SBEU 2141

SURVEY CAMP

FIELDWORK REPORT

3D NETWORK AND WORKING DATUM

PREPARED FOR

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LOCATION

KOLEJ K9

PREPARED BY

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1.0 Introduction

Second year students in University of Technology Malaysia who took Bachelor of Engineering (Geomatics) are required to take a subject called ‘Survey Camp’ with the code SBEU 2141 in their third semester. The students will be taught and guided with the topics related to the subject in which outdoor practical will expose students on how to do the fieldwork based on what has been taught during lecture session.

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.

We are required to do 3D control network using GNSS to establish datum for our survey work.There are 5 station that has been used for 3D control network which is Balai Cerap , KTDI , Helipad , Stadium and KDOJ. The data from this observation are then processed together with 2 MyRTKnet station which is JHJY and KUKP. On the same day, we also establish 2 working datum containing 3 station for each working datum at our survey site. The working datum data and linked to the Helipad station from the 3D control Network that was collecting GNSS data simultaneously.

The instrument used for this GNSS observation is Topcon GR-5. The GR-5 features the multi-constellation 226-channel Vanguard GNSS chip with Universal Tracking Channel Technology. This patented technology uses flexible and dynamic tracking methods to automatically select and track any available satellite signal enabling Topcon’s users to receive the maximum number of signals and measurements at any given time. The GR-5 is not only capable of receiving signals from the fully operational GPS and GLONASS constellations, but also has the ability to support all planned signals from developing systems such as Galileo, Beidou (BDS) and QZSS. With current and developing satellite constellations. Universal Tracking Channel Technology optimizes GNSS signal tracking to guarentee maximum satellite geometry and availability. Unfortunately , there are only 4 units of Topcon GR-5 available that limit our time to do observations at multiple stations.

2.0 Objective

Aim: To produce horizontal and vertical datum for Engineering Survey around the project area (UTM)

Objectives:

1. To establish 3D Control Network using GNSS observation.
2. To establish working datum datum for planimetric and vertical component using GNSS observation (single baseline)

3.0 Equipment

Instrument	Description
Topcon GR-05 	Capable of receiving signal from the fully operational GPS and GLONASS and ability to support all planned signal from developing system.
Tripod 	To support the total station and prism.

Measuring Tape 5m 	Measure the height of the instrument.
Tribrach 	Attachment plate used to attach a surveying instrument, for example a theodolite, total station, GNSS antenna or target to a tripod
Tibrach Adopter 	Secure the receiver to the tripod

4.0 LOCATION

4.1 3D Network

Sesion 1 :, KTDI,Helipad, Balai Cerap ,KDOJ

Sesion 2 : KTDI, Helipad, Balai Cerap, Stadium

Balai Cerap **KDOJ** **STADIUM**

Helipad **KTDI**

4.2 Working Datum

Session 1 : STN 4, STN 5, STN 6

Session 2 : STN 11, STN 12, STN 1

Location of Working Datum for session 1
STN 4, STN 5, STN 6

Location of Working Datum for session 2
STN 11, STN 12, STN 1

5.0 Schedule

5.1 3D Network

Session	New Station	CORS	Time	Date
1	Helipad – Balai Cerap – KDOJ - KTDI	JHJY – KUKP- SPGR	8.52 – 9.52	12/01/2020 Sunday
2	Helipad – Balai Cerap – KTDI - Stadium	JHJY – KUKP - SPGR	10.16 – 11.16	12/01/2020 Sunday

5.2 Working datum

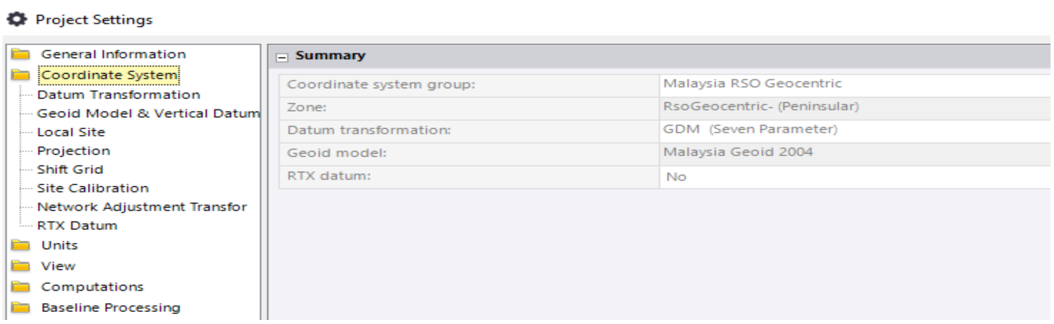
Session	Base	Project area	Time	Date
1	Helipad	Working datum 1 (Station 4 – Station 5 – Station 6)	8.18 – 8.39	13/01/2020 Monday
2	Helipad	Working datum 2 (Station 11 – Station 12 – Station 1)	9.37 - 10.07	13/01/2020 Monday

6.0 Procedure

6.1 3D Network

1. Set up new project and save the project.

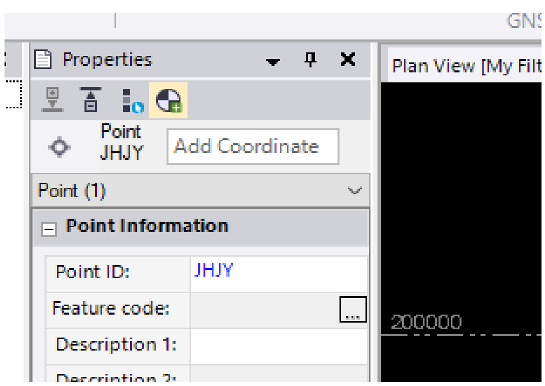
2. Choose project settings and set the preferences coordinate system, units and Default Standard error.

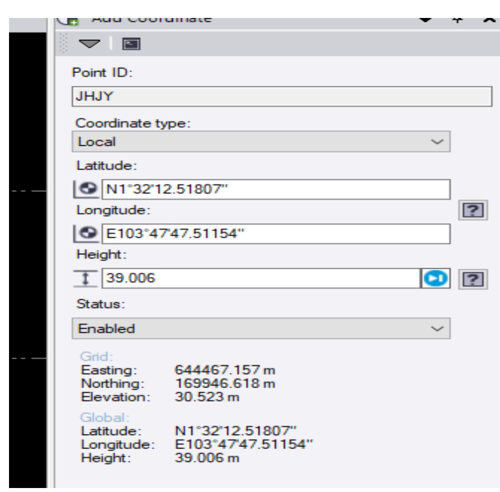


3. Import O file and N file of 3D control network, insert the height and type of antenna and type of receiver, rename the point "Default".

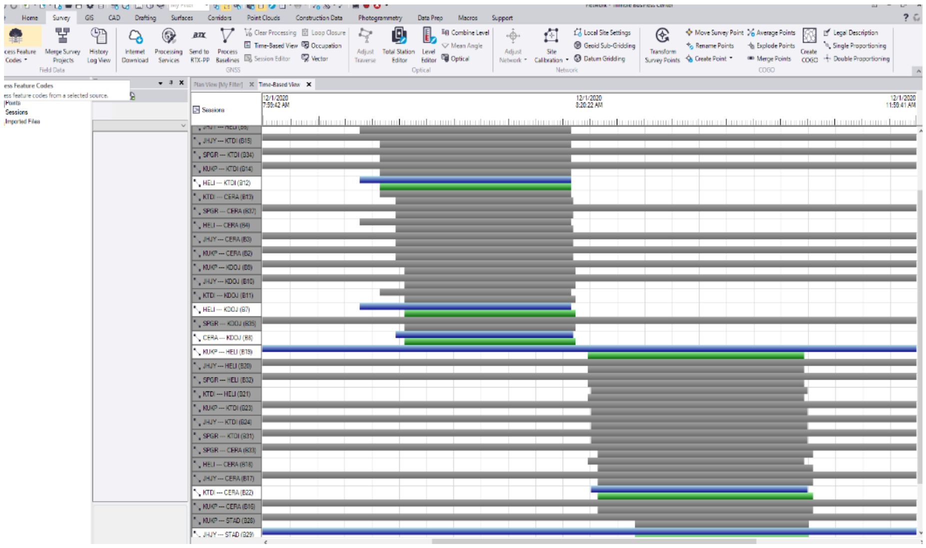
4. Choose Survey, Process the baseline.

6. Select Point and right click to add coordinate. Choose coordinate type Local and then enter coordinate. Click on the icon beside column coordinate to select the coordinate as Control Quality.



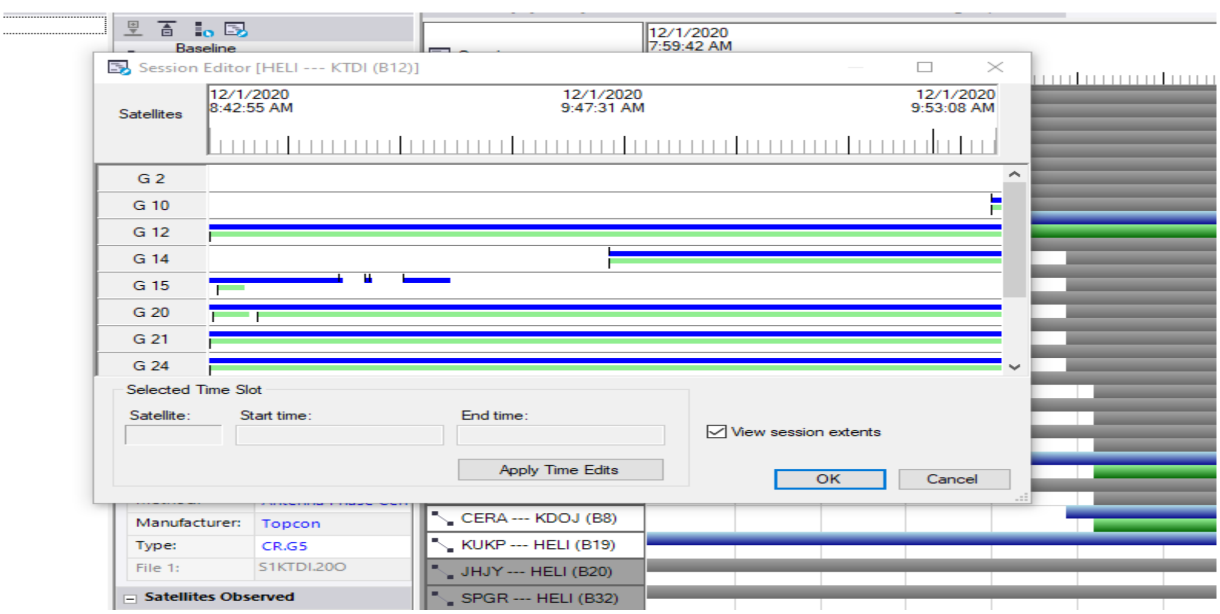


7. Choose Survey – Time Based View. Disable the baseline that we would able to disable baseline



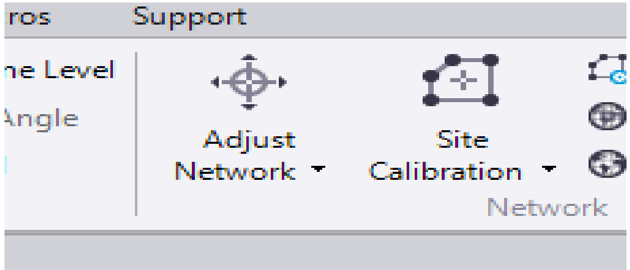
8. Check the precision and RMS. Click on the Baseline Processing Report and do troubleshooting.

9. Do data cleaning at session editor, time-based view when the horizontal precision more than 0.010, vertical precision more than 0.050 and the RMS more than 0.020.



10. Choose Setting- Baseline Processing and Click satellites. Increase the elevation mask to help eliminate bad satellites.

11. Adjust network, make sure the elevation error not more than 0.030.



12. Review the adjustment results and error ellipses in the plan view to determine horizontal and vertical residuals.

13. Weighting tab and apply scalars to variance groups for the next adjustment.

14. Readjust the network.

15. Run the Network Adjustment Report to review the results.

16. Print the network adjustment report.

17. Record the coordinate of HELI for data processing working datum.

18. Import O file and N file of working datum and HELI, just single baseline, insert the height and type of antenna and type of receiver.

19. Add the coordinate of HELI, thus process the baseline.

20. Do data cleaning at session editor, time-based view when the horizontal precision more than 0.010, vertical precision more than 0.050 and the RMS more than 0.020.

21. Print the Baseline processing report for working datum.

6.2 Working Datum

1. Decide at least 2 working datum for each project area, and at least 2 traverse station for each working datum.
2. Set up Topcon GR-5 at Helipad, Balai Cerap, KDOJ and KTDI for session 1 of 3D Control Network.
3. Press the button "ON" at least 5 second to switch on the equipment.

4. When the last station start operating, just start counting time. Observation time for 1 session 3D Control Network is 1 hour.
5. After 1 hour, switch off the Topcon GR-5 at KDOJ and move to Stadium, the other continuously switch on.
6. Repeat the step 3 and 4 for session 2.
7. After finishing GNSS observation 3D Control Network, equipment at Helipad (Base station) will continuously switch on until completing the task.
8. The other three equipment set up at working datum.
9. Observation time for 1 session working datum is 20 minutes.
10. After 20 minutes, move the three equipment to the second working datum and repeat step 9 for session 2 working datum.
11. Switch off the equipment after finishing observation.

7.0 Results and Analysis

Radius to Notch: 0.079 m

^{h}meas (mean) = Total Slant Height/Total Notch

$^{h}vert^2 = {}^{h}meas^2$ - radius to notch^2

7.1 3D Network

Sesion I

Station : Kolej Dato Onn Jaafar (KDOJ)

Measure Slant Height			
Before		After	
Notch no.	Metre	Notch no.	Metre
1.	1.426	1.	1.425
2.	1.425	2.	1.425
3.	1.425	3.	1.423

^{h}meas (mean) = 1.425
$^{h}vert^2$ = 1.423
Ant. Height = 1.255

Station : Helipad

Measure Slant Height			
Before		After	
Notch no.	Metre	Notch no.	Metre
1.	1.187	1.	1.187
2.	1.189	2.	1.188
3.	1.189	3.	1.190

^{h}meas (mean) = 1.188
$^{h}vert^2$ = 1.185
Ant. Height = 1.017

Station : Balai Cerap

Measure Slant Height			
Before		After	
Notch no.	Metre	Notch no.	Metre
1.	1.150	1.	1.150
2.	1.150	2.	1.150
3.	1.150	3.	1.150

^{h}meas (mean) = 1.150
^{h}vert² = 1.147
Ant. Height = 0.979

Station : Kolej Tun Dr. Ismail (KTDI)

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.085	**1.**	1.085
2.	1.085	**2.**	1.086
3.	1.086	**3.**	1.085

^{h}meas (mean) = 1.085
^{h}vert² = 1.082
Ant. Height = 0.914

SESION II

Station : Stadium

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.496	**1.**	1.496
2.	1.497	**2.**	1.496
3.	1.496	**3.**	1.497

^{h}meas (mean) = 1.496
^{h}vert² = 1.494
Ant. Height = 1.326

Station : Helipad

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.187	**1.**	1.189
2.	1.188	**2.**	1.191
3.	1.190	**3.**	1.189

^{h}meas (mean) = 1.189
^{h}vert^2 = 1.186
Ant. Height = 1.018

Station : Balai Cerap

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.150	**1.**	1.150
2.	1.150	**2.**	1.150
3.	1.150	**3.**	1.150

^{h}meas (mean) = 1.150
^{h}vert^2 = 1.147
Ant. Height = 0.979

Station : Kolej Tun Dr. Ismail (KTDI)

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.085	**1.**	1.085
2.	1.085	**2.**	1.086
3.	1.086	**3.**	1.085

^{h}meas (mean) = 1.085
^{h}vert^2 = 1.082
Ant. Height = 0.914

7.2 Working Datum

Session I

Station : STN 4

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.441	**1.**	1.443
2.	1.443	**2.**	1.442
3.	1.443	**3.**	1.444

^{h}**meas (mean)** = 1.443
^{h}**vert^{2} =** 1.441
Ant. Height = 1.273

Station : STN 5

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.566	**1.**	1.566
2.	1.568	**2.**	1.567
3.	1.567	**3.**	1.566

^{h}**meas (mean)** = 1.567
^{h}**vert^{2} =** 1.565
Ant. Height = 1.397

Station : STN 6

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.333	**1.**	1.333
2.	1.335	**2.**	1.333
3.	1.333	**3.**	1.333

^{h}**meas (mean)** = 1.333
^{h}**vert^{2} =** 1.331
Ant. Height = 1.163

Station : STN 11

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.440	**1.**	1.440
2.	1.439	**2.**	1.439
3.	1.440	**3.**	1.439

^{h}**meas (mean)** = 1.440
^{h}**vert²** = 1.438
Ant. Height = 1.270

Station : STN 12

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.455	**1.**	1.456
2.	1.455	**2.**	1.456
3.	1.456	**3.**	1.456

^{h}**meas (mean)** = 1.456
^{h}**vert²** = 1.454
Ant. Height = 1.286

Station : STN 1

Measure Slant Height			
Before		**After**	
Notch no.	**Metre**	**Notch no.**	**Metre**
1.	1.622	**1.**	1.622
2.	1.622	**2.**	1.622
3.	1.622	**3.**	1.622

^{h}**meas (mean)** = 1.622
^{h}**vert²** = 1.620
Ant. Height = 1.452

7.3 Adjusted Coordinate

7.3.1 3D Network

Processing Summary

Observation	From	To	Solution Type	H. Prec. (Meter)	V. Prec. (Meter)	Geodetic Az.	Ellipsoid Dist. (Meter)	ΔHeight (Meter)
CERA --- STAD (B27)	CERA	STAD	Fixed	0.003	0.017	142°24'43"	2012.429	-115.725
CERA --- KDOJ (B8)	CERA	KDOJ	Fixed	0.003	0.017	284°41'17"	2867.920	-90.640
JHJY --- STAD (B29)	STAD	JHJY	Fixed	0.006	0.033	97°25'56"	15762.595	11.779
KTDI --- CERA (B22)	KTDI	CERA	Fixed	0.003	0.016	67°29'27"	1318.033	95.159
HELI --- STAD (B26)	HELI	STAD	Fixed	0.003	0.016	98°48'34"	2142.875	-14.865
HELI --- KDOJ (B7)	HELI	KDOJ	Fixed	0.003	0.016	316°37'04"	2743.132	10.202
HELI --- KTDI (B12)	HELI	KTDI	Fixed	0.004	0.008	336°44'08"	829.348	5.700
KUKP --- HELI (B5)	HELI	KUKP	Fixed	0.008	0.049	219°24'17"	32190.057	-26.925
KUKP --- HELI (B19)	HELI	KUKP	Fixed	0.006	0.034	219°24'17"	32190.056	-26.902

Acceptance Summary

Processed	Passed	Flag	Fail
9	9	0	0

Adjusted Grid Coordinates

Point ID	Easting (Meter)	Easting Error (Meter)	Northing (Meter)	Northing Error (Meter)	Elevation (Meter)	Elevation Error (Meter)	Constraint
CERA	627613.686	0.004	173587.845	0.004	136.338	0.023	
HELI	626723.134	0.004	172321.968	0.004	35.552	0.021	
JHJY	644467.154	?	169946.621	?	30.680	?	LLh
KDOJ	624840.241	0.004	174316.300	0.004	46.078	0.024	
KTDI	626395.985	0.004	173083.939	0.004	41.163	0.023	
KUKP	606279.373	?	147462.376	?	8.123	?	LLh
STAD	628840.265	0.004	171992.783	0.003	20.908	0.022	

Adjusted Geodetic Coordinates

Point ID	Latitude	Longitude	Height (Meter)	Height Error (Meter)	Constraint
CERA	N1°34'10.83466"	E103°38'42.14862"	144.172	0.023	
HELI	N1°33'29.60121"	E103°38'13.35431"	43.357	0.021	
JHJY	N1°32'12.51818"	E103°47'47.51143"	39.163	?	LLh
KDOJ	N1°34'34.50909"	E103°37'12.39910"	53.804	0.024	
KTDI	N1°33'54.40692"	E103°38'02.75684"	48.953	0.023	
KUKP	N1°19'59.79072"	E103°27'12.35599"	15.353	?	LLh
STAD	N1°33'18.91633"	E103°39'21.86101"	28.797	0.022	

Adjusted ECEF Coordinates

Point ID	X (Meter)	X Error (Meter)	Y (Meter)	Y Error (Meter)	Z (Meter)	Z Error (Meter)	3D Error (Meter)	Constraint
CERA	-1504114.697	0.007	6195949.292	0.023	173548.494	0.004	0.024	
HELI	-1503234.125	0.006	6196094.860	0.020	172279.698	0.004	0.022	
JHJY	-1520489.929	?	6191944.494	?	169912.804	?	?	LLh
KDOJ	-1501392.613	0.007	6196495.979	0.024	174272.918	0.004	0.025	
KTDI	-1502912.204	0.007	6196157.342	0.022	173041.488	0.004	0.023	
KUKP	-1483509.865	?	6201463.440	?	147413.259	?	?	LLh
STAD	-1505290.619	0.007	6195589.770	0.021	171951.232	0.004	0.023	

7.3.2 Working Datum

STN 4

Vector Components (Mark to Mark)

From:	HELI				
Grid		Local		Global	
Easting	626723.141 m	Latitude	N1°33'29.60107"	Latitude	N1°33'29.60107"
Northing	172321.964 m	Longitude	E103°38'13.35453"	Longitude	E103°38'13.35453"
Elevation	34.455 m	Height	42.260 m	Height	42.260 m

To:	stn4				
Grid		Local		Global	
Easting	628140.302 m	Latitude	N1°33'28.49242"	Latitude	N1°33'28.49242"
Northing	172287.216 m	Longitude	E103°38'59.20848"	Longitude	E103°38'59.20848"
Elevation	22.244 m	Height	30.104 m	Height	30.104 m

Vector					
ΔEasting	1417.161 m	NS Fwd Azimuth	91°22'34"	ΔX	-1374.744 m
ΔNorthing	-34.748 m	Ellipsoid Dist.	1417.788 m	ΔY	-345.240 m
ΔElevation	-12.212 m	ΔHeight	-12.156 m	ΔZ	-34.371 m

STN 5

Vector Components (Mark to Mark)

From:	HELI				
Grid		Local		Global	
Easting	626723.141 m	Latitude	N1°33'29.60107"	Latitude	N1°33'29.60107"
Northing	172321.964 m	Longitude	E103°38'13.35453"	Longitude	E103°38'13.35453"
Elevation	34.455 m	Height	42.260 m	Height	42.260 m

To:	STN5				
Grid		Local		Global	
Easting	628095.498 m	Latitude	N1°33'28.79240"	Latitude	N1°33'28.79239"
Northing	172296.450 m	Longitude	E103°38'57.75868"	Longitude	E103°38'57.75868"
Elevation	21.718 m	Height	29.577 m	Height	29.577 m

Vector					
ΔEasting	1372.357 m	NS Fwd Azimuth	91°02'12"	ΔX	-1331.012 m
ΔNorthing	-25.513 m	Ellipsoid Dist.	1372.789 m	ΔY	-335.420 m
ΔElevation	-12.737 m	ΔHeight	-12.683 m	ΔZ	-25.175 m

Standard Errors

Vector errors:					
σ ΔEasting	0.002 m	σ NS fwd Azimuth	0°00'00"	σ ΔX	0.002 m
σ ΔNorthing	0.002 m	σ Ellipsoid Dist.	0.002 m	σ ΔY	0.004 m
σ ΔElevation	0.004 m	σ ΔHeight	0.004 m	σ ΔZ	0.002 m

STN 6

Vector Components (Mark to Mark)

From:	HELI				
Grid		Local		Global	
Easting	626723.141 m	Latitude	N1°33'29.60107"	Latitude	N1°33'29.60107"
Northing	172321.964 m	Longitude	E103°38'13.35453"	Longitude	E103°38'13.35453"
Elevation	34.455 m	Height	42.260 m	Height	42.260 m

To:	STN6				
Grid		Local		Global	
Easting	628077.104 m	Latitude	N1°33'30.68049"	Latitude	N1°33'30.68049"
Northing	172354.445 m	Longitude	E103°38'57.16260"	Longitude	E103°38'57.16260"
Elevation	22.247 m	Height	30.104 m	Height	30.104 m

Vector					
ΔEasting	1353.963 m	NS Fwd Azimuth	88°35'50"	ΔX	-1312.859 m
ΔNorthing	32.481 m	Ellipsoid Dist.	1354.545 m	ΔY	-332.092 m
ΔElevation	-12.208 m	ΔHeight	-12.156 m	ΔZ	32.812 m

Standard Errors

Vector errors:					
σ ΔEasting	0.003 m	σ NS fwd Azimuth	0°00'00"	σ ΔX	0.003 m
σ ΔNorthing	0.002 m	σ Ellipsoid Dist.	0.003 m	σ ΔY	0.006 m
σ ΔElevation	0.006 m	σ ΔHeight	0.006 m	σ ΔZ	0.002 m

STN 11

Vector Components (Mark to Mark)

From:	HELI				
Grid		Local		Global	
Easting	626723.141 m	Latitude	N1°33'29.60107"	Latitude	N1°33'29.60107"
Northing	172321.964 m	Longitude	E103°38'13.35453"	Longitude	E103°38'13.35453"
Elevation	34.455 m	Height	42.260 m	Height	42.260 m

To:	STN11				
Grid		Local		Global	
Easting	628188.050 m	Latitude	N1°33'34.27405"	Latitude	N1°33'34.27405"
Northing	172464.752 m	Longitude	E103°39'00.75059"	Longitude	E103°39'00.75059"
Elevation	23.193 m	Height	31.054 m	Height	31.054 m

Vector					
ΔEasting	1464.909 m	NS Fwd Azimuth	84°24'16"	ΔX	-1420.150 m
ΔNorthing	142.788 m	Ellipsoid Dist.	1472.060 m	ΔY	-360.260 m
ΔElevation	-11.262 m	ΔHeight	-11.206 m	ΔZ	143.175 m

Standard Errors

Vector errors:					
σ ΔEasting	0.002 m	σ NS fwd Azimuth	0°00'00"	σ ΔX	0.003 m
σ ΔNorthing	0.002 m	σ Ellipsoid Dist.	0.002 m	σ ΔY	0.003 m
σ ΔElevation	0.003 m	σ ΔHeight	0.003 m	σ ΔZ	0.002 m

STN 12

Vector Components (Mark to Mark)

From:	HELI				
Grid		Local		Global	
Easting	626723.141 m	Latitude	N1°33'29.60107"	Latitude	N1°33'29.60107"
Northing	172321.964 m	Longitude	E103°38'13.35453"	Longitude	E103°38'13.35453"
Elevation	34.271 m	Height	42.075 m	Height	42.075 m

To:	STN12				
Grid		Local		Global	
Easting	628230.521 m	Latitude	N1°33'34.01118"	Latitude	N1°33'34.01118"
Northing	172456.658 m	Longitude	E103°39'02.12492"	Longitude	E103°39'02.12492"
Elevation	23.181 m	Height	31.044 m	Height	31.044 m

Vector					
ΔEasting	1507.380 m	NS Fwd Azimuth	84°51'55"	ΔX	-1461.524 m
ΔNorthing	134.694 m	Ellipsoid Dist.	1513.601 m	ΔY	-369.903 m
ΔElevation	-11.090 m	ΔHeight	-11.031 m	ΔZ	135.109 m

Standard Errors

Vector errors:					
σ ΔEasting	0.002 m	σ NS fwd Azimuth	0°00'00"	σ ΔX	0.004 m
σ ΔNorthing	0.002 m	σ Ellipsoid Dist.	0.002 m	σ ΔY	0.015 m
σ ΔElevation	0.015 m	σ ΔHeight	0.015 m	σ ΔZ	0.002 m

STN 1

Vector Components (Mark to Mark)

From:	HELI				
Grid		Local		Global	
Easting	626723.141 m	Latitude	N1°33'29.60107"	Latitude	N1°33'29.60107"
Northing	172321.964 m	Longitude	E103°38'13.35453"	Longitude	E103°38'13.35453"
Elevation	34.455 m	Height	42.260 m	Height	42.260 m

To:	STN 1				
Grid		Local		Global	
Easting	628266.060 m	Latitude	N1°33'32.65098"	Latitude	N1°33'32.65098"
Northing	172414.867 m	Longitude	E103°39'03.27547"	Longitude	E103°39'03.27547"
Elevation	23.349 m	Height	31.213 m	Height	31.213 m

Vector					
ΔEasting	1542.919 m	NS Fwd Azimuth	86°31'33"	ΔX	-1496.349 m
ΔNorthing	92.904 m	Ellipsoid Dist.	1545.933 m	ΔY	-377.206 m
ΔElevation	-11.107 m	ΔHeight	-11.047 m	ΔZ	93.344 m

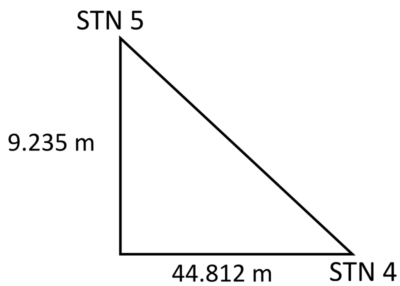
Standard Errors

Vector errors:					
σ ΔEasting	0.002 m	σ NS fwd Azimuth	0°00'00"	σ ΔX	0.003 m
σ ΔNorthing	0.001 m	σ Ellipsoid Dist.	0.002 m	σ ΔY	0.011 m
σ ΔElevation	0.012 m	σ ΔHeight	0.012 m	σ ΔZ	0.001 m

7.4. Calculated Bearing and Distance for Station

7.4.1 Using GPS data

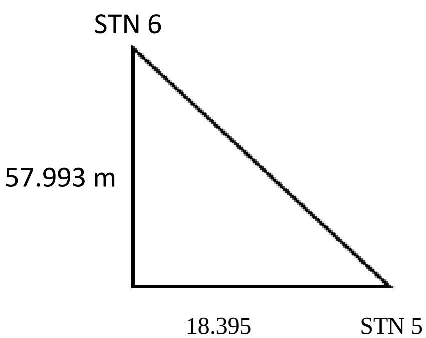
STATION	EASTING (E)	NORTHING (N)
4	628110.400	172287.197
5	628065.588	172296.432
6	628047.193	172354.425



$\tan \theta = \frac{44.812}{9.235}$

$\theta = 78^o 21' 19''$

Bearing $_{5\text{–}4}$ = $101^o\ 38'\ 41''$



$\tan \theta = \frac{57.993}{18.935}$

$\theta = 342^o\ 24'\ 05''$

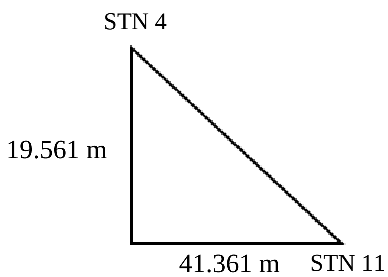
Bearing $_{5\text{–}6}$ = $342^o\ 24'\ 05''$

Bearing $_{5\text{–}6}$ – Bearing $_{5\text{–}4}$ = $342^o\ 24'\ 05''$ - $101^o\ 38'\ 54''$

= $199^o\ 14'\ 29''$

7.2.2 Using assumed coordinate

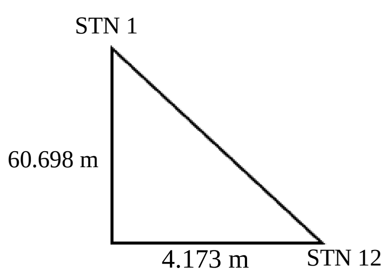
STATION	EASTING (E)	NORTHING (N)
4	1148.129	1013.664
5	1189.490	994.103
6	1193.663	933.405



$\tan\theta = \frac{19.561}{41.361}$

$\theta = 25^{o}\ 18'\ 40''$

$Bearing_{5\text{–}4} = 295^{o}\ 18'\ 40''$



$\tan\theta = \frac{4.173}{60.698}$

$\theta = 03^{o}\ 55'58''$

$Bearing_{5\text{–}6} = 176^{o}\ 04'02''$

$Bearing\ _{5\text{–}4} – Bearing\ _{5\text{–}6} = 295^{o}\ 18'05'' - 176^{o}\ 04'\ 02''$

$= 119^{o}\ 14'\ 38''$

∴ The difference bearing between using assumed coordinate with using GPS data is about $0^{o}\ 00'\ 9''$

8.0 Discussion

Global Navigation Satellite Systems (GNSS) technology has become vital to many applications that range from city planning engineering and zoning to military applications. It has been widely accepted globally by governments and organization. The GNSS consist of three main satellite technologies: GPS, Glonass and Galileo. As of today, the complete satellite technology is the GPS technology and most of the existing worldwide applications related to the GPS technology.

We have learned how to process the GNSS data from Dr Ami for 3D Control Network and Working Datum. We use the app Trimble Working Centre to process the GNSS data we get when using the Topcon GR5. For working datum we use satellite GPS and GLONASS. When using Trimble app we can learn many things to process data. We learn to make cleaning data if the horizontal, vertical and RMS more than value that Dr Ami want. For 3D Control Network we have to do network adjustment while Working Datum do not have to do network adjustment.

The GPS point has been conducted to obtain the known coordinates for six of the traverse stations to be sat out. The bearing and distance gathered from GPS coordinate of stations 4, 5 and 6 for working datum 1 and stations 11,12 and 1 is working datum 2. We can calculate distance and bearing with the coordinates that we get from data processing and do M correction.

9.0 Conclusion

Through this survey camp, we gained the more knowledge about the GPS and the experience to use the GPS. Although we had used the GPS Topcon-GR5 during the Engineering Survey Technology’s fieldwork this semester, we still didn’t very understand the concept and theory of GPS. During this survey camp, Dr Ami had given the briefing, so all of us had more understand about the GPS.

There are certain factors will affect the results of data. For example, if the surrounding of the receivers have the obstructions such as buildings, trees, and car, after we process the baseline, the precision and RMS will be high. Furthermore, the elevation mark increase, the precision maybe will be improved, but the data received will be decreased.

As one of our GPS setting under tree, and another one setting besides building, so the data of the two GPS are not very well. The horizontal and vertical precision needed to data cleaning time slot to get the compliance precision. From here, we know that the importance of choosing the place to set out GPS.

In conclusion, we gain the great experience to learn how to process the data although the process is not simple.

10.0 Recommendation

In this particular section or page, we are going to discuss about the recommendation for this project. In other words, it is about the improvements that we can imply in next projects. The main reason is to get better data acquisition and more accurate results. Here are the recommendations from our group.

- Firstly, during the setting up of the GNSS tools (in this case we use Topcon GR5) the tools must face in the same way. The front face in particularly should be faced to the North to get accurate result. However, if we choose to face towards East, everyone must do so.
- Secondly, we can use more advanced GNSS tools for this work. Plus, the site given is full of tall features such as buildings, trees and slopes. Because of these features, the data that we acquired might be wrong due to multipath error from it.
- In future work, the process of calculating and getting the working must be done in first step before doing any survey works such as traversing and detailing. This is because we can directly use the true bearing in our work instead of assuming it. This will ease the progress of work later during the process of the data.
- The theory of GNSS data processing also should be done early before the survey camp or at the start of the survey camp so that we can easily choose the most suitable locations for our stations. This is because there are a few parameter that we should take care before doing any gps work. For example, the stations must be clear of any obstacles within 10 degrees of elevation mask.
- We also can increase the number of working datums so that we can use them as checking later during the data processing.
- The number of instruments must be increased. This is because, the number of groups are many and the distance between sites is large. Hence, it takes longer time for the late group for them to use the GNSS tools. So the work will be delayed.
- Lastly, the site given should be at outside the UTM campus where the students can face more challenging situations such as how to handle public.

11 Appendix

12.0 Attachment

11. 1 3D Control Network

a) HELI

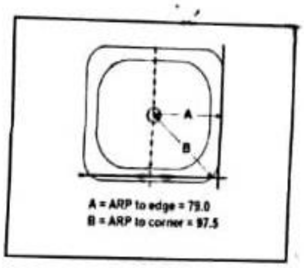
OBSERVATION SHEET: GNSS OBSERVATION

Station	HELIPAD UTM	Manufacture		Operator	
Job. No	FREU 3141	Antenna Type		Dates	13/1/2020
Client		Serial No		Time Zones	
Location					

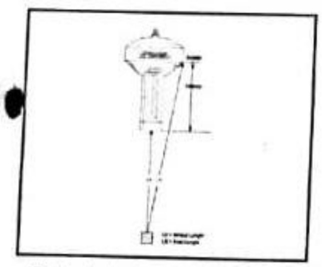
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		8.18				



ʰMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.5226		1		
2	1.26		2		
3	1.26		3		



(Refer to instrument/ Manual)

$^{h}vert^2 = {^{h}meas^2}$ - radius to notch²

Radius to notch: m

ʰmeas (mean)	1.260	m
ʰvert	1.258	m (from formula)

Ant. Height	1.090

SIGNED:

CHECKED:

b) Balai Cerap

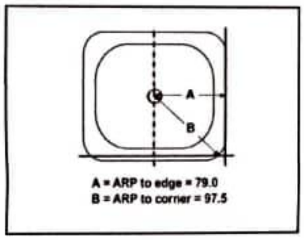
OBSERVATION SHEET: GNSS OBSERVATION

Station	BALAI CERAP	Manufacture	TOPCON	Operator	ASMIRA
Job. No	SBEU 2141	Antenna Type		Dates	12/01/2020
Client	DR. AMIN HASSAN	Serial No	GPS 04	Time Zones	
Location	~~BALAI CERAP~~ UTM				

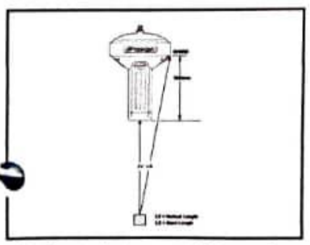
Global Coordinate	
Lat	1.569702
Long	103.644998
Ellip Ht	

Observable		
	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		sunday	0852	sunday	0953	



ʰMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.150		1	1.150	
2	1.150		2	1.150	
3	1.150		3	1.150	



ʰmeas (mean)	1.150	m
ʰvert	1.147	m (from formula)

Ant. Height	0.979

(Refer to instrument/ Manual)

$^{h}vert^2 = {}^{h}meas^2$ - radius to notch^2

Radius to notch: 0.079m

SIGNED: **CHECKED:**

c)KTDI

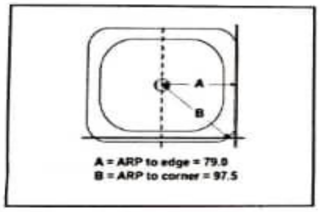
OBSERVATION SHEET: GNSS OBSERVATION

Station	Geodekit 05 UTM	**Manufacture**	Topcon	**Operator**	Elvis Ha
Job. No		**Antenna Type**	GR5	**Dates**	12/01/2020
Client		**Serial No**	GPS-03	**Time Zones**	
Location	KTDI				

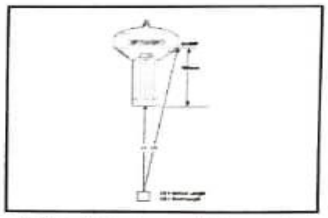
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	**L1**	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	**File Name**	**Start**		**Stop**		**Remarks**
		Day	**UTC**	**Day**	**UTC**	
		Sunday	~~1000~~ 0843	Sunday	~~1116~~ 0953	



hMeasure Slant Height					
Before			**After**		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.085		1	1.085	
2	1.085		2	1.086	
3	1.086		3	1.085	



hmeas (mean)	1.085	m
hvert	1.082	m (from formula)

Ant. Height	0.914

(Refer to instrument/ Manual)

$^h vert^2 = {}^h meas^2$ - radius to notch^2

Radius to notch: 0.079 m

SIGNED:

CHECKED:

d) Balai Cerap

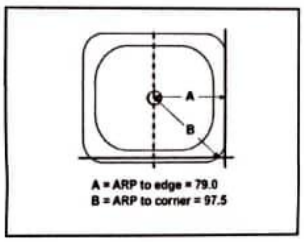
OBSERVATION SHEET: GNSS OBSERVATION

Station	BALAI CERAP	Manufacture	TOPCON	Operator	ASMIRA
Job. No	SBEU 2141	Antenna Type		Dates	12/01/2020
Client	DR. AMIN HASSAN	Serial No	GPS 04	Time Zones	
Location	~~BALAI CERAP~~ UTM				

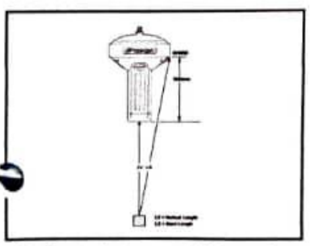
Global Coordinate	
Lat	1.569702
Long	103.644998
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		Sunday	0852	Sunday	0953	



^{h}Measure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.150		1	1.150	
2	1.150		2	1.150	
3	1.150		3	1.150	



^{h}meas (mean)	1.150	m
^{h}vert	1.147	m (from formula)

Ant. Height	0.979

(Refer to instrument/ Manual)

$^{h}vert^2 = {}^{h}meas^2 -$ radius to notch^2

Radius to notch: 0.079m

SIGNED:

CHECKED:

e) KDOJ

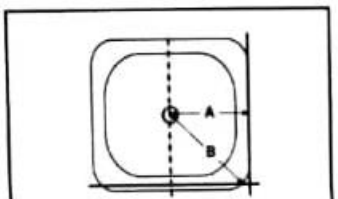
OBSERVATION SHEET: GNSS OBSERVATION

Station	KDOJ / UKK13	Manufacture	TOPCON	Operator	
Job. No		Antenna Type	GR 5	Dates	12/1/2020
Client	HARITH	Serial No	GPS01	Time Zones	
Location	KDOJ				

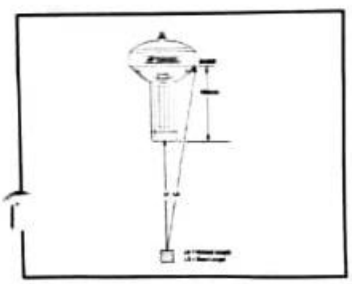
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
12/1/2020		8.52 a.m		9.52 a.m		



ʰMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.426		1	1.425	
2	1.425		2	1.425	
3	1.425		3	1.423	



ʰmeas (mean)	1.425	m
ʰvert	1.428	m (from formula)

Ant. Height	1.255

(Refer to instrument/ Manual)

$^{h}vert^2 = {}^{h}meas^2 - \text{radius to notch}^2$

Radius to notch: 0.079 m

SIGNED:

CHECKED:

f) BALAI CERAP

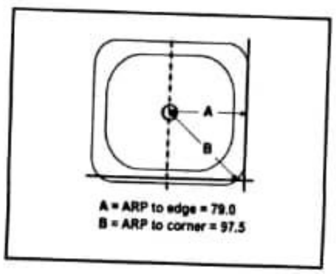
OBSERVATION SHEET: GNSS OBSERVATION

Station	BALAI CERAP	Manufacture	TOPCON	Operator	ASMIKA
Job. No	SBEU 3141	Antenna Type		Dates	12/01/2020
Client	DR. AMIN HASSAN	Serial No	GPS 04	Time Zones	
Location	UTM				

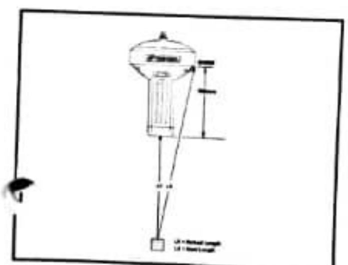
Global Coordinate	
Lat	1.569702
Long	103.644998
Ellip Ht	

Observable		
	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		SUNDAY	10.16	SUNDAY	11.16	



^hMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.150		1	1.150	
2	1.150		2	1.150	
3	1.150		3	1.150	



^hmeas (mean)	1.150	m
^hvert	1.147	m (from formula)

Ant. Height	0.979

(Refer to instrument/ Manual)

$^{h}vert^{2} = {}^{h}meas^{2}$ - radius to notch^{2}

Radius to notch: 0.079 m

SIGNED:

CHECKED:

g) STADIUM

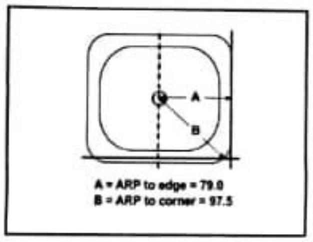
OBSERVATION SHEET: GNSS OBSERVATION

Station	STADIUM / UTM 01	Manufacture	TOPCON	Operator	
Job. No		Antenna Type	GRS	Dates	12/1/2020
Client	HARITH	Serial No	GPS 01	Time Zones	
Location	STADIUM				

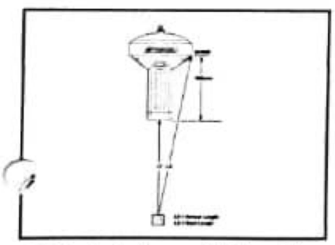
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable L1	
L1 & L2	
Format	
Min Sv's	
Sync Time	

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
2/1/2020			10.18 a.m		11.16 a.m	



ʰMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.496		1	1.496	
2	1.4967		2	1.496	
3	1.496		3	1.497	



ʰmeas (mean)	1.496	m
ʰvert	1.494	m (from formula)

Ant. Height	1.326

(Refer to instrument/ Manual)

$^{h}vert^2 = {}^{h}meas^2$ - radius to notch^2

Radius to notch: 0.079 m

SIGNED: **CHECKED:**

h) KTDI

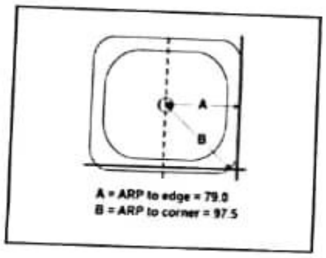
OBSERVATION SHEET: GNSS OBSERVATION

Station	Geodetic 05 UTM	Manufacture	Topcon	Operator	Elvis Hq
Job. No		Antenna Type	GR-5	Dates	12/01/2020
Client		Serial No	GPS 03	Time Zones	
Location	KTDI				

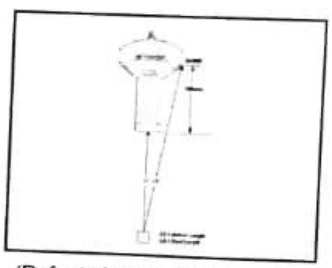
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable		
	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		SUNDAY	1000	SUNDAY	1116	



hMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.085		1	1.085	
2	1.086		2	1.085	
3	1.085		3	1.086	



hmeas (mean)	1.085	m
hvert	1.081	m (from formula)

Ant. Height	0.914

(Refer to instrument/ Manual)

$^h vert^2 = {}^h meas^2$ - radius to notch^2

Radius to notch: 0.079 m

SIGNED:

CHECKED:

12.2 WORKING DATUM

a) STN 1

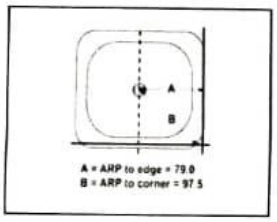
OBSERVATION SHEET: GNSS OBSERVATION

Station	1	Manufacture	Topcon	Operator	Elvis
Job. No		Antenna Type		Dates	13/01/2020
Client		Serial No	GPS ~~03~~ 05	Time Zones	
Location	K9				

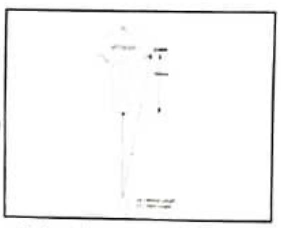
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		MONDAY	0517	MONDAY	1008	



ʰMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.622		1	1.622	
2	1.622		2	1.622	
3	1.622		3	1.622	



ʰmeas (mean)	1.622	m
ʰvert	1.620	m (from formula)

Ant. Height	1.452

(Refer to instrument/ Manual)

$^{h}vert^{2} = {}^{h}meas^{2}$ - radius to notch^{2}

Radius to notch: 0.079 m

SIGNED:

CHECKED:

b) STN 12

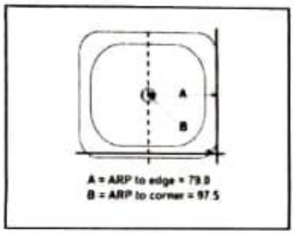
OBSERVATION SHEET: GNSS OBSERVATION

Station	12	Manufacture	Topcon	Operator	Long
Job. No		Antenna Type		Dates	13/01/2020
Client		Serial No	GPS 03	Time Zones	0857
Location	K9				

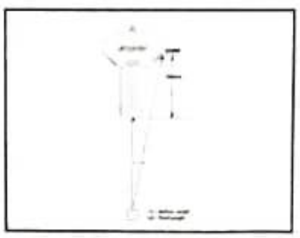
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		Monday	0937	Monday	1007	



ʰMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.455		1	1.456	
2	1.455		2	1.456	
3	1.456		3	1.456	



ʰmeas (mean)	1.456	m
ʰvert	1.454	m (from formula)

Ant. Height	1.236

(Refer to instrument/ Manual)

ʰvert² = ʰmeas² - radius to notch²

Radius to notch: m

SIGNED: CHECKED:

c) STN 11

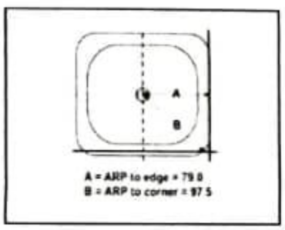
OBSERVATION SHEET: GNSS OBSERVATION

Station	11	Manufacture	Topcon	Operator	Asmira
Job. No		Antenna Type	GR 5	Dates	13 / 01 / 2020
Client		Serial No	GPS 04	Time Zones	9.37
Location	K9				

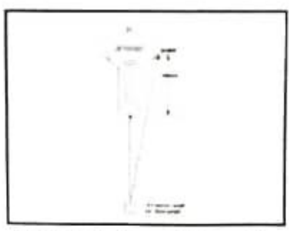
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		MONDAY	9.37	MONDAY	10.07	



hMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.440		1	1.440	
2	1.439		2	1.439	
3	1.440		3	1.439	



hmeas (mean)	1.440	m
hvert	1.438	m (from formula)

Ant. Height	1.270

(Refer to instrument/ Manual)

$^hvert^2 = {^hmeas}^2$ - radius to notch^2

Radius to notch: 0.079 m

SIGNED:

CHECKED:

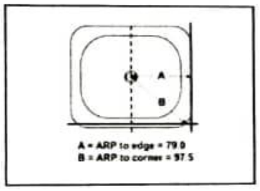
d) STN 4

Station	4	Manufacture	Topcon	Operator	Kang
Job. No		Antenna Type		Dates	
Client		Serial No	GPS 05	Time Zones	0804
Location					

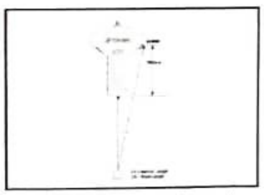
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		Monday	0818	Monday	0829	



hMeasure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.441		1	1.443	
2	1.442		2	1.442	
3	1.443		3	1.444	



hmeas (mean)	1.443	m
hvert	1.441	m (from formula)

Ant. Height	1.273

(Refer to instrument/ Manual)

$h_{vert}^2 = h_{meas}^2$ - radius to notch^2

Radius to notch: 0.079 m

SIGNED:

CHECKED:

e) STN 5

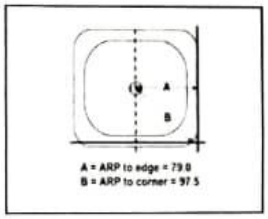
OBSERVATION SHEET: GNSS OBSERVATION

Station	5	Manufacture	Topcon	Operator	Elvis
Job. No		Antenna Type		Dates	15/01/2026
Client		Serial No	GPS 03	Time Zones	0805 AM
Location	K9				

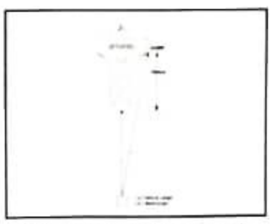
Global Coordinate	
Lat	
Long	
Ellip Ht	

Observable		
Observable	L1	
	L1 & L2	
Format		
Min Sv's		
Sync Time		

Date UTC	File Name	Start		Stop		Remarks
		Day	UTC	Day	UTC	
		MONDAY	08 19	MONDAY	08 34	



^{h}Measure Slant Height					
Before			After		
Notch no.	Metre	Inches	Notch no.	Metre	Inches
1	1.566		1	1.566	
2	1.568		2	1.567	
3	1.567		3	1.566	



^{h}meas (mean)	1.567	m
^{h}vert	1.565	m (from formula)

Ant. Height	1.397

(Refer to instrument/ Manual)

$^h vert^2 = {^h meas}^2$ - radius to notch^2

Radius to notch: 0.079 m

SIGNED:

CHECKED: