SBEU 2141

SURVEY CAMP

FIELDWORK REPORT
ENGINEERING

PREPARED FOR

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LOCATION

KOLEJ K9

PREPARED BY

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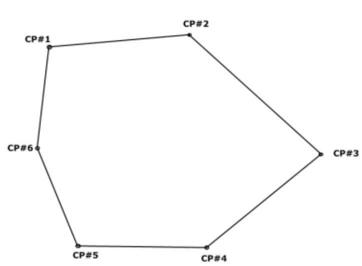
1.0 Introduction

Surveying has played an important role in human technologies, especially in construction. Without surveying, human could not acquire a lot of useful information such as distance, bearing, elevation and so on. With these useful information, strategic and planned boundaries could be build.

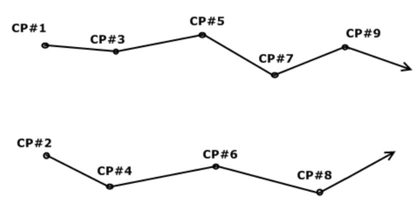
Automation, which is the product of technologies have greatly helped surveyor, consume less manpower during their field job. With automation, traversing, levelling, detailing, and booking can be done digitally. In past, surveyor have to record all their result in booklet, and process manually by hand. With powerful software such as CDS, AutoCAD, microcomputer in total station and data logger, the process from measurement to map drawing could be done digitalize.

This survey camp is intended to provide students of 2 SGHU with experience to carry out field practical engineering survey and GPS survey with comprises of data acquisition, processing and presentation. The field practical will expose students to project planning, acquiring working datum by using GNSS tools, traversing, leveling, detailing and plan producing. The students faced a 10 days of intensive survey camp which located in UTM itself.

Traverse as one of a method in field surveying is widely used in establish control networks and geodesy. There are two types of traverse which is open traverse and closed traverse. For open traverse, it started and end at a known point, whether it is at same point (closed loop traverse) or different point (open loop traverse). For open traverse, it started at a known point, while stop at a random unknown point. Thus, open traverse can’t compute linear misclosure.



Closed traverse



Open traverse

However, in order to start the traverse work, the students need to acquire the working datum in their traverse area. This also one of the main target of this survey camp where the students use GNSS tools to get the working datum. The working datum that are needed to start the progress are the true bearing and the reduced level of the stations and change points. It is very crucial to get these working datum because it will ease the combination of map and for future reference. Before the use of GNSS, surveyors use sun observation to get the true bearing and transfer the height from the nearest benchmark.

Levelling is a technique used by surveyor to compute the elevation height of a point refer to mean sea level. By transferring height from a vertical datum, the elevation height can be transfer slowly from vertical datum to certain point. There are two ways to process levelling, which is by rise and fall method or height of collimation method. Both methods are great in computing height in different aspect. Height of collimation method is used when there are many intermediate point while rise and fall method is used when there are only backsight and foresight data. Normally rise and fall method is used when we are calculating elevation height for traverse station while height of collimation method is used for contouring.

There are three main uses of Levelling which is referencing of Tide Gauges to determine and check the vertical stability of the tide gauge bench mark (TGBM) with respect to reference points (benchmarks) in its immediate vicinity. In order to isolate any local movements, there should be at least three such benchmarks, and the levelling should be repeated on an annual or semiannual basis. Next, connection to GPS Reference Points to determine its regional stability and to separate sea level rise from vertical crustal motion, the TGBM should be connected via GPS to reference stations fixed in a global coordinate system. Generally speaking, the GPS antenna cannot be directly placed on the TGBM and a GPS reference point must be established a short distance away. This must be connected to the TGBM by levelling. Lastly, it uses to connection to National Levelling Network. Mean sea level is used to define vertical datum for national surveying and mapping - hence the TGBM must be connected to the national leveling network. Connection to the network will also allow all tide gauges to be connected to each other, providing information on spatial variations in mean sea level.

Detailing is the survey of physical situation on the land. The features we take for measurement include natural features such as vegetation or manmade features such as drainages, roads, building etc. In detail survey, the elevation and coordinates of these features can be acquire through computation of bearing and distance from a known point, which could be a traverse point. Thanks to the invention of automation, surveyor can save data in data logger and export to CDS for further process. There are two important things to be done before detail survey, which are reconnaissance and create features code. With certain features code, it assigned the same kind of features to that features code, allow surveyor to process data more easily. Reconnaissance is crucial so that surveyor knew that what to measure during fieldwork.

In Survey Camp I, group 1 will conduct a traverse, levelling and detail survey at K9 Universiti Teknologi Malaysia. This survey is conducted by 6 students from 2SGHU. In this survey camp, group 1 will take the topographic information at College 9, finally produce a topographic map with a scale of 1: 700. All the students in this survey camp also need to produce a combined topographic map where all the groups will work together to create a big topographic map of the designated area.

2.0 AIM/OBJECTIVE

2.1 Traversing

Aim : To establish control points where their position being determine by measuring distances between the traverse stations and the angles substended at the various stations by their adjacent stations.

Objective :

- To familiarize students with real survey work outside which is Student can improve knowledge on how to handle and get hands-on experience in setting up and equipment.
- To learn on how to establish the traverse station from given work site.
- To able the student to sharpen their skill in basic surveying computation such as traversing adjustment, linear misclosure, easting and northing computation.
- To develop our skills on how to deal with other groups in sharing station.

2.2 Leveling

Aim : To establish points at given elevations or different elevations with respect to a given or assumed datum.

Objective :

- To measure on the ground features including the nature detail and man-made creation.
- To obtain the reduced level between the points on the surface of earth.
- To produce topographic maps contained detailed information and contour lines for the purpose of planning a construction project.
- Concerns all features of the landscape that can be shown for the particular map scale.

2.3 Detail Survey

Aim : To present information about our purposes of land valuation and to produce a topographic map

Objective :

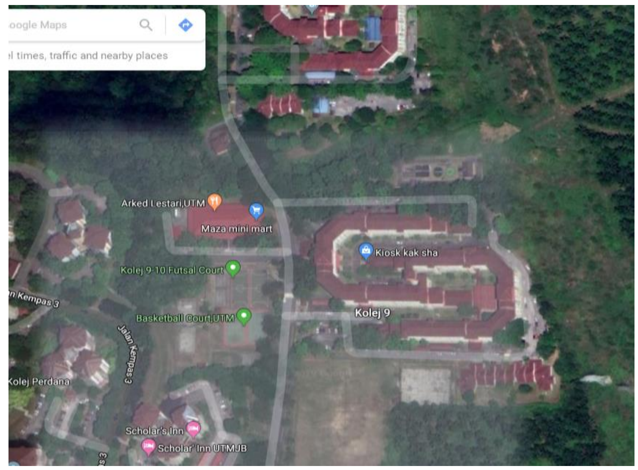
- To measure on the ground features including the nature detail and man-made creation.
- To obtain the reduced level between the points on the surface of earth.
- To produce topographic maps contained detailed information and contour lines for the purpose of planning a construction project.
- Concerns all features of the landscape that can be shown for the particular map scale.

3.0 Working Scope

3.1 Study Area

Our project for this semester’s survey camp are carried out at block UA1, UA2 and UA3, K9 in UTM campus area. We have setup some stations around the K9 area so that we do traverse

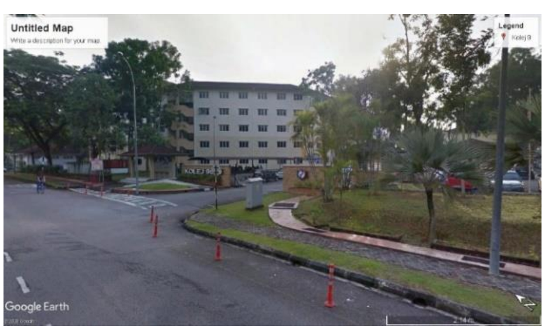
Traverse location

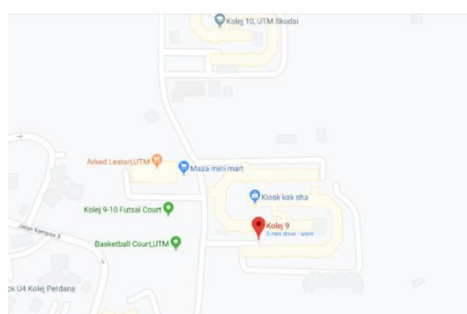


Street view of group 9 fieldwork area

We have 12 stations for this project. The stations are setup according to clockwise direction starting from station 1 and then to station 7 then close back to initial point (STN 1).

The station7, station8 and station9 our group shared with group 4, their project area is K10. While the station5, station6 and station7 we shared point with group 5 who beside our project area.There are some man-made features such as basketball court located beside K9. There is also some steep slope between K9 and K10 which require us to setup more stations to ensure the level between stations does not differ too much. This is to prevent some extreme conditions during the setup of instruments (such as we need to set the total stations/prisms very low or very high).





Map view of K9

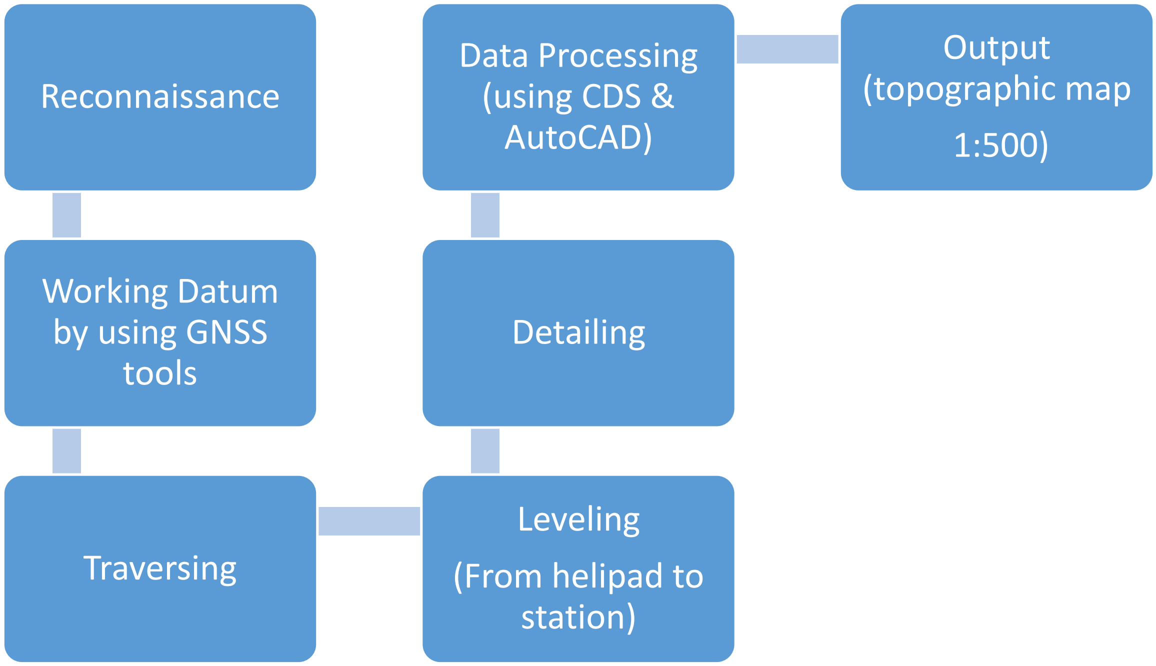
3.2 Survey Classification

For our traversing, we are using the first class linear misclosure as our working scope with a misclosure of 1:8000. We are putting angular mislclosure of 1’20” as our upper limit in traverse. In the case of leveling, the tolerance that we accept is based on the formula :

$$12\sqrt{k} \qquad \text{where k is the distance in km}$$

For the detail survey we are doing a 1:700 scale topographic map. Hence, any objects or area that are bigger than 500 mm will be taken.

4.0 Methodology



4.1 Instruments Specification

Instruments	Specification
Total station Topcon ES-105 	• Ultra-Powerful, Advanced EDM • Has dual LCD screen, very convenience with different angles • Accuracy 5 Second • Can perform with both reflector and reflectorless situation • 500m non-prism range • 4000m prism range Less than 1 second fine measurement • LongLink Communication function • Long range bluetooth • Water resistant • 36 hours battery life • Alphanumeric keypad

Leica sprinter 250m Digital Level 	• Leica Sprinter 250m built in software • Delta Height • Line Levelling • Cut & Fill • Store up to 2000 measurements, download and transfer them for further calculations to Excel® to a PC via USB. • The 0.7mm accuracy of the 250M and the monitoring program allow machine and construction subsidence measurements
TOPCON GR-5 	• Paradigm G3 Technology • 216 all-in-view Universal Tracking Channels • Sophisticated, High Accuracy RTK technology with position updates up to 100Hz • Integrated, dual-communications system with multiple radio and cellular options • 32 GB SDHC storage support • Dual hot-swappable batteries • Advanced Fence Antenna™ Technology - unsurpassed tracking and performance

The DFT and Two-Peg test are as follows:

DFT : 0.001m (error in distance)

4” (for angle < 90 deg) and 7” (for angle > 90 deg)

Two-peg test : 0.001m (mislcose level reading)

4.2 Instruments Used

4.2(a) Traversing

Instrument	Description
Total Station ES-105 	To simultaneously measure angles and distances and determine the positions and heights of points.
Tripod 	To support the total station and prism.
Prism 	Used as a target and to secure control points for distance measurement with pinpoint accuracy.
Compass 	To measure horizontal angles.

Wooden Picket 	As mark points of station points usually pointed underground with a center marks with small dot using nails.
Hammer 	Strike the picket into ground.
Measuring tape (50m & 5m) 	Measure the distance and the height of total station and reflector.
Safety vest 	To keep wearer clearly in view.

4.2(b) Detail Survey

Instrument	**Description**
Total Station (Topcon ES 105) 	• A combination of theodolite and Electronic Distance Measurement (EDM). • Can measure both vertical and horizontal angle and also can measure vertical and horizontal distance.
Tripod 	• Ensure a stable support to instrument such as prism and total station for more reliable measurements.
Prism 	• Prism is a reflector of electromagnetic wave from total station for distance measurement purpose. • As a pointing target for vertical And horizontal angle measurement. • Use to check back bearing.
Tape (5m) 	• To measure the height of instrument. • Having a limit of 5m in length.
Mini prism 	• Also as a reflector of Electromagnetic wave from total station. • Small in size yet accurate and perfect for works that requires a lot of control points to obtained
Pole 	• Hold mini prism securely in place • Marks the aimed control points

4.2(c) Levelling

Instrument	Description
Leica Sprinter Digital Level 	• Electronic digital level for horizontal distance measurement. • Provides real time error calculation.
Tripod 	• Ensure a stable support to instrument such as prism and total station for more reliable measurements.
Level staff 	• Provides difference in height measurement between points directly to digital level.
Bubble 	• As an indicator that the level staff is securely level in its position.

4.3 Theory In Survey

4.3(a) Traverse

Bowditch Traverse Adjustment

Method to adjust errors in bearings due to angular or linear inaccuracies where it assumes observations are all done to the same degree of precision and that misclosures could be logically distributed within the Survey Run.

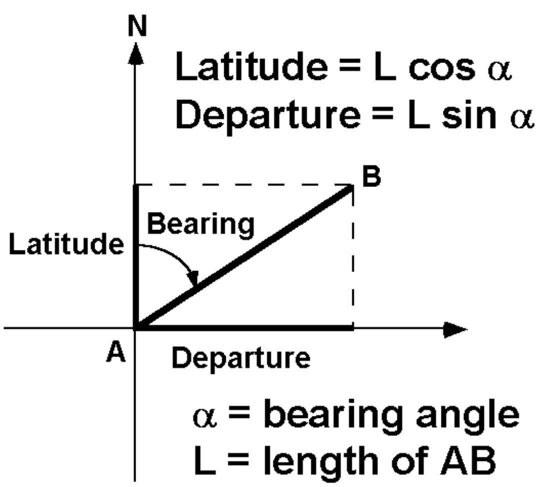
DETERMINING BEARINGS OR AZIMUTHS

- Requires the direction of at least one line within the traverse to be known or assumed
- For many purposes, an assumed direction is sufficient
- A magnetic bearing of one of the lines may be measured and used as the reference for determining the other directions
- For boundary surveys, true directions are needed

LATITUDES AND DEPARTURES

- The latitude of a line is its projection on the north-south meridian and is equal to the length of the line times the cosine of its bearing
- The departure of a line is its projection on the east-west meridian and is equal to the length of the line times the sine of its bearing
- The latitude is the y component of the line and the departure is the x component of the line

LATITUDES AND DEPARTURES



CLOSURE OF LATITUDES AND DEPARTURES

- The algebraic sum of all latitudes must equal zero or the difference in latitude between the initial and final control points
- The algebraic sum of all departures must equal zero or the difference in departure between the initial and final control points

CALCULATION OF LATITUDES AND DEPARTURES

Example: Using bearings

Station	Bearing	Length	Latitude	Departure
A				
	N 26° 10'E	285.10	+255.88	+125.72
B				
	S 75° 25'E	610.45	-153.70	+590.78
C				
	S 15° 30'W	720.48	-694.28	-192.54
D				
	N 1° 42'W	203.00	+202.91	-6.02
E				
	N 53° 06'W	647.02	+388.48	-517.41
A				
MISCLOSURE			-0.71	+0.53

ADJUSTMENT OF LATITUDES AND DEPARTURES (Bowditch Rule)

Correction in Latitude of AB =

$$\frac{\text{Total Latitude Misclosure}}{\text{Traverse Perimeter}} * \text{Length of AB}$$

Correction in Departure of AB =

$$\frac{\text{Total Departure Misclosure}}{\text{Traverse Perimeter}} * \text{Length of AB}$$

ADJUSTMENT OF LATITUDES AND DEPARTURES

Example:

Station	Azimuth	Length	Latitude	Departure
A			+0.08	-0.06
	26° 10'	285.10	+255.88	+125.72
B			+0.18	-0.13
	104° 35'	610.45	-153.70	+590.78
C			+0.21	-0.15
	195° 30'	720.48	-694.28	-192.54
D			+0.06	-0.05
	358° 18'	203.00	+202.91	-6.02
E			+0.18	-0.14
	306° 54'	647.02	+388.48	-517.41
A				
TOTALS		2466.05	-0.71	+0.53

CALCULATING X AND Y COORDINATES

Given the X and Y coordinates of any starting point A, the X and Y coordinates of the next point B are determined by:

$$Y_B = Y_A + \text{latitude AB}$$

$$X_B = X_A + \text{departure AB}$$

linear misclosure = $\sqrt{(\partial E^2 + \partial N^2)}$

proportional linear misclosure

the linear misclosure is divided by total distance measured, and this figure is expressed as a ratio e.g. 1 : 10000. In the example given, if the total distance measured along a traverse is 253.56m, and the linear misclosure is 0.01m, then the proportional linear misclosure is (0.01/253.56 = 1/25356 or approximately 1 : 25000

4.3(b) Leveling

Reduced Level:

The height of any target point is referred to as Reduced Level (RL), because it is reduced to a known datum.

Backsight (BS):

First staff reading taken immediately after setting up the instrument.

Foresight (FS):

last staff reading taken before moving the instrument to another location.

Intermediate sight (IS) :

all readings taken between a BS and a FS.

Rise and Fall Method:

It consists of determining the difference of elevation between consecutive points by comparing each point after the first that immediately preceding it. The difference between there staff reading indicates a rise fall according to the staff reading at the point. The R.L is then found adding the rise to, or subtracting the fall from the reduced level of preceding point.

Arithmetic check Sum of B.S. – sum of F. S. = sum of rise – sum of fall = last R. L. – first R.L.

This method is complicated and is not easy to carry out. Reduction of levels takes more time. Visualization is necessary regarding the nature of the ground. This method is preferable for check levelling where number of change points are more.

4.3(c)Detailing

Topographic or" Detail" Surveys are used in many situations where Architects , Designers or Engineers need to know the current physical situation in terms of features and levels of the site in question. This survey is then used to design buildings, extensions, roads, bridges, schools, factories, wineries, pipes, dams, subdivisions, almost anything that is built.

The word 'features' here means both natural and man-made structures on a piece of land – such as vegetation, types of soil, buildings, land utilities, fences and boundaries, roads, land marks and so on.

This kind of survey is usually confined to the boundaries of the parcel of land. The survey will often include data such as the elevation of the land, that is, how high the land is above an arbitrary datum (level).

A commonly used arbitrary level is the Mean Sea Level which is taken as zero metres high. The Easting and Northing coordinates of the land (exact position in relation to the earth's surface) may have to be taken too.

They are generally carried out using survey equipment such as total stations and theodolites. The data is then carried to the office for analysis and preparation of detail maps known as Digital Terrain Models, which provide the details that have been collected in the form of a map.

These maps are useful for engineers and architects who use them in their designs and plans. The survey should be carried out by a qualified land surveyor who may be assisted by a chainman.

Tacheometry is a system of rapid surveying, by which the horizontal and vertical positions of points on the earth's surface relative to one another are determined without using a chain or tape, or a separate levelling instrument. Instead of the pole formerly employed to mark a point, a staff similar to a level staff is used. This is marked with heights from the base or foot, and is graduated according to the form of tacheometer in use.

The horizontal distance is inferred from the vertical angle included between two well- defined points on the staff and the known vertical distance between them. Alternatively, also by readings of the staff indicated by two fixed stadia wires in the diaphragm (reticle) of the telescope. The difference of height is computed from the angle of depression or elevation of a fixed point on the staff and the horizontal distance already obtained. The azimuth angle is determined as formerly. Thus all the measurements requisite to locate a point both vertically and horizontally with reference to the point where the tacheometer is centered are determined by an observer at the instrument without any assistance beyond that of a man to hold the staff.

4.3(d) GPS survey

Global Navigation Satellite System (GNSS) refers to a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. The receivers then use this data to determine location.

By definition, GNSS provides global coverage. Examples of GNSS include Europe's Galileo, the USA's NAVSTAR Global Positioning System (GPS), Russia's Global'naya Navigatsionnaya Sputnikovaya Sistema (GLONASS) and China's BeiDou Navigation Satellite System.

The performance of GNSS is assessed using four criteria:

- Accuracy: the difference between a receiver's measured and real position, speed or time;
- Integrity: a system's capacity to provide a threshold of confidence and, in the event of an anomaly in the positioning data, an alarm;
- Continuity: a system's ability to function without interruption;
- Availability: the percentage of time a signal fulfils the above accuracy, integrity and continuity criteria.

Site selection must be "OPEN", VISIBLE and NO OBSTRUCTIONS (e.g. BUILDINGS,TREES CARS,PEOPLE)
GNSS Control Network Design

- Determine the independent (non-trivial) and dependent (trivial) baselines, where: independent means observed/measured baselines. Dependent means computed baselines (over-estimated)
- The network design must be like a "scaffolding"; able to support a person from any direction.
- The choice of which baseline should be dependent and independent is up to the user with regard to a "trial and error" basis.
- There must be dependent baselines for each session in order not to produce an over-estimated solution.
- The number of independent baselines are baselines are determined using (n-1); where n is the number of receivers

Observation criteria

- Duration for static observation: >1hour
- Duration for fast observation: >20minutes
- Observation interval: 10 seconds

- Cut off angle: 10 degrees
- Avoid rain and any natural hazards (e.g. monsoons, earthquakes, tsunamis)

4.3(e)AutoCAD

Before starting drawing the plan, we need to set the direction, units such as precision and type of length and angle, units to scale inserted content. These drawing units will be affected the plan. Plans are usually "scale drawings", meaning that the plans are drawn at a specific ratio relative to the actual size of the place or object. Various scales may be used for different drawings in a set.

AutoCAD is a 3D computer-assisted design software by Autodesk that’s created for manufacturing planning, product designing, building designing, construction, and civil engineering. More than making 3D models, AutoCAD is also used for drafts, documents, and 2D drawings. The 2D drawing, annotation features, and drafting allow users to customize texts, add dimension styles, tie in data from Microsoft Excel tables and spreadsheets to the drawings, and use dynamic blocks. AutoCAD allows them to take data from PDF files to work with teammates as drawings and models are reviewed.

AutoCAD can alter text appearances in 2D drawings. Through changing the text settings, users can change line spacing, font, justification, and even color. Additionally, when text settings are changed, every text object used in the drawing will also automatically follow when the settings are updated.

4.3(e)CDS

Civil Design and Survey or popularly known as CDS/TRPS which run under Microsoft Window is one of the software used to process surveying data for plan production. This package was able to perform analysis for engineering works.

Consists of four modules:

•Coordinate Geometry (COGO)

•Model

•Road

•Piling

CDS software has a variety of facilities to help surveyors and engineers in data processing and designing. These facilities are:

- Traverse entry and computation
- Road design
- Piling
- Detail surveying
- Cadastre survey
- Volume computation
- Earthwork
- Road and highway design
- Housing and industrial estate design R
- GIS data collection.

Types of data format accepted by most surveying packages:

- Leica
- Sokkia
- Topcon
- Trimble

CDS Display

Title Bar : Consist of the program's name CDS/TRPS and project name .

Menu Bar: Same as WINDOWS except specified modules for CDS/TRPS software only .

Coordinate Display: Shows the coordinates values with respect to the coordinate system used.

Graphic/Stadia Display: Where graphic and surveying data (stadia) are displayed.

4.3(f)Plan

Plans are a set of drawings or two-dimensional diagrams used to describe a place or object, or to communicate building or fabrication instructions. Usually plans are drawn or printed on paper, but they can take the form of a digital file. Plans are often for technical purposes such as architecture, engineering, or planning. Their purpose in these disciplines is to accurately and unambiguously capture all the geometric features of a site, building, product or component.

As the numbers in the scale get bigger, i.e. 1:50 – 1:200, the elements in the drawing actually get smaller. This is because in a drawing at 1:50 there is 1 cm for every 50cm in real life. A drawing of 1:200 is representing 200 cm for every one unit – and therefore is showing the elements smaller than the 1:50 drawing.

4.4 Methodology

4.4(a) Centering and Levelling Prism

1. Establish tripod at a suitable height.

2. Loosen the tripod stand leg screws.

3. Extend the tripod stand to suitable height.

4. Tighten the tripod stand leg screws.

5. Open the tripod stand legs widely.

6. The centre hole of the mounting plate should be over the nail of the peg.

7. Press one of the tripod stand legs into the ground.

8. Mount the prism by placing it atop the tripod.

9. Screw the prism with the mounting knob.

10. Centre the centre mark of prism to the nail of the peg by adjusting two of the tripod stand legs while observe through optical plummet.

11. Press all the tripod stand legs into the ground firmly.

12. Adjust the height the tripod stand legs to centre the circular bubble into bull's eye of circular level vial.

13. Faced the prism over the direction of total station.

14. Repeat step 1 until step 13 at another station.

4.4(b) Centering and Levelling Total Station

1. Establish the tripod at a suitable height.

2. The centre hole of the mounting plate should be over the nail of the peg.

3. Press one of the tripod stand legs into the ground.

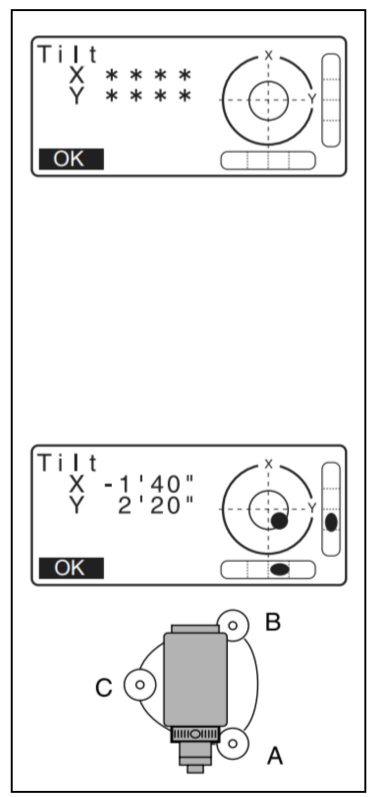
4. Mount the total station on the head of tripod and attach securely with centre screw.

5. Grasp two tripod legs and observe through the optical plummet, adjust the legs so that the bullseye is over the point.

6. Press all the tripod stand legs into the ground firmly.

7.Center the bubble in the circular level by either shortening the tripod leg closest to the offcenter direction of the bubble or by lengthening the tripod leg farthest from the offcenter direction of the bubble. Adjust one more tripod leg to center the bubble. Turn the levelling foot screws while checking the circular level until the bubble is centered in the center circle.

7. Turn on the total station.



8. The circular level is displayed on the screen. "•" indicates bubble in circular level. The range of the inside circle is ±4' and the range of the outside circle is ±6'. Tilt angle values X and Y are also displayed on the screen. "•" is not displayed when the tilt of the instrument exceeds the detection range of the tilt sensor. Level the instrument while checking the air bubbles in the circular level until "•" is displayed on the screen.

9. Turn the instrument until the telescope is parallel to a line between levelling foot screws A and B, then tighten the horizontal clamp.

10. Set the tilt angle to 0° using foot screws A and B for the X direction and levelling screw C for the Y direction. Loosen the centering screw slightly. Looking through the optical plummet

eyepiece, slide the instrument over the tripod head until the survey point is exactly centered in the reticle. Retighten the centering screw securely

11. Confirm that the bubble is positioned at the center of the circular level on the screen. If not, repeat the procedure starting from step 10.

12. When levelling is completed, press [OK] changes to the OBS mode.

13. Observe the optical plummet again. If the centre mark is not centre with the nail of the peg, loose the mounting knob and move the total station slowly to centre with the nail of the peg.

14. Screw the tripod mounting screw firmly.

15. Make sure that the circular bubble is exactly centre to bull's eye of circular level vial, if not readjust the levelling foot screws to centre the bubble into plate level.

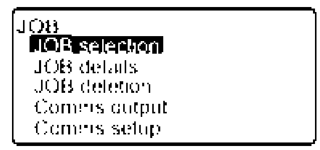
4.4(c) Traverse Methodology

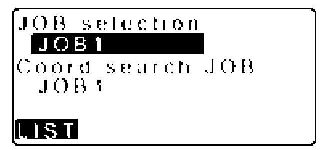
1. The total station is set up (level and centre) on station 2. While the prism on the station 1 and 3.
2. Face the total station to prism 1 as the backsight.
3. Obtain the bearing using a compass as the datum and enter the value in the Topcon Total Station as face left reading and measure the distance.
4. Obtain the face right reading of the first prism by turning the prism 180° and measure the distance.
5. Next, turn the total station facing the second prism as fore sight and observe it's face left bearing and distance.
6. Obtain the face right bearing and distance of the second prism.
7. All the reading was recorded in the fieldbook.
8. The mean bearing foresight station was calculated.

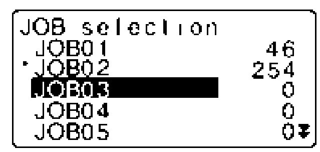
9. The total station was moved to the next station (3,4,5…)(foresight station) until closed traverse by repeating the steps 4-6, while the prism on the foresight and backsight stations.

10. Calculate the linear misclosure and bearing misclosure after the work done to ensure the accuracy of the work.

Selecting a job



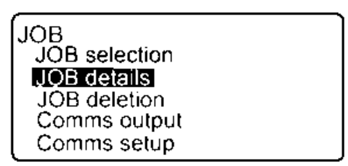


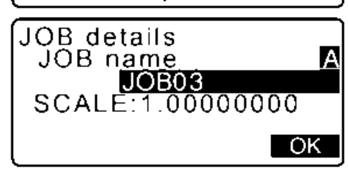


1. Select “JOB” in Data Mode.
2. Select “JOB selection”. is displayed.
3. Press [LIST]. The numbers to the right represent the number of data items in each JOB. “*” means that the JOB has not been output to an external device yet.
4. Align the cursor with the desired JOB as the current JOB and press {ENT}. The JOB is determined. 5. Press {ENT}. is restored. 6. Align the cursor with “Coord search JOB” and press [LIST]. is displayed. 7. Align the cursor with the desired JOB as the coordinate search JOB and press {ENT}. The JOB is determined and is restored.

Inputting a job name

1. Select “JOB” in Data mode.
2. Select in advance the JOB whose name to be changed.
3. Select “JOB details” in “JOB”. After inputting the detailed information for the JOB, press [OK]. is restored. Enter the scale factor for the current JOB.





Recalling the measured data

1. Allocate the [CALL] softkey to the OBS mode screen.
2. Press [CALL]. The stored data that is most recently measured is displayed. If you have pressed [SHV] beforehand, the distance values are converted into the horizontal distance, elevation difference, and the slope distance and recalled.
3. Press {ESC} to return to OBS mode.

Output the data by inserting the USB memory device

1. Slide the catch on the external interface hatch cover down to open.
2. Insert the USB memory device in the respective slot.
3. Press [USB] on the status screen.
4. Select "T type" or "S type". Press [ENT] after selection.
5. Select "Save data" in USB mode.
6. In the list of JOBs, select the JOB to be recorded and press {ENT}. "Out" is displayed to the right of the selected JOB. Multiple JOBs can be selected.
7. After selecting the JOB(s), press [OK].
8. Select output format. (When T type is selected) Enter the file name. Press {ENT} to set the data.
9. Press [OK] to save the JOB to the external memory media. After saving a JOB, the screen returns to the JOB list. If {ESC} is pressed while data is being recorded, data recording is canceled.

4.4(d)Detail Survey Methodology

A detail survey is a survey for detail of selected features of a specific area. This type of survey is regularly used when designing for roads, buildings, extensions and other new infrastructure.

1. Set the Total Station at station and level it. Then, measure the instrument height by using measuring tape.

2. Set the prism at station (back station) and level it, measure the height of the prism.

3. Input back bearing for station into the total station, will be the same value in the project Traverse.

4. Now, the detail can be surveyed by putting the detail pole at the detail point and only coordinates need to be recorded.

5. Identified features to be surveyed and the "code" and "point" number of each of the features were defined as example in the following table.

Item	code
Building	BO

6. The process measurements of the above detail was measures.

7. Repeat step 1 to 3 for station 4, 5 and 6.

8. Once completed field data measurement, data was downloaded into computer.

9. Data obtained was processed using CDS and AutoCAD to produce the detail plan at our assigned study area (K9).

4.4(e) Levelling Methodology

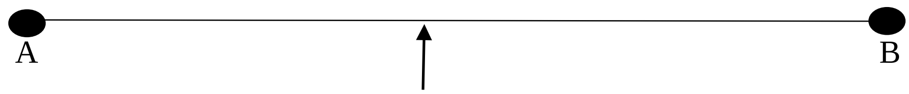
Levelling survey is a method that used to measure the height of a point above the earth surface that are compared to a reference point called datum. It is a measurement process which is used to determine the height difference between points above the earth's surface. They are provided for the following purposes:

- To provide heights or contour on maps.
- To provide data for producing cross-section plans in engineering works and for the calculation of volume of earth.
- To provide level or the steepness of ground surface for the purpose of setting out in construction works.

<u>Set up tripod and digital level</u>

1. Loosen the tripod stand leg screws.
2. Extend the tripod stand to the suitable height.
3. Tighten the tripod stand leg screws.
4. Open the tripod stand legs widely.
5. Step on tripod legs to drive into the ground.
6. Mount the automatic level by placing it on the tripod.
7. Screw the automatic level with the mounting knob.
8. Adjust the foot screws to bring the bubble to center of the circular level.

Procedure of Levelling



1. Hold levelling staff A at bench mark and hold levelling staff B on the base plate
2. Make sure that the distance between digital level and each staff is almost the same.
3. Hold the staff bubble together with levelling staff to bring the bubble to center of the circular so that make sure the levelling staff is in balance.
4. Observe the staff reading of A as backsight reading and then record.
5. Observe the staff reading of B as foresight reading and the record.
6. Move the levelling staff A to next station. This will be foresight.
7. Place the automatic level in between the levelling staffs.
8. Rotate levelling staff B to face the digital level on the same location. This will be backsight.
9. Repeat steps 4-10 until the target location.
10. Continue the steps from the target location close back to the bench mark.
11. Calculate the reduced level, add up the backsight and foresight columns for the entire traverse and note the difference between them.

5.0 Data and Calculation

5.1 Traverse

5.1.1 For Station Traverse

Line	Distance	Bearing	Latitude/ΔN		Departure/ΔE	
			+ve	-ve	+ve	-ve
2-3	48.631	3°1’20”	48.563		2.564	
3-4	149.686	103°29’4”		34.904	145.560	
4-5	45.753	115°18’45”		19.562	41.360	
5-6	60.842	176°4’5”		60.699	4.172	
6-7	108.036	189°46’39”		106.467		18.347
7-8	25.293	170°20’38”		24.935	4.243	
8-9	69.309	239°5’29”		35.602		59.466
9-10	75.249	351°15’17”	74.374			11.441
10-11	50.239	283°22’58”	11.628			48.875
11-12	43.243	294°26’4”	17.888			39.370
12-1	54.862	333°18’10”	49.013			24.648
1-2	80.794	3°0’0”	80.683		4.228	
	811.937		dN=-0.020		dE=-0.020	

The perimeter=811.937m

Closing error= $\sqrt{(-0.020)^2 + (-0.020)^2}$

=0.028284271

Linear misclosure = $1 : \frac{811.937}{0.028284271}$

=1:28706.308

=1:28700

Line	Correction ΔN		Correction ΔE	
	+	-	+	-
2-3	0.001		0.001	
3-4		0.004	0.004	
4-5		0.001	0.001	
5-6		0.001	0.001	
6-7		0.003		0.003
7-8		0.001	0.001	
8-9		0.002		0.002
9-10	0.002			0.002
10-11	0.001			0.001
11-12	0.001			0.001
12-1	0.001			0.001
1-2	0.002		0.002	
Σ=	0.008	0.012	0.010	0.010

Line	The adjusted value ΔN		The adjusted value ΔE	
	+	-	+	-
2-3	48.564		2.565	
3-4		34.900	145.564	
4-5		19.561	41.361	
5-6		60.698	4.173	
6-7		106.464		18.344
7-8		24.934	4.244	
8-9		35.600		59.464
9-10	74.376			11.439
10-11	11.629			48.874
11-12	17.889			39.369
12-1	49.014			24.647
1-2	80.685		4.230	
Σ=	dN=0.000		dE=0.000	

Line	Point	Northing	Easting
	2	1000.000	1000.000
2-3	3	1048.564	1002.565
3-4	4	1013.664	1148.129
4-5	5	994.103	1189.490
5-6	6	933.405	1193.663
6-7	7	826.941	1175.319
7-8	8	802.007	1179.563
8-9	9	766.407	1120.099
9-10	10	840.783	1108.660
10-11	11	852.412	1059.786
11-12	12	870.301	1020.417
12-1	1	919.315	995.770
1-2	2	1000.000	1000.000

5.1.2 Traverse CP to CP

Result & Calculation

Line	Distance	Bearing	Latitude/ΔN		Departure/ΔE	
			+ve	-ve	+ve	-ve
1-CP8	69.832	109°56'11"		23.811	65.647	
CP8-CP7	63.175	105°18'33"		16.680	60.933	
CP7-CP6	26.700	44°49'47"	18.936		18.824	
CP6-CP5	98.338	283°45'31"	23.388			95.516
CP5-CP4	25.818	338°56'43"	24.094			9.275
CP4-CP3	27.695	68°24'03"	10.195		25.750	
CP3-CP2	47.594	95°29'11"		4.550	47.376	
CP2-CP1	64.383	115°50'43"		28.067	57.943	
CP1-6	28.285	67°57'11"	10.617		26.217	
6-5	60.842	356°04'15"	60.699			4.169
			147.929	73.108	302.690	108.960
	512.662		dN=0.033		dE=0.010	

The perimeter=512.662m

Closing error=$\sqrt{(-0.033)^2 + (0.010)^2}$

=0.034481879

Linear misclosure $= 1 : \frac{512.662}{0.034481879}$

=1:14867.577

=1:14900

Line	Correction ΔN		Correction ΔE	
	+	-	+	-
1-CP8		0.004	0.001	
CP8-CP7		0.004	0.001	
CP7-CP6	0.002		0.001	
CP6-CP5	0.006			0.002
CP5-CP4	0.002			0.000
CP4-CP3	0.002		0.001	
CP3-CP2		0.003	0.001	
CP2-CP1		0.004	0.001	
CP1-6	0.002		0.001	
6-5	0.004			0.001
Σ=	0.018	0.015	0.007	0.003

Line	The adjusted value ΔN		The adjusted value ΔE	
	+	-	+	-
1-CP8		23.815	65.646	
CP8-CP7		16.684	60.932	
CP7-CP6	18.934		18.823	
CP6-CP5	23.382			95.518
CP5-CP4	24.092			9.275
CP4-CP3	10.193		25.749	
CP3-CP2		4.553	47.375	
CP2-CP1		28.071	57.942	
CP1-6	10.615		26.216	
6-5	60.695			4.170
	147.911	73.123	302.683	108.963
Σ=	dN=0.000		dE=0.000	

Line	Point	Latitude/N	Departure/E
	1	919.315	995.770
1-CP8	CP8	895.500	1061.416
CP8-CP7	CP7	878.816	1122.348
CP7-CP6	CP6	897.750	1141.171
CP6-CP5	CP5	921.132	1045.653
CP5-CP4	CP4	945.224	1036.378
CP4-CP3	CP3	955.417	1062.127
CP3-CP2	CP2	950.864	1109.502
CP2-CP1	CP1	922.793	1167.444
CP1-6	6	933.408	1193.660

5.1.3 Traverse from GPS data

References line 4-5

Assumed bearing is 115°18’45”

True bearing is 281°38’50”

All station to be +166°20’5”

From	To	Bearing (dd.mmss)	Distance (m)	Northing +	Northing -	Easting +	Easting -
2	3	169.2125	48.631		47.794	8.982	
3	4	269.4909	149.686		0.472		149.685
4	5	281.3850	45.753	9.237			44.811
5	6	342.2410	60.842	57.995			18.394
6	7	356.0644	108.036	107.787			7.325
7	8	336.4043	25.293	23.227			10.013
8	9	45.2534	69.309	48.643		49.372	
9	10	157.3522	75.249		69.566	28.688	
10	11	89.4303	50.239	0.248		50.238	
11	12	100.4609	43.243		8.080	42.481	
12	1	139.3815	54.862		41.803	35.530	
1	2	169.2005	80.794		79.398	14.953	

Line	Coordinate N	Coordinate E
	172335.469	628251.107
2-3	172287.675	628260.089
3-4	172287.202	628110.403
4-5	172296.439	628065.592
5-6	172354.434	628047.199
6-7	172462.221	628039.873
7-8	172485.448	628029.860
8-9	172534.091	628079.232

9-10	172464.525	628107.920
10-11	172464.773	628158.159
11-12	172456.693	628200.640
12-1	172414.890	628236.170
1-2	172335.492	628251.122

5.1.4 CP coordinate from GPS data

CP	Corrected Coordinates	
	N	E
STN 1	172414.890	628236.170
8	172422.513	628166.755
7	172424.318	628103.605
6	172401.469	628089.788
5	172401.306	628188.125
4	172380.084	628202.830
3	172364.092	628180.217
2	172357.318	628133.107
1	172370.897	628070.172
STN 6	172354.434	628047.199

5.2 Levelling

5.2. 1 Leveling TBM to TBM

Point No	Back Sight	Inter medi ate sight	Fore sight	colimation Height		Reduced Level	Correction (M)	Adjusted Level	Distance		Remark
				Rise	Fall				Back sight	Fore sight	
1	2.5617					17.3280	0.000000	17.328	64.453		TBM
2	3.7647		0.8066	1.7551		19.0830	-0.000175	19.083	59.791	46.105	CP1
3	2.0499		0.9219	2.8437		21.9267	-0.000350	21.9236	28.413	50.289	STN 6
4	1.3309		1.2165	0.8334		22.7601	-0.000525	22.7596	11.678	79.992	STN7
5	3.402		1.2354	0.0955		22.8556	-0.000700	22.8549	49.281	13.602	STN 8
6	1.1072		1.4876	1.9144		24.7700	-0.000875	24.7691	3.861	60.742	STN 9
7	1.155		2.9571		1.8499	22.9201	-0.00105	22.9190	26.100	71.289	STN 10
8	1.2709		1.1673		0.0123	22.9078	-0.001225	22.9066	16.979	24.009	STN 11
9	1.2498		1.1619	0.109		23.0168	-0.001400	23.0154	28.874	26.656	STN 12
10	1.2944		1.2397	0.0101		23.0269	-0.001575	23.0253	33.912	26.646	STN 1
11	1.3539		1.2335	0.0609		23.0878	-0.001750	23.0860	17.790	46.675	STN 2
12	0.9044		1.182	0.1719		23.2597	-0.001925	23.2578	77.624	30.736	STN 3
13	1.1184		2.2297		1.3253	21.9344	-0.002100	21.9232	23.649	72.009	STN 4
14	2.2589		1.6471		0.5287	21.4057	-0.002275	21.4034	31.637	22.000	STN 5
15	0.8954		1.7369	0.522		21.9277	-0.002450	21.9252	49.597	29.115	STN 6
16	0.8163		3.7381		2.8427	19.089	-0.002625	19.0824	41.293	60.456	CP 1
17			2.5705		1.7542	17.3308	-0.002800	17.3280		70.122	TBM
				8.3160	8.3131				1295.37 3		

Misclosure = 0.003m

Tolerance = $12\sqrt{1.295}$

= 13.65 ~ 14mm

5.2.2 Leveling CP to CP

Misclosure = 0.003m

Point No	Back Sight	Intermediate sight	Fore sight	collimation Height		Reduced Level	Correction (M)	Adjusted Level	Distance		Remark
				Rise	Fall				Back sight	Fore sight	
1	2.2527					21.9236	0	21.9236	23.298		STN 6
2	1.3818		1.1948	1.0579		22.9815	0.0003	22.9818	34.011	5.178	CP1
3	1.5158		1.3937		0.0119	22.9696	0.0007	22.9703	20.542	31.925	CP2
4	1.5791		1.3363	0.1795		23.1491	0.001	23.1501	23.487	27.087	CP3
5	1.3863		1.3861	0.193		23.3421	0.0014	23.3435	2.546	4.546	CP4
6	1.3657		1.6491		0.2628	23.0793	0.0017	23.081	40.463	27.856	CP5
7	1.4428		1.4549		0.0892	22.9901	0.0021	22.9922	12.44	57.698	CP6
8	1.3969		1.4429		0.0001	22.99	0.0024	22.924	35.085	16.63	CP7
9	1.5237		1.4657		0.0688	22.9212	0.0028	22.924	21.979	27.981	CP8
10			1.4227	0.101		23.0222	0.0031	23.0253		47.861	STN 1

Tolerance = $12\sqrt{0.46}$

= 8.138 ~ 8mm

5.2.3 Levelling BM to TBM

Misclosure = 0.016m

No.	Back Sight	Intermediate sight	Fore sight	collimation Height		Reduced Level	Correction (M)	Adjusted Level	Distance		Remark
				Rise	Fall				Back sight	Fore sight	
1	0.0925					34.1980	0.000	34.198	21.405		GM Helipad (34.198)
2	0.2408		4.6907		4.5982	29.5998	0.000	29.599	18.214	20.896	
3	0.0509		4.1907		3.9499	25.6499	-0.001	25.649	22.185	37.096	
4	0.0375		4.8408		4.7899	20.8600	-0.001	20.859	27.311	36.84	
5	0.1756		4.1258		4.0883	16.7717	-0.002	16.770	19.826	36.363	
6	3.2393		3.2868		3.1112	13.6605	-0.002	13.658	51.43	51.608	BM Pintu Gerbang (14.791)
7	2.4122		3.3841		0.1448	13.5157	-0.003	13.513	48.698	30.003	
8	0.5711		1.6842	0.7280		14.2437	-0.003	14.241	43.518	87.591	
9	0.8356		2.4535		1.8824	12.3613	-0.003	12.358	92.474	89.981	
10	3.8203		1.2240		0.3884	11.9729	-0.004	11.969	83.265	47.019	
11	3.6204		0.4519	3.3684		15.3413	-0.004	15.337	55.981	25.845	
12	2.1805		0.1738	3.4466		18.7879	-0.005	18.783	62.225	29.796	
13	1.1219		3.0263		0.8458	17.9421	-0.005	17.937	73.278	57.824	
14	2.2933		1.0249	0.0970		18.0391	-0.006	18.033	74.581	81.883	
15	4.7388		1.5409	0.7524		18.7915	-0.006	18.785	64.766	67.682	
16	0.3351		4.1999	0.5389		19.3304	-0.006	19.324	55.276	106.385	
17	1.3625		3.6945		3.3594	15.9710	-0.007	15.964	31.422	72.19	
18	0.9331		4.2115		2.8490	13.1220	-0.007	13.115	77.054	33.595	
19	4.5281		0.5853	0.3478		13.4698	-0.008	13.462	45.808	69.881	
20	0.6459		0.6620	3.8661		17.3359	-0.008	17.328	22.833	22.465	
21	0.5412		4.5137		3.8678	13.4681	-0.009	13.459	69.529	45.316	
22	4.0549		0.8882		0.3470	13.1211	-0.009	13.112	31.388	78.131	
23	3.7837		1.2024	2.8525		15.9736	-0.010	15.964	73.746	32.978	
24	4.2280		0.4229	3.3608		19.3344	-0.010	19.324	102.855	53.893	
25	0.6628		4.0510	0.1770		19.5114	-0.010	19.501	82.009	85.755	
26	1.0149		2.1283		1.4655	18.0459	-0.011	18.035	81.445	72.033	
27	3.1997		1.1081		0.0932	17.9527	-0.011	17.941	63.146	73.425	
28	0.1913		2.3498	0.8499		18.8026	-0.012	18.791	30.05	56.93	
29	0.3806		3.6377		3.4464	15.3562	-0.012	15.344	26.745	55.835	

30	1.3140		3.7510		3.3704	11.9858	-0.013	11.973	57.616	82.15	
31	2.3131		0.9206	0.3934		12.3792	-0.013	12.366	87.656	81.821	
32	4.0424		0.4311	1.8820		14.2612	-0.013	14.248	52.965	45.769	
33	4.2020		1.0983	2.9441		17.2053	-0.014	17.191	40.129	25.882	
34	4.8136		0.5295	3.6725		20.8778	-0.014	20.864	36.944	31.704	
35	4.4927		0.0271	4.7865		25.6643	-0.015	25.650	40.868	22.121	
36	4.9254		0.5404	3.9523		29.6166	-0.015	29.601	32.476	14.635	
37			0.3280	4.5974		34.2140	-0.016	34.198		30.372	GM Helipad (34.198)

Tolerance = $12\sqrt{3.8}$

= 23.39 ~ 23 mm

5.3 Detailing

Please refer to the attachment for the topographic map of our site and combined map.

6.0 Discussion

6.1 Traverse

Our group has been conducted a traverse for the K9 college. This section is primarily discussed on the results that have been worked out from the field work thus it is necessarily included with explanations. This measurement is done by using closed traverse and to mark the area of traverse work, 12 pegs used around the building with intervisible to each other and every distance of the peg is more than and less than 30m from each other. In our traverse measurement, we found out that our misclosure is 31" which is below allowable misclosure of 2'30" and total distances was 811.937 m. The correction for our readings is 2.58" for each 12 station. 3 pegs used as a sharing point between our group and two other group.

In this traverse work, there are some error might and makes our measurement not accurate. These errors such as the total station and prism did not set up properly. The others factor that creating error is the unstable condition of the soil either it's to soft or hard. After the tripod has been setting up in the unstable soil, it will slowly sink into the ground thus creating error in total station and prism and some mistake in booking and random error by the observer also exist when taking reading from the prism. To avoid this, we took the reading more than two and calculate the average. Also, make sure the bubble of the instrument at the centre.

6.2 Levelling

Levelling is operation the comparison of heights of point on the surface of the earth. In levelling the things that we have to measure is the backsight and the foresight. Apart from traversing, the levelling has been conducted from the benchmark which is closer to our building. The temporary benchmark has been established with known Reduced Level which could be useful for us to make the connection from the benchmark given. In levelling there are two methods of calculating level. The first one is collimation method and the second one is Rise-and-Fall method. Our group choose Rise-and-Fall method to calculate level. We have measure backsight and the foresight. The levelling is performed to transfer the height level to every traverse station in order to obtain the height for each station.

The error may occur when taking the measurement due to parallax error. To prevent this error, we have to take the repeated readings and find the average. Then, while holding the staff, the bubble of the staff may not be in the middle of the circle. This make the staff do not vertically straight. To prevent this error, we have to make sure that the bubble in the middle of the circle.

6.3 Detail Survey

The topographic survey has to be surveyed in detailed such as culvert, trees, road, building, electrical posts, lamp posts, and as well as spot heights. Spot heights are essentially to generate the contour of DTM and DEM into the plan. Note that the feature codes in the instrument should refer to the features during topographic survey such as JO for road, IL for inverted level and so on. The area of survey has 10-20m offset away from the building for detail survey. The traverse is required to achieve second class traverse, but our traversing can perform up to first-class traverse based on the misclosure.

Finally, data collection in the instrument is then transferred to the computer for plotting the map. We were using CDS software as well as AutoCAD since CDS software has its specialities in generating the contour DTM. The processing of data has all information and done during the fieldwork by total station, so it is basically done straightforward.

7.0 Conclusion

In conclusion, this is our report on traversing, levelling and detailing. For traversing, we were required to carry out a closed loop traverse survey that is located at the area around Kolej 9(K9). After successfully completion the traverse booking form , we compute the data by using the Traversing Adjustment and Computation , Linear Misclosure, find both Easting and Northing and lastly to obtain the Coordinates of all 12 Control Station at the given assigned site. We were using the values that obtained by using Total Station, a complete computation has been done to identify the traverse class level and this equipment gave an accurate and a good result.

After complete the traversing, we were assigned to do Levelling. We were given a second equipment which is 'Leica Digital Level (Sprinter)', Tripod, bubble staff, levelling plate and Leveling Staff. We repeat the same procedure as Traversing but Levelling is to measure height differences and to transfer, measure, and set heights of known objects or marks at our location which is in this project is from geodetic marker at the helipad. Procedures from setting up the equipment to record the measurement are different to Traversing. This is because we need to measure the height off at every control station using all the given equipment and lastly at benchmark. Usually to record the measurement, there is a backsight and foresight using 2 staff and Leica Digital Level (Sprinter). In this project, we get the reduced level for each stations from the nearest TBM (created by students) which located at the junction near the Scholar Inn. This is because it is more easy to transfer the height from the TBM rather than from the helipad.

After successfully completing the levelling booking form, we were compute using the Rise & Fall method, find correction and lastly to obtain the corrected reduced levels at the given assigned group block. If error occurred, we adjust the reduced level by using the loop misclosure method that had been thaught in class, which is $\pm 12\sqrt{K}$. The answer must be within the loop misclosure or else it is not acceptable

As we know, Total Station are used to measure horizontal and vertical angles for surveying, it will give an accurate and a better result. On this report, we able to use the equipment so it will give a better measurement reading from the calculation recorded. Next, we complete a detailing booking form for their assigned block at the Kolej 9 (K9) area.

The data is then carried to the office for analysis and preparation of detail maps known as Digital Terrain Models, which provide the details that have been collected in the form of a map.

These maps are useful for engineers and architects who use them in their designs and plans. The survey should be carried out by a qualified land surveyor who may be assisted by a chainman. In addition, doing practical using detailing equipment will sharpen the student skills handling the equipment itself and at the same time expose students to various challenges in the surveying industry.

The Traversing And Levelling Survey Have Lead Us To Get Such Data.

A. Traverse of station

References line 4-5

Assumed bearing is 115°18’45”

True bearing is 281°38’54”

All station to be +166°20’9”

Linear misclosure of this traverse is 1: 28700

A. Levelling from TBM to station

Misclosure = Reduced level - Actual level

= 17.3308 – 17.3208

= 0.003m

Correction = - (Misclosure/BS)

= (0.003/16)

= 0.0001875

We also has do discussions about the stuff bubble, planning and reconnaissance, pegging Traverse Station, and how to clearing the obstacle. We were try hard to learning with a spirit of not giving up even though there were a lot of obstacles. We really do likes site surveying because we can actually feel that we are working together.

In a nutshell, we appreciate with highest gratitude to our lecturers and staffs especially Dr Khairulnizam, Dr Wahid and Dr Ami for giving us an opportunity to learn and hands on in this survey camp. We hope that next time we can have a chance to conduct a survey like this again with even more challenging sites. Finally, we can all agree that doing this work is rather challenging and enjoyable. We get the experience to find new knowledge as well as the experience to do the work. Though this survey camp, we learned how to planning, such as shared point with the group beside our site. We all believe that this knowledge is going to be useful for us in the future, and we can never forget the feelings of doing the work. We hope that we can learn much more things and explore new knowledge for our career and our future.

8.0 APPENDICES





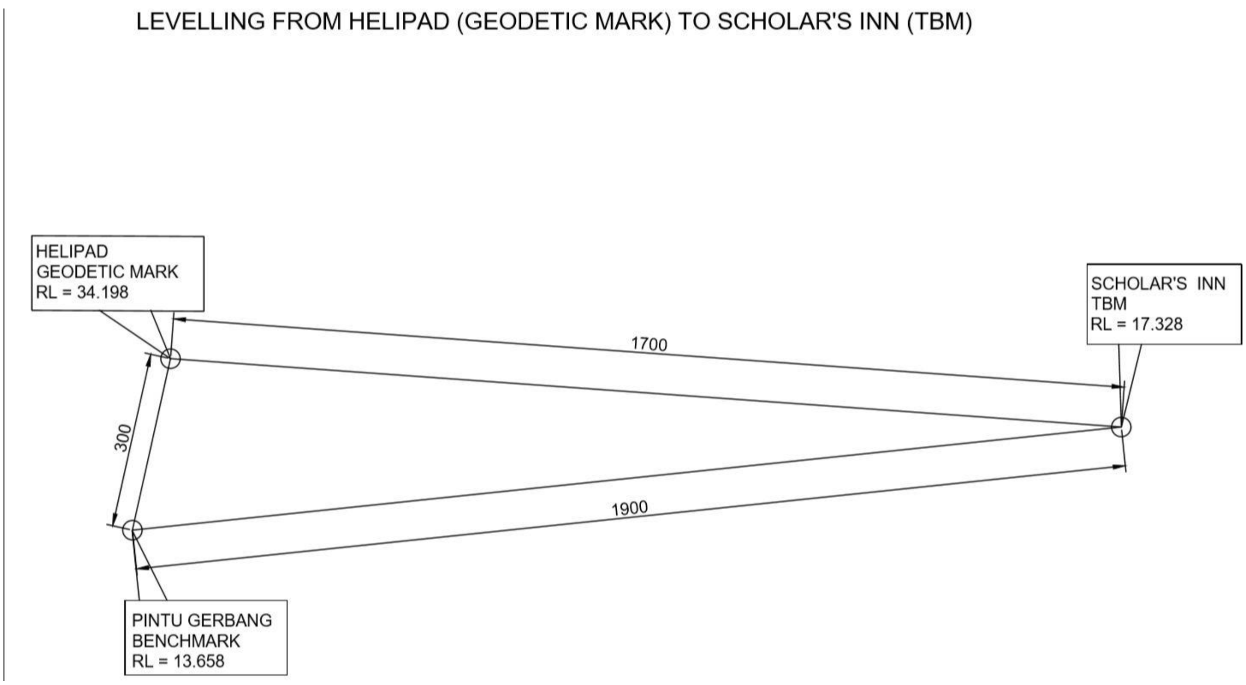

9.0 Attachment

1) Booking form

a) Traverse

Traverse station

Leveling from helipad to TBM



Traverse

TRAVERSE FORM

STATION		BEARING /ANGLE FACE LEFT	FACE RIGHT	MEAN	FROM STN	LINE FINAL BEARING	TO STN	VERTICAL ANGLE (+)	DISTANCE	FINAL DISTANCE
					2	183 00 00	1	~~89 59 05~~	80.795 ~~48.631~~	
2	1	183 00 00	03 00 00					89 59 05	48.631	48.631
	3	3 01 24	183 01 22	3 01 25 -0 00 2.58	2	3 1 20.42	3	270 01 09	48.631	
3	2	183 01 25	3 01 25					90 31 39	149.686	149.686
	4	103 29 13	283 29 05	103 29 09 -0 00 5.16		103 29 3.84		269 28 48	149.685	
4	3	283 29 09	103 29 09					90 55 30	45.752	45.753
	5	115 18 54	295 18 52	115 18 53 -0 00 7.74		115 18 45.26		269 04 44	45.753	
5	4	295 18 53	115 18 53					89 37 01	60.843	60.842
	6	176 04 11	356 04 19	176 04 15 -0 00 10.32		176 4 4.68		270 23 22	60.841	
6	5	356 04 15	176 04 15					89 43 22	108.036	108.036
	7	189 46 55	9 46 49	189 46 52 -0 00 12.9		189 46 39.1		270 16 39	108.036	
7	6	9 46 52	189 46 52					89 45 30	25.293	25.293
	5	170 20 53	350 20 53	170 20 53 -0 00 15.48		170 20 37.52		270 14 36	25.293	
8	7	350 20 53	170 20 53					88 21 50	69.309	69.309
	9	239 05 48	59 05 46	239 05 47 -0 00 18.06		239 5 28.94		271 38 09	69.309	
9	8	59 05 47	239 05 47					91 18 45	75.248	75.249
	10	351 15 34	171 15 41	351 15 38 -0 00 20.64		351 15 17.36		268 41 31	75.249	
10	9	171 15 38	351 15 38					89 53 50	50.239	50.239
	11	283 23 14	103 23 28	283 23 21 -0 00 23.22		283 22 57.78		270 06 31	50.238	

Makmal ukk

TRAVERSE FORM

STATION		BEARING /ANGLE FACE LEFT	FACE RIGHT	MEAN	FROM STN	LINE FINAL BEARING	TO STN	VERTICAL ANGLE (+)	DISTANCE	FINAL DISTANCE
11	10	103 23 21	283 23 21					89 50 11	43.243	43.243
	12	294 26 30	114 26 29	294 26 30 -0 00 25.8		294 26 4.2		270 10 09	43.243	
12	11	114 26 30	294 26 30					90 03 49	54.862	54.862
	1	333 18 35	153 18 40	333 18 38 28.38		333 18 9.62		269 56 29	54.862	
1	12	153 18 38	333 18 38					89 55 27	80.794	80.794
	2	3 00 29	183 00 32	3 00 31 30.96		3 0 0.04		270 04 45	80.794	
										811.437
				3 00 31 3 00 00 + 0 00 31 - 0.00 2.58						

Makmal ukk

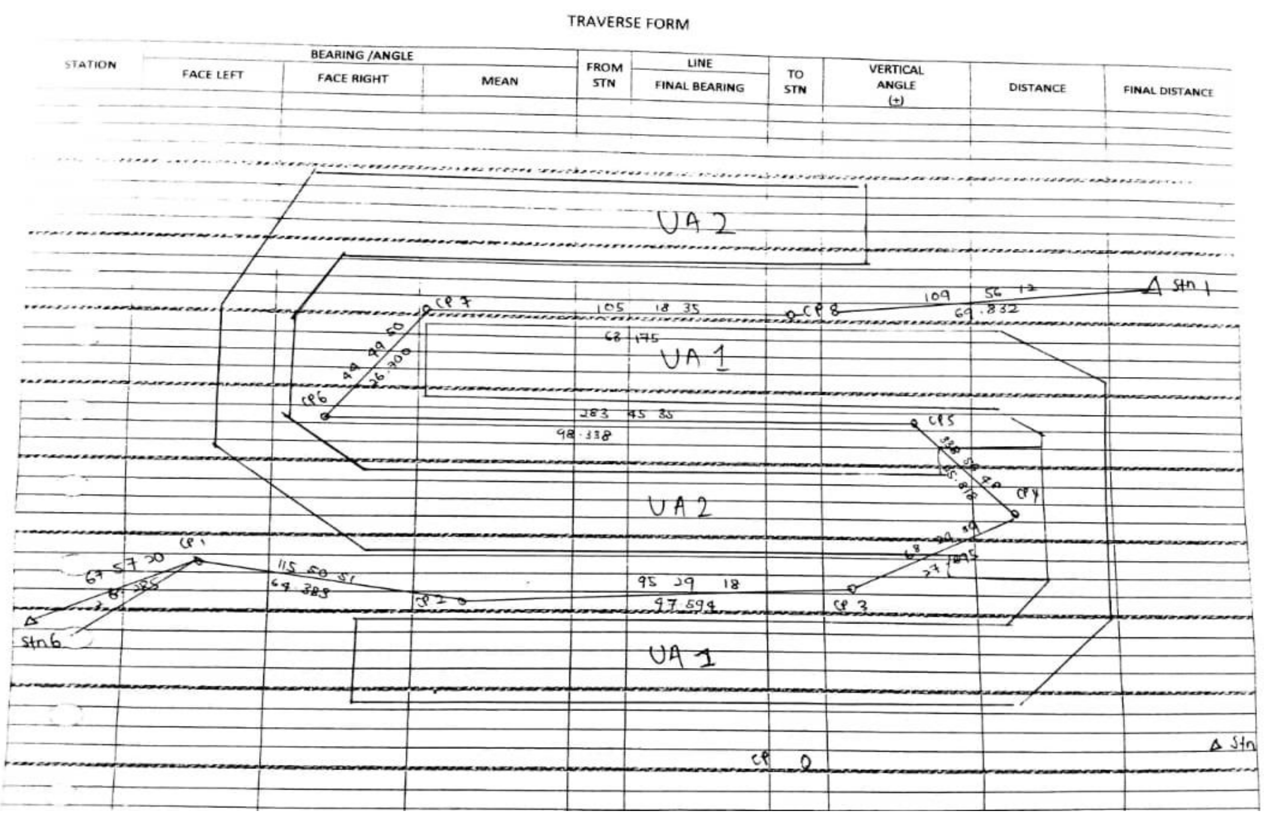
b) Traverse CP to CP

TRAVERSE FORM

TRAVERSE CP TO CP

STATION	BEARING /ANGLE FACE LEFT	BEARING /ANGLE FACE RIGHT	MEAN	FROM STN	LINE FINAL BEARING	TO STN	VERTICAL ANGLE (±)	DISTANCE	FINAL DISTANCE
2	163 17 10	333 17 10							
(1)			109 56 12	1	109 56 12	CP8		69.832	69.832
CP8	109 56 10	289 56 14						69.831	
1	289 56 12	109 56 12							
(CP8)			105 18 35	CP8	105 18 35	CP7		63.175	63.175
CP7	105 18 34	285 18 36						63.175	
CP8	285 18 35	105 18 35							
(CP7)			44 49 50	CP7	44 49 50	CP6		26.700	26.700
CP6	44 49 47	224 49 53						26.700	
CP7	224 49 50	44 49 50							
(CP6)			283 45 35	CP6	283 45 35	CP5		98.338	98.338
CP5	283 45 34	103 45 36						98.337	
CP6	103 45 35	283 45 35							
(CP5)			338 56 48	CP5	338 56 48	CP4		25.817	25.818
CP4	338 56 48	158 56 48						25.818	
CP5	158 56 48	338 56 48							
(CP4)			68 24 09	CP4	68 24 09	CP3		27.695	27.695
CP3	68 24 03	248 24 15						27.695	
CP4	248 24 09	68 24 09							
(CP3)			95 29 18	CP3	95 29 18	CP2		47.593	47.594
CP2	95 29 18	275 29 17						47.594	
CP3	275 29 18	95 29 18							
(CP2)			115 50 51	CP2	115 50 51	CP1		64.380	64.383
CP1	115 50 48	295 50 54						64.383	
CP2	295 50 51	115 50 51							
(CP1)			67 57 20	CP1	67 57 20	6		28.285	28.285
6	67 57 14	247 57 26						28.284	
CP1	247 57 20	67 57 20							
(6)			356 04 25	6		5			
5	356 04 27	176 04 23							

Makmal ukk



Levelling

a) TBM to TBM

Leveling & Adjustment Spreadsheet

ob Title	TBM to TBM
ob No	
ate	13/01/2026
bserver	
taff man	

UTM

Makmal Ukur Kejuruteraan & Kadaster

Start Value	
Finish value	
Misclosure	
Set-Ups	
Error/ set up	

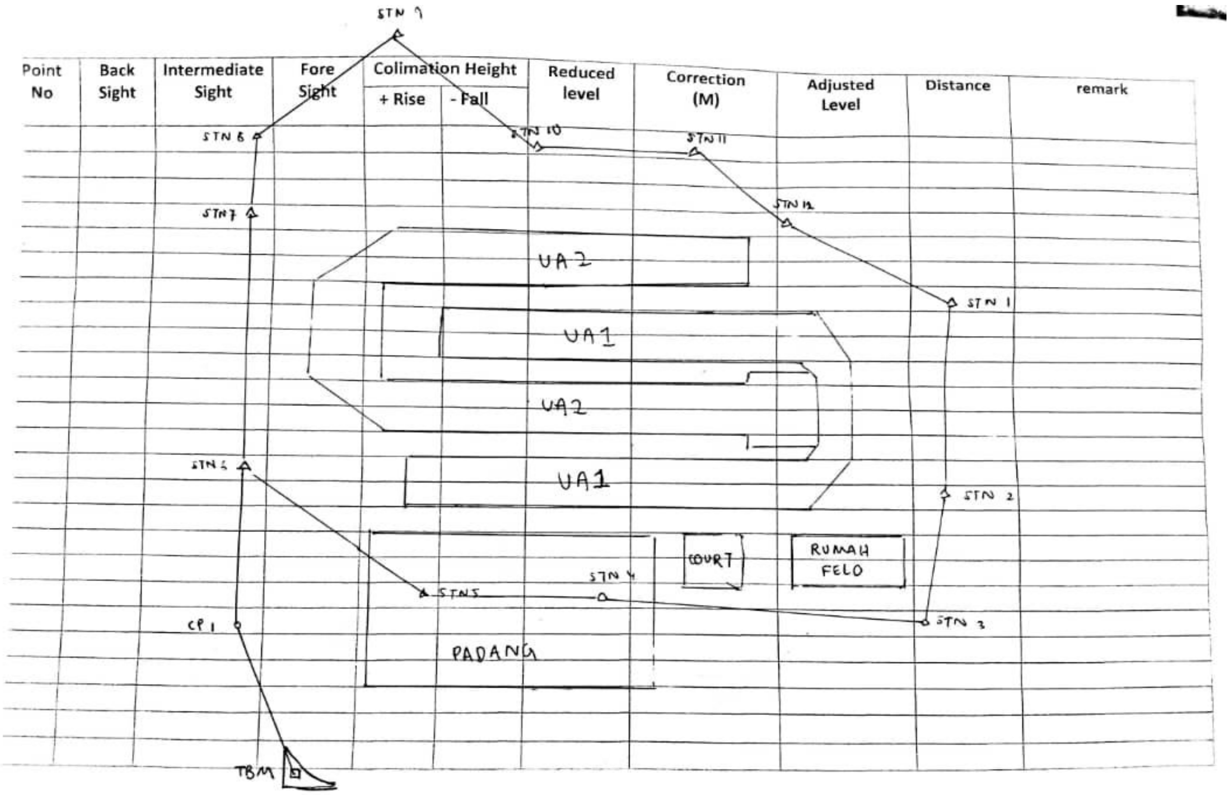
Point No	Back Sight	Intermediate Sight	Fore Sight	Colimation Height		Reduced level	Correction (M)	Adjusted Level	Distance	remark
				+ Rise	- Fall					
1	2.4617					17.3280	0	17.3280	64.453	TBM
2	3.7647		0.8066	1.7551		19.083	-0.000175	19.0830	59.791 / 46.105	CP1
3	2.0499		0.9210	2.8437		21.9267	-0.00035	21.9236	28.413 49.642 / 50.359	Stn 6
4	1.3309		1.2165	0.8334		22.7601	-0.000525	22.7596	11.678 / 79.991	Stn 7
5	3.4020		1.2354	0.0955		22.8556	-0.0007	22.8599	49.281 / 13.602	Stn 8
6	1.1072		1.4876	1.9144		24.770	-0.000875	24.7691	3.861 / 60.742	Stn 9
7	1.1550		2.9571		1.8499	22.9201	~~-0.000105~~ 0.00105	22.9190	26.100 / 71.289	Stn 10
8	1.2709		1.1673		0.0123	22.9078	-0.001225	22.9066	16.979 / 24.069	Stn 11
9	1.2498		1.1619	0.1090		23.0168	-0.001400	23.0159	28.874 / 26.656	Stn 12
10	1.2944		1.2397	0.0101		23.0269	-0.001575	23.0250	33.912 / 26.646	Stn 1
11	1.3639		1.2335	0.0609		23.0878	-0.00175	23.0860	17.790 / 46.675	Stn 2
12	0.9044		1.1820	0.1719		23.2597	-0.001925	23.2578	77.614 / 30.736	Stn 3
13	1.1184		2.2297		1.3253	21.9349	-0.002100	21.9323	23.649 / 72.009	Stn 4
14	2.2589		1.6471		0.5287	21.4057	-0.002275	21.4039	51.637 / 22.000	Stn 5
15	0.8954		1.7369	0.5220		21.9277	-0.002450	21.9252	49.597 / 29.115	Stn 6
16	0.8163		3.7381		2.8427	19.085	-0.002625	19.0824	41.293 / 60.456	CP 1
17			2.5705		1.7542	17.3308	-0.002800	17.3280	70.122	TBM
				Σ=8.3160	Σ=8.3131				Σ= 1295.375m	

DH known = 17.3280

calculated = 17.3308

misclosure = -0.0028

correction = -0.000175



b) CP to CP

Leveling & Adjustment Spreadsheet

Job Title	CP TO CP	
Job No		
Date	15/01/2020	
Observer	ELVIS	
Staff man	FATHIHAH	ASMIRA

UTM

Makmal Ukur Kejuruteraan & Kadaster

Start Value	
Finish value	
Misclosure	
Set-Ups	
Error/ set up	

Point No	Back Sight	Intermediate Sight	Fore Sight	Colimation Height + Rise	Colimation Height - Fall	Reduced level	Correction (M)	Adjusted Level	Distance	remark
1.	2.2527					21.9236	0	21.9236	23.298	STN 6
2.	1.3818		1.1948	1.0579		22.9815	0.0003	22.9818	34.011/5.178	CP 1
3	1.5158		1.3937		0.0119	22.9696	0.0007	22.9703	20.592/31.925	CP 2
4.	1.5791		1.3363	0.1795		23.1491	0.0010	23.1501	23.487/27.057	CP 3
5.	1.3863		1.3861	0.1930		23.3421	0.0014	23.3435	9.546/4.546	CP 4
6.	1.3657		1.6491		0.2628	23.0790	0.0017	23.0810	40.463/27.856	CP 5
7.	1.4428		1.4549		0.0892	22.9901	0.0021	22.9922	12.440/57.698	CP 6
8.	1.3969		1.4429		0.0001	22.9900	0.0024	22.9924	35.085/16.630	CP 7
9.	1.5237		1.4657		0.0688	22.9212	0.0028	22.9240	21.919/27.981	CP 8
10.			1.4227	0.1010		23.0222	0.0031	23.0253	47.861	STN 9

Misclosure = 23.0253 − 23.0222
= 0.0031

Correction = 0.0031 ÷ 9
= 0.00034444

Leveling & Adjustment Spreadsheet

Leveling & Adjustment Spreadsheet

Job Title	
Job No	
Date	
Observer	
Staff man	

UTM

Makmal Ukur Kejuruteraan & Kadaster

Start Value	
Finish value	
Misclosure	
Set-Ups	
Error/ set up	

Point No	Back Sight	Intermediate Sight	Fore Sight	Colimation Height		Reduced level	Correction (M)	Adjusted Level	Distance	remark
				+ Rise	- Fall