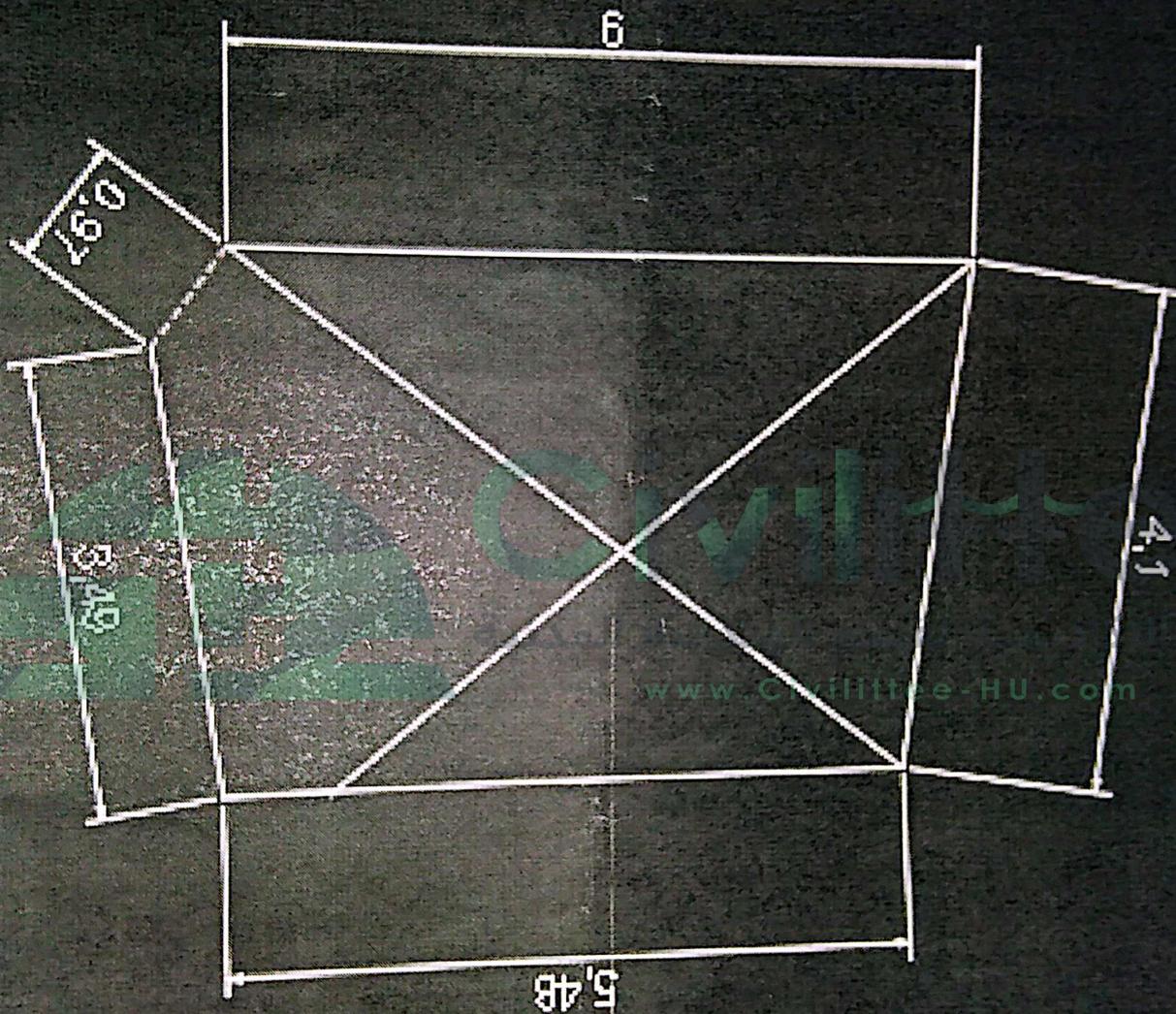
- Draw the traverse ABCDA' to scale (1:100) using ruler and protractor.
- The linear closing error is0.97.....m.

$$\text{Measured BD} = \sqrt{((3.49)^2 + (6)^2 - (3.49 \cdot 6 \cdot \cos D))} = 6.838$$

$$\text{Actual BD} = \sqrt{((6)^2 + (3.5)^2 - (2 \cdot 6 \cdot \cos D))} = 7.096$$

$$\text{Measured AC} = \sqrt{((3.49)^2 + (5.48)^2 - (2 \cdot 5.48 \cdot 3.49 \cdot \cos D))} = 6.8$$

$$\text{Actual AC} = \sqrt{((3.5)^2 + (5.5)^2 - (2 \cdot 5.5 \cdot 3.5 \cdot \cos D))} = 7$$



Measure angles:

$$-(6.8)^2 = (3.49)^2 + (5.48)^2 - (2 \cdot 3.49 \cdot 5.48 \cdot \cos D) =$$
$$D = 96.04706133$$

$$-\sin a_2 / 5.48 = \sin D / 6.8$$
$$a_2 = \sin^{-1}(\sin D \cdot 5.48 / 6.8) =$$
$$a_2 = 53.26382729$$

$$-c_1 = \sin^{-1}(\sin D \cdot 3.49 / 6.8) =$$
$$c_1 = 30.68911138$$

$$-(6.8)^2 = (6)^2 + (4.1)^2 - (2 \cdot 6 \cdot 4.1 \cdot \cos B) =$$
$$B = 82.32599378$$

$$-a_1 = \sin^{-1}(\sin B \cdot 4.1 / 6.8) =$$
$$a_1 = 36.69399882$$

$$-c_2 = \sin^{-1}(6 \cdot \sin B / 6.8) =$$
$$c_2 = 60.9800074$$

$$a_1 + a_2 = 89.957862611$$

$$c_1 + c_2 = 91.66911878$$

Actual angles:

$$-(7)^2 = (3.5)^2 + (5.5)^2 - (2 \cdot 3.5 \cdot 5.5 \cdot \cos(D)) =$$
$$D = 99.7198677$$

$$-\sin a_2 / 5.5 = \sin D / 7$$
$$a_2 = \sin^{-1}(\sin D \cdot 5.5 / 7) =$$
$$a_2 = 50.75386705$$

$$-c_1 = \sin^{-1}(\sin D \cdot 3.5 / 7) =$$
$$c_1 = 29.5262626525$$

$$-(7)^2 = (4)^2 + (6)^2 - (2 \cdot 4 \cdot 6 \cdot \cos B)$$
$$B = 86.4166783$$

$$-a_1 = \sin^{-1}(\sin B \cdot 4 / 7)$$
$$a_1 = 34.77194403$$

$$-c_2 = \sin^{-1}(\sin B \cdot 6 / 7)$$
$$c_2 = 58.81137767$$

$$a_1 + a_2 = 85.52581108$$

$$c_1 + c_2 = 88.33764292$$

Experiment 4

Getting to know the level instrument

- Fill the blanks with rod reading in meters

Metric 'E' Rod

Each whole meter section alternates between black and red

Very top of this mark measures 1.000 m

Top of marks are even centimeters

- 0.98
- 0.96
- 0.94
- 0.92



Civilittee
اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilittee-HU.com

©Vectors Inc.
vectorsinc.com

• Apparatus:-

						
Automatic level	Tripod	Plump Bob	Tape	Chalk	Level staff or rod	Rod level

- Sketch, data
- The true difference in elevation between the points (B & D).
- The collimation error (m/m); show your calculation.
- Correct the rod readings for all points.

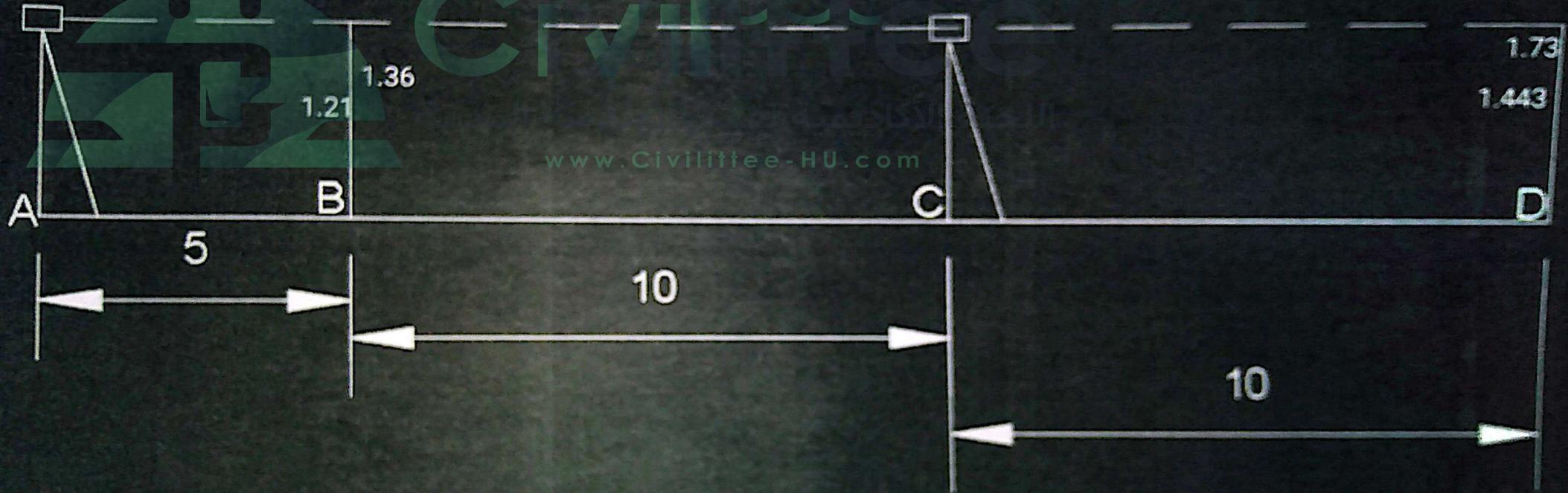
	Rod reading	Corrected rod readings
R _{cb}	1.36	1.39
R _{cd}	1.443	1.203
R _{ab}	1.21	1.04
R _{ad}	1.73	1.13

$\Delta H = R_{cd} - R_{cb} = 1.443 - 1.36 = 0.083$

$R_{AD} = 1.73 - 25x - (1.21 - 5x) = 0.083$
 $X = 0.024 \text{ m/m}$

$0.083 = 1.73 - 25x - 1.21 + 5x$
 $0.083 = 0.52 - 20x$
 $x = 0.02185$

$R_{cb} = 1.63 - (0.024 * 10) = 1.39$
 $R_{cd} = 1.443 - (0.024 * 10) = 1.203$
 $R_{ab} = 1.21 - (0.034 * 5) = 1.04$
 $R_{ad} = 1.73 - (0.024 * 25) = 1.13$



Experiment 5

Differential leveling

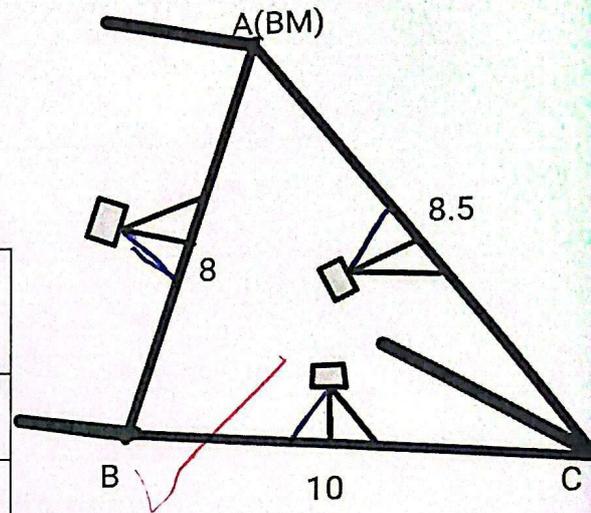
Required

Printed report

Sketch, data

Fill the tables below

BS	FS	Hi	Cumulative distance	elevation	Point
1.027		601.027	-	600	A(B.M)
1.244	1.308	600.963	8	599.719	B
1.302	1.299	600.966	18	599.664	C
	0.971		26.5	599.995	A



- Calculate the arithmetic check.
 - Find the error in elevation (A)
 - Calculate the allowable error if the company 3rd order
- Formula: $C = \pm m \cdot (K)^{0.5}$

Leveling Class	Use Case	m (mm)
First-Order Class I	National Geodetic Networks	4
First-Order Class II	High-Precision Engineering	5
Second-Order Class I	Regional Control, Major Engineering	6
Second-Order Class II	Standard Engineering Projects	8
Third-Order	Construction, Topographic Surveys	12

- Is the error accepted , explain your answer
- Find the accuracy

Point	Elevation	Correction(# of set up)	Corrected elevation using (# of set up)	Correction (cumulative distance)	Corrected elevation using (cumulative distance)
A	600	0	600	-	600
B	599.719	$1/3 \times 0.005$	599.721	$8/26.5 \times 0.005$	599.721
C	599.664	$2/3 \times 0.005$	599.667	$18/26.5 \times 0.005$	599.667
A	599.995	0.005	600	0.005	600

● calculate the arithmetic check

$$BS = 1.302 + 1.244 + 1.027 = 3.573$$

Number BS = Number FS

$$FS = 1.308 + 1.299 + 0.971 = 3.578$$

BS - FS = -0.005

=

(Last-first) elevation = -0.005

● error in elevation =

$$(Last-first) \text{ elevation} = -0.005$$

● allowable error =

$$C = m\sqrt{K}$$

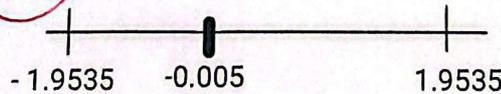
$$C = 12 \times \sqrt{26.5 \times 10^{-3}} = 1.9535 \text{ mm}$$

Civilittee
 اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilittee-HU.com

■ Is the error accepted:

$$-1.9535 < -0.005 < 1.9535$$

*The error is accepted



accuracy = error / total distance

$$0.005 / 26.5 = 1/5300$$

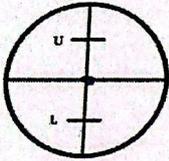
$12 \sqrt{K}$
 cumulative distance

Experiment 6

Contouring From Grid (Spot Elevation)

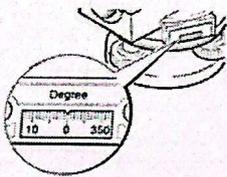
Required

- Calculate the horizontal distance from your level to the BM



Upper Stadia Hair BM = 1.57
 Lower Stadia Hair BM = 1.41
 Horizontal Distance = 16

- Calculate the azimuth, bearing, latitude and departure for the BM

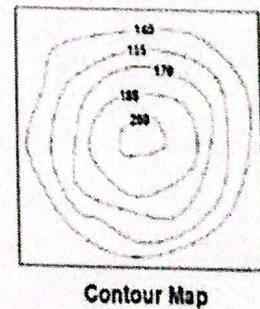
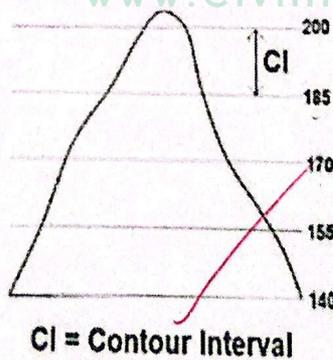
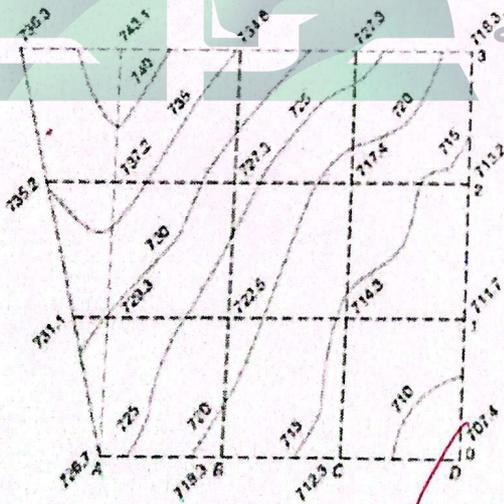


If the north is zero degree
 The horizontal angle (BM) from north = 65

$16 \cos(65) = 6.726$
 $16 \sin(65) = 14.501$

Azimuth angle = 65° , latitude S (BM) = 6.762 m
 Bearing angle = $N 65^\circ E$, departure S (BM) = 14.501 m

- For this drawing

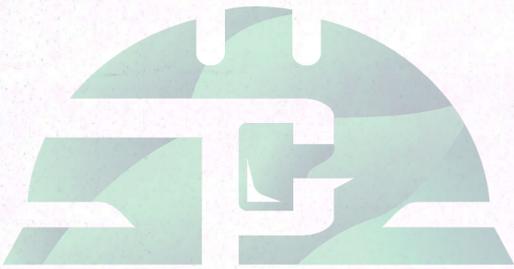


* The contour interval = 5

The contour interval = 15



1. Calculate the elevation for all points.
2. Draw the grid and place elevation on each point (The drawing should be to scale).
3. Draw the contour lines (5 lines) and write the elevations on contour lines (the Contour interval= 0.05 m)
Elevation for contour lines 1 = min. elevation + the contour interval
4. Draw profile for **line 2**



Civilittee
اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilittee-HU.com

Point	IS	Elevation	BS	FS	HI
BM		600		1.3	601.3
W1		599.36		1.37	600.73
W2		599.17	1.678	1.56	600.848
A1	2.331	598.517			
A2	2.314	598.534			
A3	2.308	598.54			
A4	2.309	598.539			
B1	2.541	598.307			
B2	2.522	598.326			
B3	2.486	598.362			
B4	2.375	598.473			
C1	2.641	598.207			
C2	2.599	598.249			
C3	2.463	598.385			
C4	2.414	598.434			
D1	2.672	598.176			
D2	2.661	598.187			
D3	2.54	598.308			
D4	2.484	598.364			
E1	2.694	598.154			
E2	2.682	598.166			
E3	2.651	598.197			
E4	2.596	598.252			
F1	2.724	598.124			
F2	2.728	598.12			
F3	2.723	598.125			
F4		598.158			

2.69
Civilittee

اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilittee-HU.com

Contour Lin
 $598.12 + 0.05$

$= 598.12 + 0.05 = \underline{\underline{598.17}}$

Line 2

$598.17 + 0.05 = 598.17 + 0.05 = \underline{\underline{598.22}}$

Line 3

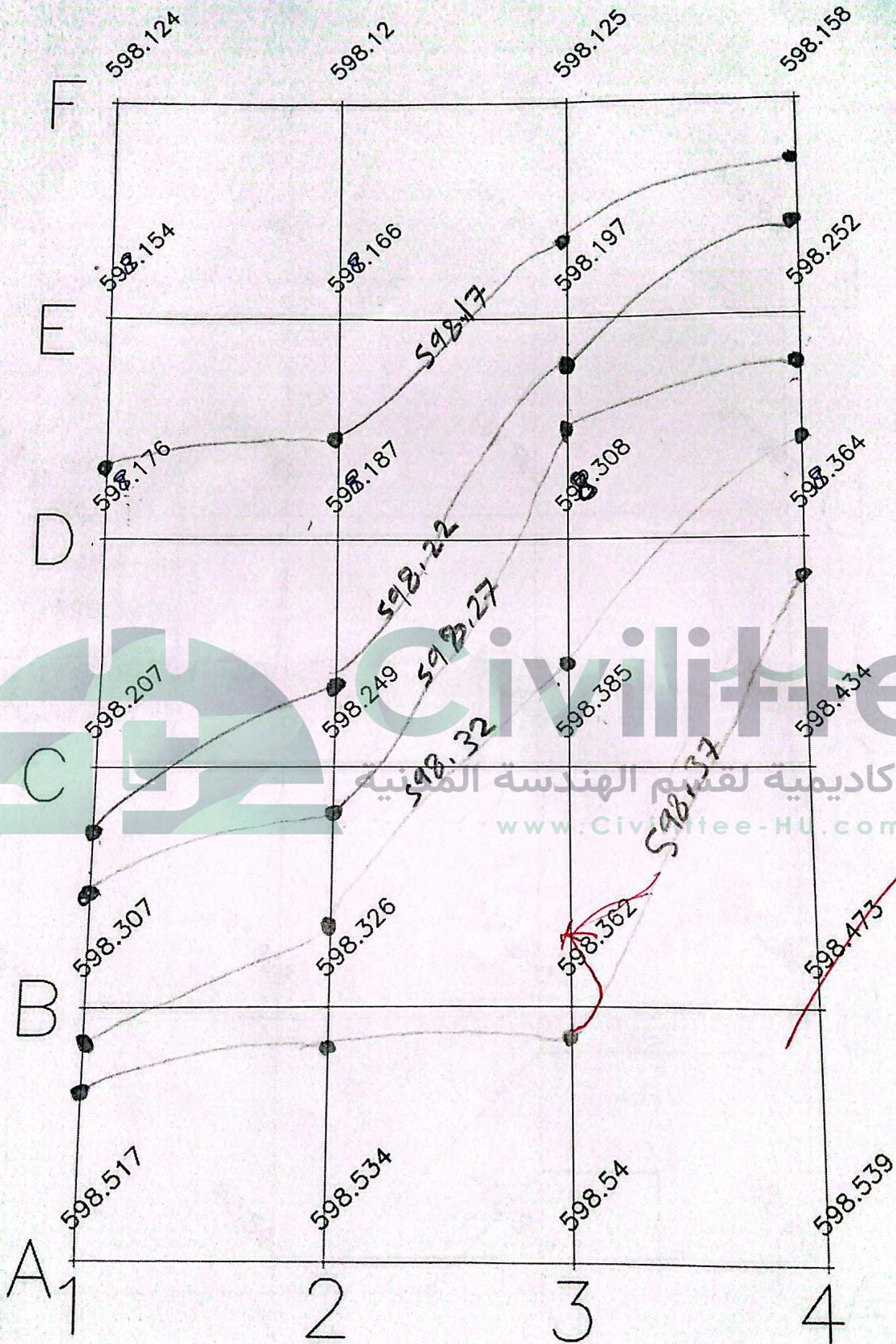
$598.22 + 0.05 = 598.22 + 0.05 = \underline{\underline{598.27}}$

Line 4

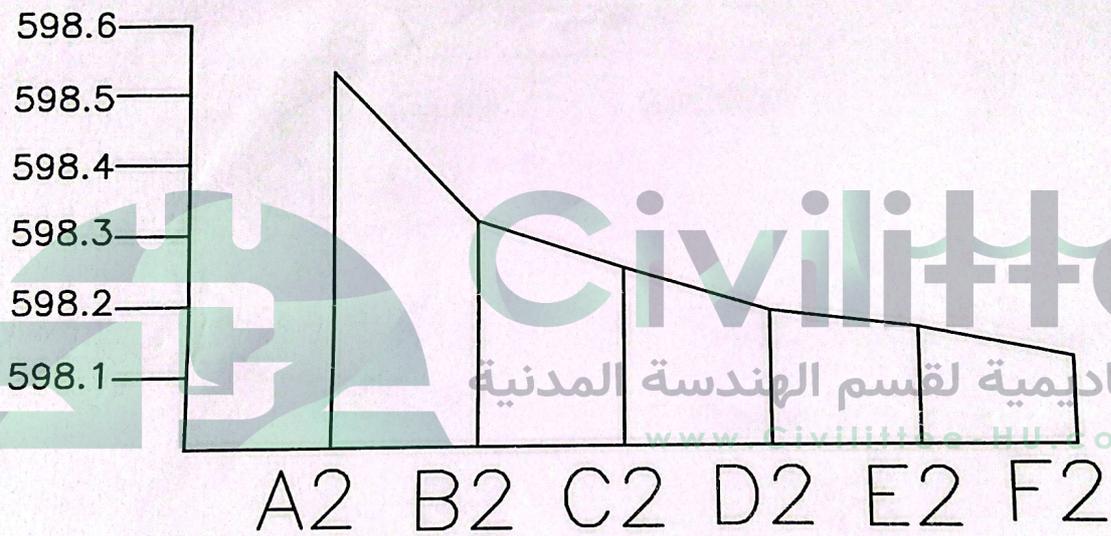
$598.27 + 0.05 = \underline{\underline{598.32}}$

Line 5

$598.32 + 0.05 = \underline{\underline{598.37}}$



اللجنة الأكاديمية لعقيم الهندسة المدنية
www.Civiltitee-HU.com



0.5

[Handwritten signature]

Experiment 7

Route Survey & Profiles

Required

ONE REPORT FOR THE GROUP

Street ABC has this data; draw profile (AutoCAD, save it as 2007 program)
Find the deflection angles

Station_m	Center_Elev_m	Left_Elev_m	Right_Elev_m
0	150	150.06	149.94
5	149.99	150.05	149.93
10	149.98	150.04	149.92
15	149.97	150.03	149.91
20	149.96	150.02	149.9
25	149.95	150.01	149.89
30	149.94	150	149.88
35	149.93	149.99	149.87
40	149.92	149.98	149.86
45	149.91	149.97	149.85
50	149.9	149.96	149.84
55	149.89	149.95	149.83
60	149.88	149.94	149.82
65	149.87	149.93	149.81
70	149.86	149.92	149.8
75	149.85	149.91	149.79
80	149.84	149.9	149.78
85	149.83	149.89	149.77
90	149.82	149.88	149.76
95	149.81	149.87	149.75
100	149.8	149.86	149.74
105	149.79	149.85	149.73
110	149.78	149.84	149.72
115	149.77	149.83	149.71
120	149.76	149.82	149.7
125	149.75	149.81	149.69
130	149.74	149.8	149.68

$$G = \Delta Z / \Delta X \\ = (149.99 - 150) / (5 - 0) \\ = -0.002$$

$$\text{Angel} = \tan^{-1}(-0.002) = 0.114$$

small angel

اللجنة الأكاديمية لقسم الهندسة المدنية
vilittee-HU.com

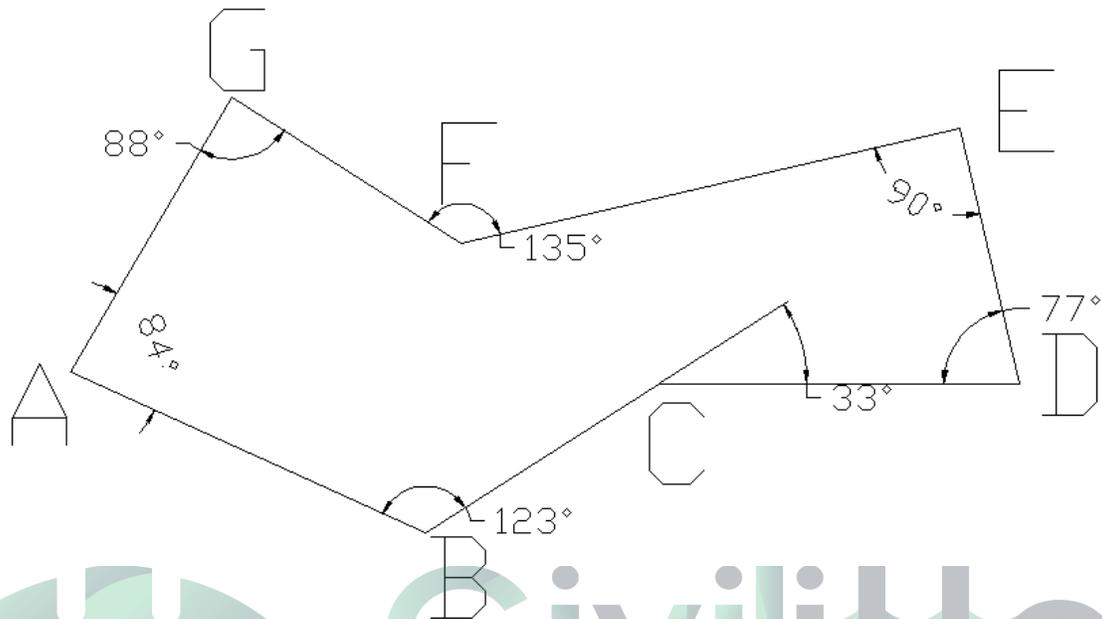
135	149.73	149.79	149.67
140	149.72	149.78	149.66
145	149.71	149.77	149.65
150	149.7	149.76	149.64
155	149.69	149.75	149.63
160	149.68	149.74	149.62
165	149.67	149.73	149.61
170	149.66	149.72	149.6
175	149.65	149.71	149.59
180	149.64	149.7	149.58
185	149.63	149.69	149.57
190	149.62	149.68	149.56
195	149.61	149.67	149.55
200	149.6	149.66	149.54
205	149.61	149.67	149.55
210	149.62	149.68	149.56
215	149.63	149.69	149.57
220	149.64	149.7	149.58
225	149.65	149.71	149.59
230	149.66	149.72	149.6
235	149.67	149.73	149.61
240	149.68	149.74	149.62
245	149.69	149.75	149.63
250	149.7	149.76	149.64
255	149.71	149.77	149.65
260	149.72	149.78	149.66
265	149.73	149.79	149.67
270	149.74	149.8	149.68
275	149.75	149.81	149.69
280	149.74	149.8	149.68
285	149.73	149.79	149.67
290	149.72	149.78	149.66
295	149.71	149.77	149.65
300	149.7	149.76	149.64
305	149.69	149.75	149.63
310	149.68	149.74	149.62
315	149.67	149.73	149.61
320	149.66	149.72	149.6
325	149.65	149.71	149.59

Civilitee

اللجنة الأكاديمية لقسم الهندسة المدنية

Civilitee-HU.com

Find the deflection angle for all sides



Send this report to
Haifad@hu.edu.jo

Civilittee

اللجنة الأكاديمية لقسم الهندسة المدني

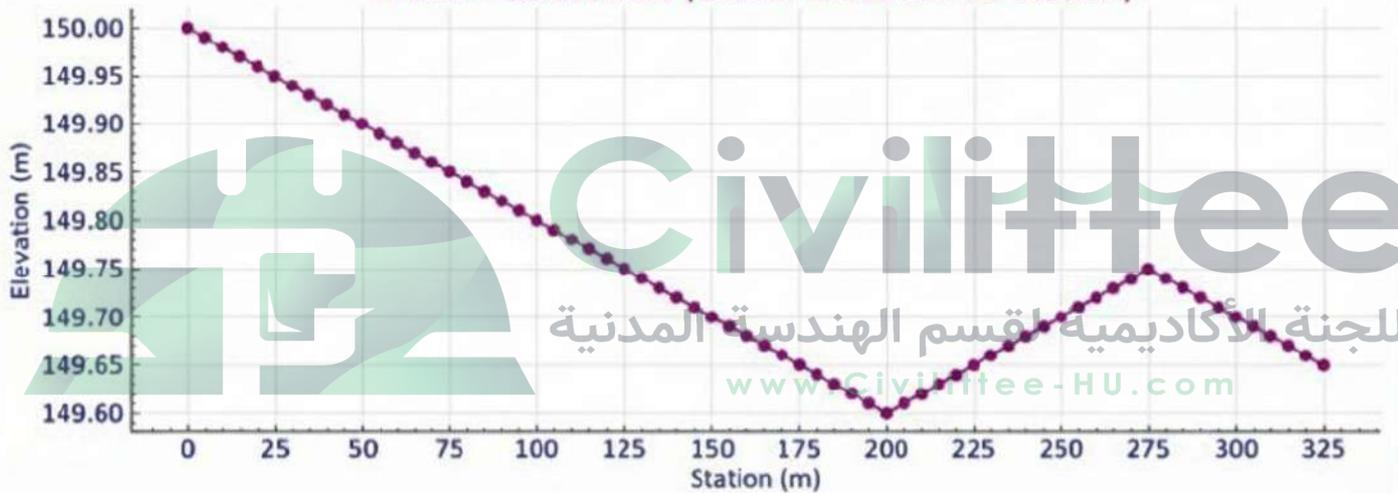
www.Civilittee-HU.com

point	Deflection angle
A	96 R
B	57 L
C	147 R
D	103 L
E	90 L
F	45 R
G	92 L



Civilttee
اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilttee-HU.com

Profile - Street ABC (Center Elevation vs Station)



Civilittee
اللجنة الأكاديمية لقسم الهندسة المدنية
www.Civilittee-HU.com