PRACTICAL WORK, WORKSHEET & REPORT WRITING

ENGINEERING SURVEY

latest edition




NAFISAH & NORAYAHATI

POLITEKNIK SULTAN AZLAN SHAH

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Practical 1 (a)

TWO-PEG TEST

Method For Checking and Recalibrating a Level

INTRODUCTION

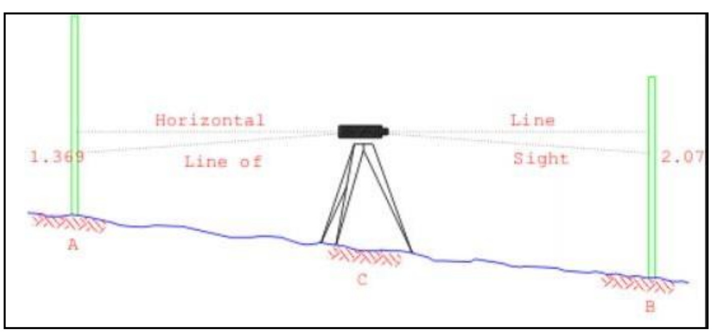
All instruments are subject to errors. The checking of the instrument (level) is therefore important. The main error is where the line of sight is not parallel to the horizontal line of collimation. In this case your levels will not be correct. A test for checking the level is known as the two peg test. This test determines the amount of error and if an error occurs notify the technician (the level must be serviced).

EQUIPMENT

a. Level (Automatic Level)	1
b. Tripod	1
c. Staff	2

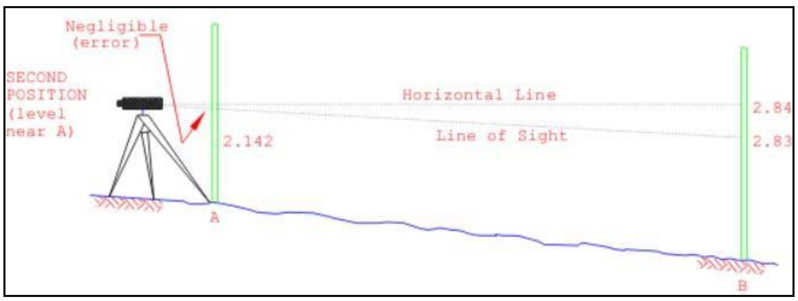
STAGE 1

- Establish two points approximately 50 metres apart on level ground as shown below. Set the level half way between the two points.
- Take the two staff readings. In our example an error will exists (line of sight does not coincide with line of collimation).



STAGE 2

- Move the level as close as possible to one of the peg. (In the case above 'Peg A'). Take the two staff readings again.
- If the difference in height is the same the level is okay. If not, as shown in the example above, the instrument needs to be serviced.
- Do comparison between two set of readings and the collimation should within the distance. If more than that it is advised to do instrument calibration.



SAMPLE : <u>TWO-PEG TEST</u>

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks
A_1 = 1.545									
A_2 = 1.629		B_1 = 1.332							
		B_2 = 1.413							
Difference = $(A_1 – B_1) – (A_2 – B_2)$									
= (1.545 – 1.332) – (1.639 – 1.413)									
= (0.213 – 0.215)									
= -0.002 m									
Difference of equipment is 0.002 m, that is still acceptable									

TWO-PEG TEST

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Practical 1 (b)

LEVELING : SERIES LEVELING

INTRODUCTION

Leveling is the procedure used when one is determining differences in elevation between points that remote each other. These practical will be introduce students to the leveling concept, field works skillful including the calculation involved in leveling and the algebraic checking, whereas are necessary in the level measurement.

OBJECTIVE

i. Determine the height of all points related.
ii. Handling the level equipment.
iii. An exposure to the students, the significant of leveling work in any construction project and mostly to Civil Engineered.

EQUIPMENT

a. Level (Automatic Level)	1
b. Tripod	1
c. Staff	2
d. Nail/pegs	some
e. Bubble Clip-on	2
f. Spray	1
g. Hammer	1

PROCEDURE

i. Starting from vertical datum or known point (elevation) provided. Temporary Bench Mark (TBM).
ii. Back sight (BS) should be held on known point (TBM) and fore sight to any point interested.
iii. Recommend the distance between instruments to bolt staff is within 10 to 20 meters. (if possible).
iv. Position of foresight station should be defined visibly to instrument.

v. The stations have marked by peg/spray.
vi. Observations must be recorded carefully on level book provided.
vii. Jobs must be looping back to TBM (original point) as a condition to accomplish the job.
viii. Reduce all the elevations to station numbers either by rise and fall or HPC methods (choose either one).
ix. Applying an algebraic checking and an accuracy of leveling as to ensure that there is no error in reading or recording.
x. Determine the accuracy of previous leveling jobs by $\pm 12\sqrt{K}$ mm, where K is the length of the circuit in km. The result must be compared on the differences of TBM values. The differences is ±0.013.

TASK

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

RESULTS

According to the practical, each group need to prepare a proper report with the format suggested below:

i. Introduction
ii. Objective
iii. Theory and principles
iv. Equipment
v. Raw data
vi. Data analysis
vii. Discussion
viii. Conclusion
ix. Reference
x. Appendix (if possible)

This report must be accomplished within 7 days after practical training and should be submitted on the next practical session.

Practical 1 (c)

LEVELING : LONGITUDINAL SECTION (PROFILE) & CROSS SECTION

INTRODUCTION

Leveling is the procedure used when one is determining differences in elevation between points that remote each other. These practical will be introduce students to the leveling concept, field works skillful including the calculation involved in leveling and the algebraic checking, whereas are necessary in the level measurement.

OBJECTIVE

i. Calculate reduce level for all point.
ii. Plot a longitudinal section (profile) and cross section with a suitable scale.

EQUIPMENT

a. Level (Automatic Level)	1
b. Tripod	1
c. Staff	2
d. Nail/pegs	some
e. Bubble Clip-on	2
f. Spray	1
g. Hammer	1
h. Tape	1

PROCEDURE

1. **Longitudinal section leveling for 60 m length.**
    i. The suitable position for the level to be set up is selected.
    ii. The level is set up. The temporary adjustment is made.
    iii. The staff is placed at the bench mark and the reading is taken.
    iv. The reading is noted in the form provided.
    v. Another staff is place at the distance of 7.5 m from the first staff.
    vi. The reading of second staff is taken and is noted as the intermediate sight.
    vii. A distance of 7.5 m is measured and the third staff position is placed. The reading is noted in the field sheet as an intermediate sight.
    viii. Step v – vii is repeated until the staff cannot be read. The last reading of the staff before the level is moved is noted in the column of foresight. The staff at the foresight position must not move until the back sight reading is taken.
    ix. The level is moved to new suitable position and the temporary adjustment is made.
    x. The back sight reading is taken.
    xi. A cross section reading is taken at every 15 m.
    xii. Step v – x are repeated until the work is completed.
    xiii. A fly level is performed back to the benchmark.
    xiv. The HOC and the reduced level of all the staff positions is calculated.
    xv. The longitudinal and cross section profile of the road is plotted.

2. **Cross Section Leveling for 0 m, 80 m, 120 m, 160 m and 200 m length.**
    i. Five staff positions is selected perpendicular to the longitudinal line at position A, B, C, D and E.
    ii. The staff is placed at point A and the reading is taken.
    iii. The reading is entered as intermediate sight if the level is still not being moved from the previous position.
    iv. Taking reading for points B, C, D and E is continued.
    v. After completed cross section leveling, taking the longitudinal leveling is continued until completed.

TASK

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

RESULTS

According to the practical, each group need to prepare a proper report with the format suggested below:

ii. Introduction
iii. Objective
iv. Theory and principles
v. Equipment
vi. Raw data
vii. Data analysis
viii. Discussion
ix. Conclusion
x. Reference
xi. Appendix (if possible)

This report must be accomplished within 7 days after practical training and should be submitted on the next practical session.

Practical 1 (d) (i)

LEVELING : GRID MEASUREMENT

INTRODUCTION

A grid survey to identify highs and lows is required. A grid spacing of 20m x 20m is often adequate, although 10m x 10m will be more accurate. For practical purpose and with experience, grid surveys can be done by pacing off the distances (rather than measuring). This method is ideal on relatively flat land, especially on comparatively small sites.

A map is then drawn to indicate which areas are high (and required soil to be cut) and the lows which require soil to be added. The areas of highs and lows (cut and fill) can be marked in the field by using different color pegs or cloth attached to pegs.

OBJECTIVES

i. To improve the skill of the students on how to use the level equipment.
ii. Show the students, one of the uses of the leveling work.
iii. To see the elevation of the particular earth surfaces.

EQUIPMENTS

i. Level (automatic level)
ii. Tripod
iii. Staff
iv. Nail/pegs/spray
v. Bubble clip-on
vi. Hammer

PROCEDURES

a) Choose the area to be survey, preferred an open and sloppy areas.
b) Assume the known point to be as vertical reference
c) Plan and create the grid with the intervals of 10m x 10m for 1600m sq areas.
d) Peg the intersection points with the proper marker.

e) Reduced the level to all points and accomplish the computations with the proper arithmetic check.
f) Plot the points on a paper with an appropriate scale respected to the sizes of the surveyed area.

TASK

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

RESULTS

According to the practical, each group need to prepare a proper report with the format suggested below:

i. Introduction
ii. Objective
iii. Theory and principles
iv. Method and figure
v. Equipment
vi. Raw data
vii. Data analysis
viii. Discussion
ix. Conclusion
x. Reference
xi. Appendix (if possible)

This report must be accomplished within 7 days after practical training and should be submitted on the next practical session.

Practical 1 (d) (ii)

LEVELING : CONTOURING SURVEY

INTRODUCTION

A contour is a line joining points of equal altitude. Contour lines are shown on plans as dotted lines, often in distinctive color, overlaying the detail. The vertical distance between successive contours is known as the vertical interval and the value of this depends on the scale of the plan and the use of the plan. A contour line must make a closed circuit even though it may not be within the area covered by the plan. There are few methods to carry out the survey fieldwork to generate the contour line. The following used ones for contouring.

i. Gridding
ii. Radiation lines
iii. Direct contouring

However, this practical will be considered the gridding method as a basic exposure of how technically contouring survey has been done.

OBJECTIVES

i. To give an exposure to the students of the uses of the leveling works.
ii. To develop a simple contour lines from a method mentioned.

EQUIPMENTS & MATERIALS

a) Scaled plotting of Practical 1 (d) (i)
b) Drawing set
c) Calculator

PROCEDURES

i. Using the result from Practical 1 (d) (i) (Leveling : Grid Measurement), determine the contour interval. Preferred fix to 1m intervals.
ii. Construct the contour lines by a manual technique.

TASK

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

RESULTS

According to the practical, each group need to prepare a proper report with the format suggested below:

ii. Introduction
iii. Objective
iv. Theory and principles
v. Equipment
vi. Raw data
vii. Data analysis
viii. Discussion
ix. Conclusion
x. Reference
xi. Appendix (if possible)

This report must be accomplished within 7 days after practical training and should be submitted on the next practical session.

LEVELING SKETCH

LEVELING SKETCH

LEVELING SKETCH

LEVELING SKETCH

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise (+)	Fall (-)	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

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Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

LEVELING

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Report Writing

CIVIL ENGINEERING DEPARTMENT
POLYTECHNIC OF SULTAN AZLAN SHAH
DCC20063 ENGINEERING SURVEY
(ENGINEERING SURVEY LABORATORY/WORKSHOP)

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Introduction

Safety and Health Procedure

Objective

Theory

Equipment

Procedures

Data Collections

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Analysis

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Calculation

Plan

Discussion

Conclusion

Reference

Report Writing

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Safety and Health Procedure

Objective

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Analysis

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Calculation

Plan

Discussion

Conclusion

Reference

Report Writing

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NAME		
REGISTRATION NUMBER		
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LECTURER'S NAME		
LECTURER'S COMMENT	**MARKING CRITERIAL**	**GIVEN MARKS**
	Work Procedure	
	Data Collection/Results	
	Data Analysis	
	Drawing Plan	
	Conclusion	
	TOTAL MARKS	

Introduction

Safety and Health Procedure

Objective

Theory

Equipment

Procedures

Data Collections

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Analysis

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Calculation

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Introduction

Safety and Health Procedure

Objective

Theory

Equipment

Procedures

Data Collections

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Analysis

Back Sight	Inter Sight	Fore Sight	Rise	Fall	Height Of Collimation	Reduce Level	Corr.	Final Reduce Level	Remarks

Calculation

Plan

Discussion

Conclusion

Reference

Practical 2 (a)

DIFFERENTIAL FIELD TEST

Method For Checking and Recalibrating a Total Station

INTRODUCTION

When starting new job/work, surveyor must conduct DFT to the Electronic Distance Measurement (EDM)/Total Station (TS). This is to make sure that the measurement is in good conditions.

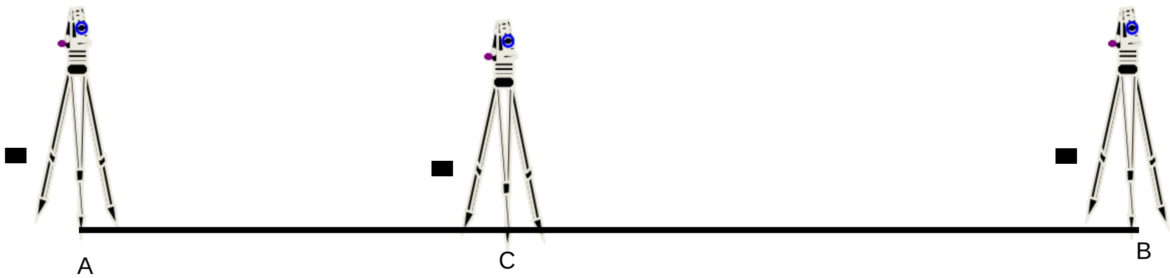
EQUIPMENT

a. Total Station	1
b. Tripod	1
c. Tape	2

PROCEDURE

i. First, plant picket at point A and point B with the distance of more than 50 meters.

ii. Set up the EDM/TS at point A and the prism at point B.
iii. Measure the distance of point A to B.
iv. Record the measurement in the field book.
v. Plant picket at point C which is about at the center of line AB.



vi. Move the EDM to point C and set up the prism at point A & B.
vii. Measure the distance of AB with the sum of distance CA + CB.

AB = CA + CB.

viii. Record the measurement in the field book.

If the difference is more then ± 10mm, the EDM/TS cannot be used. It must be submitted to calibration test to make sure weather it is in good condition or not.

SAMPLE : <u>DIFFERENTIAL FIELD TEST</u>

Station	Bearing/Angle			From	Line	To	Vertical Angle	Distance	Temperature	Final Distance
	Face Left	Face Right	Min Bearing		Final Bearing					
	DFT			A		B	H	67.000		67.000
								(67.000)		
				C		A	H	39.399		39.399
								(39.399)		
c	pkt above	line A-B								
				C		B	H	27.600		27.600
								(27.600)		
				C		A				39.399
				A		B				67.000 Tot

Measure distance between two points, let say Distance A-B, 67 meter. Move the equipment from A to C. Measure the distance between CA & CB.

CA = 27.580 m

CB = 39.399 m

So, Difference : = AB – (CA + CB)

= 67.000 – (39.399 + 27.600)

= 67.000 – 66.979 = 0.021 m = 2.1 mm, ±10 mm, acceptable.

DIFFERENTIAL FIELD TEST

Station	Bearing/Angle			From	Line	To	Vertical Angle	Distance	Temperature	Final Distance
	Face Left	Face Right	Min Bearing		Final Bearing					

Practical 2 (b)

THEODOLITE/TOTAL STATION (EDM) : CLOSED TRAVERSE

INTRODUCTION

Traverse are a series of established stations tied together by angle and distance. A traverse is a form of control survey that is used in a wide variety of engineering and property surveys. A closed traverse is beginning and ends at known points.

OBJECTIVE

i. Gives the basic principles of traversing and experiences of the field works procedure, so that students are able to establish the control points by surveying approach with minimize errors and practicable.
ii. To develop skill in using Total Station thus could be explored more function that assist on the instrument.

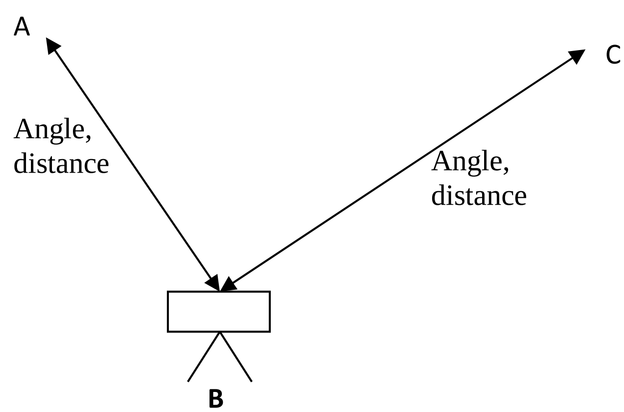
EQUIPMENTS

a. Total Station	1
b. Tripod	3
c. Prism with Tribach	2
d. Prismatic Compass	1
e. Nail/peg	some
f. Spray	1
g. Hammer	1
h. Umbrella	1

PROCEDURE

ii. Choose positions for stations as close as possible to the objects to be located. (minimum 4 station)
iii. Mark the stations by peg/picket with the ground and should be visible each other.
iv. The chosen distance between point >30m and ≤100m.
v. Use the prismatic compass to assume the baseline.
vi. Observations of angle and distance could be clockwise from baseline.

vii. Set up a total station/theodolite on the face left at station B, center it over the ground station mark and level it accurately with leveling screws.
viii. Sight the telescope towards station A, clamp the upper and lower plates and sight the signal at A accurately. Set up the angle and target distance BA.
ix. Unclamp the upper plate, swing the TS/theodolite clockwise and sight the signal at C. Accurate bisection of the signal is made by using upper tangent screw only. Read the angle and distance BC.
x. Repeat step (vii) to (viii) to get the face right at station BA and BC.
xi. Read both the angle and find the average reading.
xii. Shift the TS/theodolite to the next traverse stations in turn and repeat the steps (vi) to (x) at every traverse station in the same sequential order.
xiii. Calculate the areas, accuracy ratio and apply correction of traversing.



TASK

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

RESULTS

According to the practical, prepare a report related. Reports need to be as a individual writing includes the individual comment :

i. Introduction
ii. Objective
iii. Theory and principles
iv. Equipment
v. Raw data
vi. Data analysis
vii. Discussion (per person)
viii. Conclusion
ix. Reference
x. Appendix (if possible)

This report must be accomplished within 7 days after practical training and should be submitted on the next practical session

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SAMPLE : LATITUDES AND DEPARTURES COMPUTATION

Stn.	Bearing (Azimuth)	Distance (Meters)	Latitude		Departure		Final Latitude	Final Departure	Coordinate	
			N	S	E	W			N / S	E / W
2									1000.000	1000.000
3	74˚ 32’ 16”	228.511	60.922 + 0.038		220.240 - 0.040		+ 60.960	+ 220.200	1060.960	1220.200
4	78˚ 20’ 12”	209.800	42.413 + 0.035		205.468 - 0.036		+ 42.448	+ 205.432	1103.408	1425.632
5	211˚ 44’ 48”	312.269		265.548 - 0.051		164.305 + 0.054	- 265.497	- 164.359	837.911	1261.273
1	255˚ 48’ 34”	205.560		50.393 - 0.034		199.287 + 0.036	- 50.359	- 199.323	787.552	1061.95
2	343˚ 45’ 00”	221.251	212.412 + 0.036			61.9120 + 0.038	+ 212.448	- 61.950	1000.000	1000.000
	∑ Distance = 1177.391 m		315.747	315.941	425.708	425.504	0	0		
			Latitudes *0.194*		*Departures* *+ 0.204*		Correction for Latitudes & Departures Correction Latit :- (Latit x Line distance) / ∑ Distance Correction Depart :- (Depart x Line distance) / ∑ Distance			

Linear Misclosure = $(Latit)^2 + (Depart)^2$
= 0.282 m

Accurancy Ratio = Linear Misclosure / £ Distance
= 0.282 / 1177.391
= 1 / 4182.200 @
= 1 / 5000

CLOSED TRAVERSE SKETCH

CLOSED TRAVERSE SKETCH

CLOSED TRAVERSE SKETCH

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CLOSED TRAVERSE

Station	Bearing/Angle			From	Line	To	Vertical Angle	Distance	Temperature	Final Distance
	Face Left	Face Right	Min Bearing		Final Bearing					

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POLYTECHNIC OF SULTAN AZLAN SHAH
DCC20063 ENGINEERING SURVEY
(ENGINEERING SURVEY LABORATORY/WORKSHOP)

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Station	Bearing/Angle			From	Line	To	Vertical Angle	Distance	Temperature	Final Distance
	Face Left	Face Right	Min Bearing		Final Bearing					

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Station	Bearing/Angle			From	Line	To	Vertical Angle	Distance	Temperature	Final Distance
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POLITEKNIK MALAYSIA
SULTAN AZLAN SHAH

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Practical 3 (a) (i)

SETTING OUT : BUILDING

Introduction

For buildings with normal strip foundation the corners of the external walls are established by pegs located direct from the survey control or by measurement from the site grid. As these pegs would be disturbed in the initial excavations their positions are transferred by total station on the profile boards set well clear of the area of disturbance.

Objectives

i. To explain the general procedure for set up a building.
ii. To identify the types of error that might be happen in setting out works.
iii. To do the setting out works at site.

Equipment

a.	Total station	1
b.	Tripod	2
c.	Pole	3
d.	Mini prism	3
e.	Pegs/picket	10
f.	Tape	1

Procedure

a) Observation

An observation to the area must be done before the site works for any areas. Therefore, to get the clear information on site. Then, the planning can be done and the works will be done smoothly. Then, the suitable station have to be marked.

b) Control Station

In the setting out works for a building, the control station must be observed and each of them must be the true station. Usually the control station will be put in the construction area.

c) Setting out procedure

Set up the total station above the control station. Refer to the site plan to get the measurement of building.

Depend on the control station that have been marked, and as known, the distance of building from the middle of line is 8.5 m. The road bearing is 90^0 20' 30".

Then, put the picket at each side of building depend on the distance given.

Traverse table:

Line	Bearing	Distance (m)
1-2	275° 45' 30"	17.228
2-3	12° 35' 50"	27.622
3-4	96° 24' 30"	29.142
4-Pp3	182° 32' 20"	26.700
Pp3-1	270° 49' 00"	16.707

Remarks for each of bearing value and the distance that have been observe in the booking method.

Redraw the site plan and sketch the position of observed bearing at the site plan for setting out purposes.

Task

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :

a. Introduction
b. Objective
c. Theory and principles
d. Problems and solving method
e. Skills technique
f. Equipment
g. Discussion
h. Differences between computation and measured distance onto field
i. Explain the sources of errors created
j. Conclusion
k. References
l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

Practical 3 (a) (ii)

SETTING OUT : BUILDING BASEMENT/BASELINE

Introduction

For buildings with normal strip foundation the corners of the external walls are established by pegs located direct from the survey control or by measurement from the site grid. As these pegs would be disturbed in the initial excavations their positions are transferred by total station on the profile boards set well clear of the area of disturbance.

Objectives

i. To explain the general procedure for set up a building basement/baseline.
ii. To identify the types of error that might be happen in setting out works.
iii. To do the setting out works at site.

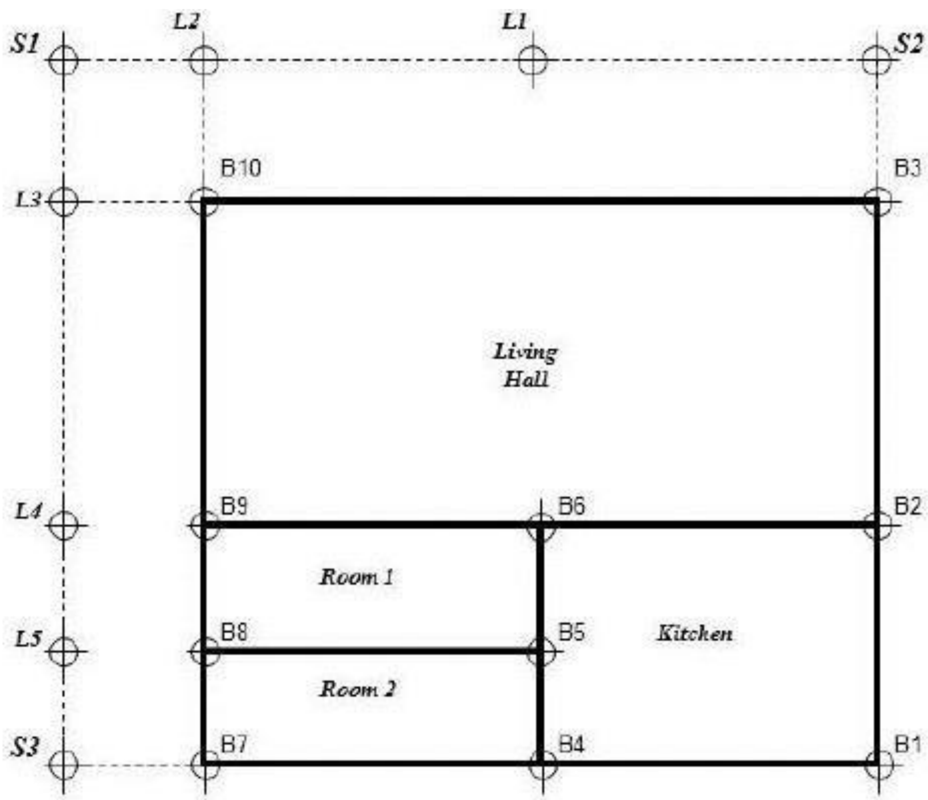
Equipment

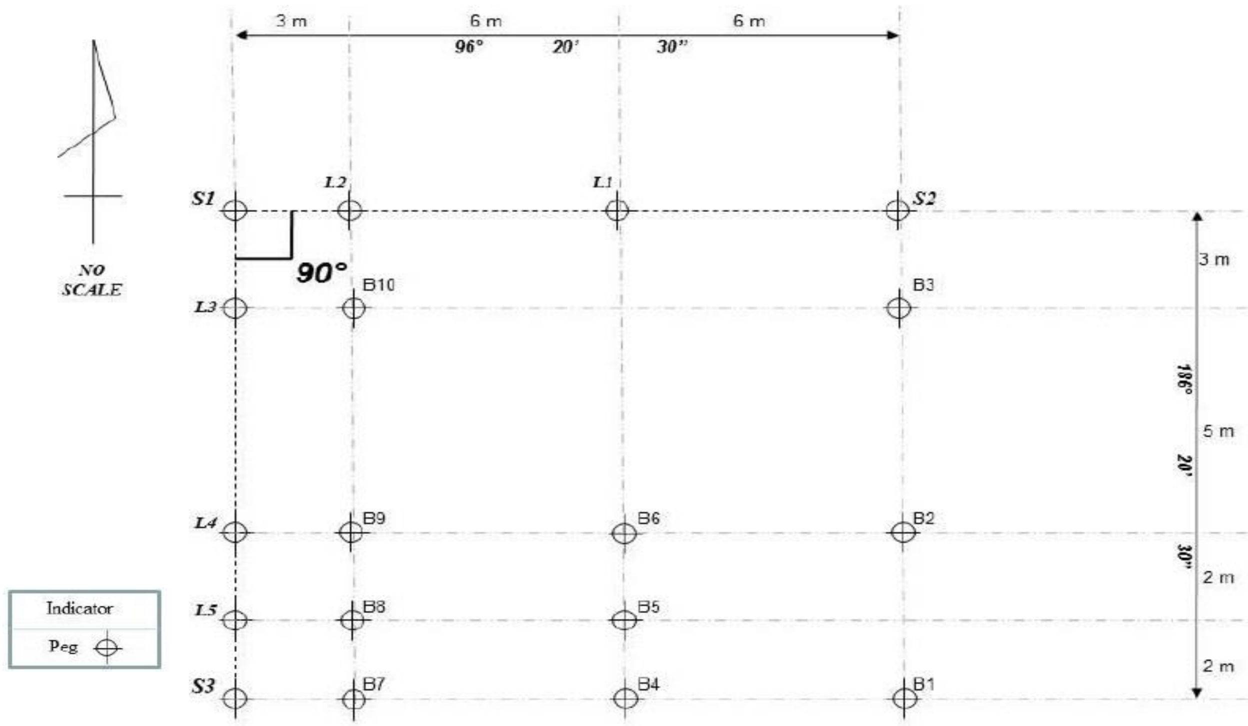
1. Total Station	1
2. Plumbob	1
3. Tripod	1
4. Ranging Pole	2
5. Arrows	5
6. Measurement tape	1
7. Wood picket	10
8. Construction String	1
9. Hammer	1

Procedure

Ground marking for building basement/baseline :

i. Find some space which is flat ground anywhere inside campus area.
ii. You are going to do this task with digital theodolite and 30 meter measurement tape. You also provided with ranging pole and arrows.
iii. Locate baseline point S1 and then S2 so do S3 According to setting out plan given to you. Make sure you are using the finest bearing and distance.
iv. Along the S1-S2 and S1-S3 baselines, there are several references point that you have to knock for checking purpose. There are L1, L2, L3, L4 and L5.
v. Make sure all the offset pegs were firmly knock in and the inner angle of S1 should be 90°.
vi. Begin to mark the building baseline points start from B1 and finish by B10 according to the point form given. Make sure you knock the peg firmly into its position and also to the length you measure with measuring tape must be exact to its direction.
vii. When you done with all those pegs, bind your provided construction string towards your pegs start from offset pegs to another opposites pegs. You will reveal that pegs you knocked inside rest house will be in the lines along with the string.
viii. Record errors and refine your error of there any.





Task

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :

a. Introduction
b. Objective
c. Theory and principles
d. Problems and solving method
e. Skills technique
f. Equipment
g. Discussion
h. Differences between computation and measured distance onto field
i. Explain the sources of errors created
j. Conclusion
k. References
l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

Practical 3 (b) (i)

SETTING OUT : DRAIN

Introduction

This worksheet concerns a leveling survey carried out for a drainage run. The main existing sewer runs down the middle of the road; it is a combined sewer. Survey process is the process of devising a plan or map, while setting out from the plan or map to produce engineering projects. Setting out is a process that is important in any kind of construction work in either construction works, pipe routes, roads and so on.

Objective

i. To explain the general procedure for set up a drain.
ii. To identify the types of error that might be happen in setting out works.
iii. To do the setting out works at site.

Equipment

i.	Level	1
ii.	Staff	3
iii.	Bubble staff	3
iv.	Tripod	1
v.	Tape	1
vi.	Plumb bob	1

Procedure

Benchmark drain station and then mark the point (3 points per station) at the station (interval 0.5 m). Outside of work is to determine the points or items for the stations to be marked.

a) Observation

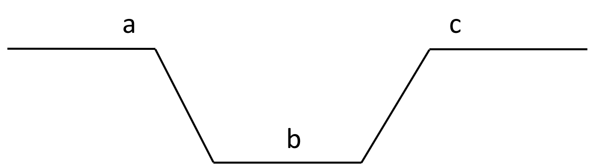
An observation to the area must be done before the site works for any areas. Therefore, to get the clear information on site. Then, the planning can be done and the works will be done smoothly. Then, the suitable station have to be marked.

b) Control Station

In the setting out works for a drain, the control station must be observed and each of them must be the true station. Usually the control station will be put in the construction area.

c) Setting out procedure

i. Set up the instruments from the BM (benchmark) or TBM (temporary benchmark) to the first station
ii. Then, set up the equipment at suitable area. Place staff at the points of stations a, b and c.



iii. Make observation at the staff reading (a, b & c) and record the data into the leveling form.
iv. Repeat step (ii) to (iii) for the next point at interval 0.5m.
v. Observations must be include back sight (a), inter sight (b) and fore sight (c), difference of height, reduce level, height of instrument and remarks.

Task

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :

a. Introduction
b. Objective
c. Theory and principles
d. Problems and solving method
e. Skills technique
f. Equipment
g. Discussion
h. Differences between computation and measured distance onto field
i. Explain the sources of errors created
j. Conclusion
k. References
l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

Practical 3 (b)

SETTING OUT : PIPELINES

Objective

i. To explain the general procedure for set up a pipelines.
ii. To identify the types of error that might be happen in setting out works.
iii. To do the setting out works at site.

Equipment

i.	Level/Total Station	1
ii.	Staff	3
iii.	Bubble staff	3
iv.	Tripod	1
v.	Tape	1
vi.	Plumb bob	1

Procedure

i. Pipeline installation refers to the laying of a pipeline to transport natural resources from the place of extraction to where they can be used or even within the place of their extraction.
ii. Design and develop process for pipelines.
iii. Do detail survey measurement, for example at 500 m and produce detail drawing and cross section drawing.
iv. Make the chain mark at every 25 m for cross section work.
v. Then, the engineers do the route design according to the appropriate gradient.
vi. Surveyor peg the center line for the final propose following the coordinate that have been given by engineer includes the depth. Find x and y coordinates (using total station) z (using level).
vii. The excavation work has begun. The surveyor standby at site to set the finishing/design level on the site, as required (follow to the design plan).
viii. Pipe installation work is done.
ix. Once done, before buried the pipe, take as built survey.
x. Produce a drawing as built survey.

Task

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :

a. Introduction
b. Objective
c. Theory and principles
d. Problems and solving method
e. Skills technique
f. Equipment
g. Discussion
h. Differences between computation and measured distance onto field
i. Explain the sources of errors created
j. Conclusion
k. References
l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

SETTING OUT FORM

Leveling No: …………………………… Height of Inst.:………………………….. Date :…………………………..

View			Height of collimation		Reduce level	Corr.	Final Reduce Level	Distance (m)	Remarks
BS	IS	FS	Rise	Fall					

SETTING OUT FORM

Leveling No: …………………………… Height of Inst.:………………………….. Date :…………………………..

View			Height of collimation		Reduce level	Corr.	Final Reduce Level	Distance (m)	Remarks
BS	IS	FS	Rise	Fall					

SETTING OUT FORM

Leveling No: …………………………… Height of Inst.:………………………….. Date :…………………………..

View			Height of collimation		Reduce level	Corr.	Final Reduce Level	Distance (m)	Remarks
BS	IS	FS	Rise	Fall					

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SETTING OUT FORM

Leveling No: …………………………… Height of Inst.:………………………….. Date :…………………………..

View			Height of collimation		Reduce level	Corr.	Final Reduce Level	Distance (m)	Remarks
BS	IS	FS	Rise	Fall					

Analysis

SETTING OUT FORM

Leveling No: ……………………………   Height of Inst.:…………………………..   Date :…………………………..

View			Height of collimation		Reduce level	Corr.	Final Reduce Level	Distance (m)	Remarks
BS	IS	FS	Rise	Fall					

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BS	IS	FS	Rise	Fall					

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Leveling No: …………………………… Height of Inst.:………………………….. Date :…………………………..

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BS	IS	FS	Rise	Fall					

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Leveling No: …………………………… Height of Inst.:………………………….. Date :…………………………..

View			Height of collimation		Reduce level	Corr.	Final Reduce Level	Distance (m)	Remarks
BS	IS	FS	Rise	Fall					

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Practical 4 (a)

CURVE : OFFSET FROM THE TANGENT LINE

Introduction

Offset from the tangential angle is suitable for linear measurements only. Setting out methods for curves employing linear measurement only are suitable where the ground is flat i.e without undulations. Curve is not very long the length being restricted, preferably to 250m and very high degree of accuracy is not required. A dozen of arrows may be employed to mark the ends of chain line.

Objective

i. Expose to student or survey instrument, especially total station.
ii. To compute this method from the data given.
iii. Set out curve point onto field by using offset from tangent method.

Equipment

i.	Total Station	1
ii.	Mini prism	1
iii.	Prism	1
iv.	Tripod	2
v.	Arrow pin	2
vi.	Tape	1
vii.	Hammer	1
viii.	Umbrella	1

Procedure

i. Computation of deflection angle.
ii. Define the location of curve routes.
iii. Choose the baseline.
iv. Indicate the location of BC and PI with arrow pin.
v. Set up total station the T1/BC (Beginning of curve)
vi. Set a zero setting to reference point I.

vii. Using tape, measure the distance from PI to EC at the end of work.

viii. The curve T1T2 has to be set out by driving *n* arrow marked *I* through and to divide the curve by (n + 1) chords of length Y1.

ix. The arrow are to be set with the help of chords lengths and deflection angle to the arrow pegs.

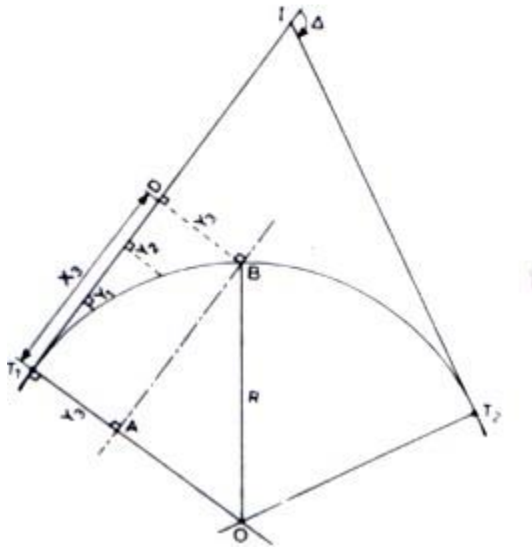

Figure 4 (a) Setting Out By Offset From Tangent

(Source: Engineering Surveying, W. Schofield)

thus for any offset Y_i, at distance X_i, along the tangent

$$Y_i = R - \sqrt{(R^2 - X_i^2)}^{\ ½}$$

Complete the table below

Curve Geometry	Distance (Comp)
Sub-Tangent (T1-I)	
Offset from T1 - I	

Group	Data :	Group	Data :
A	θ = 40° 23′ 00″ Radius = 50 m Chords = 3 m	D	θ = 40° 20′ 00″ Radius = 45 m Chords = 3m
B	θ = 30° 13′ 00″ Radius = 50 m Chords = 4 m	E	θ = 50° 00′ 00″ Radius = 55 m Chords = 4 m
C	θ = 35° 20′ 00″ Radius = 45 m Chords = 5 m	F	θ = 35° 00′ 00″ Radius = 55 m Chords = 4 m

Task

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :

a. Introduction
b. Objective
c. Theory and principles
d. Problems and solving method
e. Skills technique
f. Equipment
g. Discussion
h. Differences between computation and measured distance onto field
i. Explain the sources of errors created
j. Conclusion
k. References
l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

OFFSET FROM THE TANGENT LINE

SKETCH

OFFSET FROM THE TANGENT LINE

SKETCH

OFFSET FROM TANGENT LINE

No. of Survey: …………………………… Date :………………………….. Page :…………………………..

Point	Y (m)	X (m)	Remarks

OFFSET FROM TANGENT LINE

No. of Survey: …………………………… Date :………………………….. Page :…………………………..

Point	Y (m)	X (m)	Remarks

Practical 4 (b)

CURVE : OFFSET FROM THE LONG CHORD

Introduction

Offset from the long chord is suitable for linear measurements only. Setting out methods for curves employing linear measurement only are suitable where the ground is flat i.e without undulations. Curve is not very long the length being restricted, preferably to 250m and very high degree of accuracy is not required. A dozen of arrows may be employed to mark the ends of chain line.

Objective

i. Expose to student or survey instrument, especially total station.
ii. To compute this method from the data given.
iii. Set out curve point onto field by using offset from tangent method.

Equipment

i.	Total station	1
ii.	Mini prism	1
iii.	Prism	1
iv.	Tripod	2
v.	Arrow pin	2
vi.	Tape	1
vii.	Hammer	1
viii.	Umbrella	1

Procedure

i. Computation of deflection angle.
ii. Define the location of curve routes.
iii. Choose the baseline.
iv. Indicate the location of BC and PI with arrow pin.
v. Set up total station the T1/BC (Beginning of curve)
vi. Set a zero setting to reference point I.

vii. Using tape, measure the distance from PI to EC at the end of work.
viii. The curve T1T2 has to be set out by driving *n* arrow marked *I* through and to divide the curve by (n + 1) chords of length Y1.
ix. The arrow are to be set with the help of chords lengths and deflection angle to the arrow pegs.

Group	Data :	Group	Data :
A	θ =22° 00′ 00″ Radius =80 m Chords =3 m	D	θ =25° 00′ 00″ Radius =80 m Chords =4 m
B	θ =23° 00′ 00″ Radius =90 m Chords =4 m	E	θ =26° 00′ 00″ Radius =80 m Chords =3 m
C	θ =24° 00′ 00″ Radius =90 m Chords =3 m	F	θ =27° 00′ 00″ Radius =90 m Chords =4 m

Task

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :

a. Introduction
b. Objective
c. Theory and principles
d. Problems and solving method
e. Skills technique
f. Equipment
g. Discussion
h. Differences between computation and measured distance onto field
i. Explain the sources of errors created
j. Conclusion
k. References
l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

OFFSET FROM THE LONG CHORD

SKETCH

OFFSET FROM THE LONG CHORD

SKETCH

OFFSET FROM LONG CHORD

No. of Survey: ……………………………   Date :…………………………..   Page :…………………………..

Point	Y (m)	X (m)	Remarks

OFFSET FROM LONG CHORD

No. of Survey: …………………………… Date :………………………….. Page :…………………………..

Point	Y (m)	X (m)	Remarks

Practical 4 (c)

CURVE : DEFLECTION ANGLE USING THEODOLITE/TOTAL STATION

Introduction

A highway route survey was initially laid out as a series of straight lines (tangent). Once the centerline location alignment has being confirmed, the tangent was joined by circular curves that allow for smooth vehicle operation at the speed for which the highway was designed.

Objective

i. Expose to student or survey instrument, especially total station.
ii. To compute circular curve geometries from a question given.
iii. Set out curve point onto field by using deflection angle method.

Equipment

i.	Total station	1
ii.	Mini prism	1
iii.	Prism	1
iv.	Tripod	2
v.	Arrow pin	2
vi.	Tape	1
vii.	Hammer	1
viii.	Umbrella	1

Procedure

i. Prepared the data required into the table given.
ii. Define the location of curve routes.
iii. Choose the baseline.
iv. Indicate the location of BC and PI with nail, etc.
v. Set-up Total Station the BC (Beginning of Curve).
vi. Set a zero setting to reference point PI.
vii. Turn-out all angles from the baseline (tangent line).
viii. Using tape, measure the distance from PI to EC at the end of work.

ix. Also indicate a marking on a long chord sight right angle with PI, and then measure the distance from PI to that marking. (Compare with the calculations of E and M).

Complete the table below

Curve Geometry	Distance (Comp)	Distance (Tape)	Diff
Sub-Tangent (BC-PI)			
Length of curve			
Long chord (C)			

Group	Data :	Group	Data :
A	θ =22° 00′ 00″ Radius =150 m Point , I =220 m Chords =5 m	D	θ =25° 00′ 00″ Radius =130 m Point, I =222 m Chords =6 m
B	θ =23° 00′ 00″ Radius =130 m Point, I =222 m Chords =5 m	E	θ =26° 00′ 00″ Radius =160 m Point, I =222 m Chords =5 m
C	θ =24° 00′ 00″ Radius =200 m Point, I =222 m Chords =6 m	F	θ =27° 00′ 00″ Radius =130 m Point, I =222 m Chords =5 m

Circular curve geometry

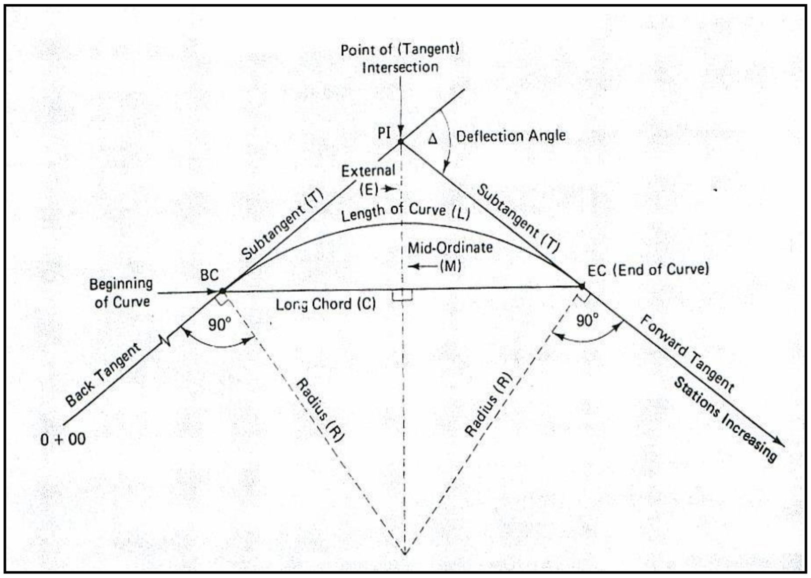

Figure 4 (c) Circular Curve Terminologies

(Source: Surveying With Construction Application, B.F. Kavanagh)

Given the certain of circular geometries

a. Deflection angles per meter = $(\Delta/2) / L$
b. Length of curve, $L = 2\pi R\ (\Delta/360)$
c. Tangent line, $T = R \tan(\Delta/2)$
d. Chord length, $C = 2R \sin(\Delta/2)$
e. Mid-ordinate, $M = R\ \{1- \cos(\Delta/2)\}$
f. $E = R\ \{1/(\cos \Delta/2)-1\}$

TASK

Students will be divided to small groups which are limited of four members per group. Each group will be given the equipment listed and their own route in PSAS areas.

Results

According to the practical, you have to prepare a report that followed condition suggested :-

a. Introduction
b. Objective
c. Theory and principles
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e. Skills technique
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g. Discussion
h. Differences between computation and measured distance onto field
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l. Appendix (if possible)

The report must be accomplished within 7 days after practical training and should be submitted on the next practical sessions.

OFFSET BY DEFLECTION ANGLE USING THEODOLITE/TOTAL STATION

SKETCH

OFFSET BY DEFLECTION ANGLE USING THEODOLITE/TOTAL STATION

SKETCH

OFFSET BY DEFLECTION ANGLE USING THEODOLITE/TOTAL STATION

No. of Survey: …………………………… Date :………………………….. Page :…………………………..

Point	Chainage (m)	Long chord (m)	Individual deflection angle	Cumulative of deflection angle

OFFSET BY DEFLECTION ANGLE USING THEODOLITE/TOTAL STATION

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Point	Chainage (m)	Long chord (m)	Individual deflection angle	Cumulative of deflection angle

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Point	Y (m)	X (m)	Remarks

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OFFSET METHOD FROM TANGENT LINE

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Point	Y (m)	X (m)	Remarks

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Point	Chainage (m)	Long chord (m)	Individual deflection angle	Cumulative of deflection angle

Analysis

OFFSET BY DEFLECTION ANGLE USING THEODOLITE/TOTAL STATION

No. of Survey: …………………………… Date :………………………….. Page :…………………………..

Point	Chainage (m)	Long chord (m)	Individual deflection angle	Cumulative of deflection angle

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Rubrics Individual Report, Fieldwork, Teamwork, Peer & Practical Test