



# Absolute & Relative GPS Orthometric Heights using Regional Fitted Geoid

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**Commission No.5**


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FIG

## INTRODUCTION




- Classical equipment and method of observation in determination of height is labor intensive and time consuming.
- It also highly dangerous and tedious.
- GPS/ GNSS technology can be used as a tools for horizontal and height determination.
- GPS/GNSS ellipsoidal height can easily transform to orthometric height by having a Geoid Model.
- MyGEOID- Malaysia Geodetic Infrastructure developed and maintain by DSMM with  $RMS=\pm 3cm$






FIG

## INTRODUCTION



- Two(2) GPS/GNSS height concept can be used in determination of orthometric height; Absolute and Relative
- The accuracy of both technique will be examine and evaluate in this study.





**FIG** BASIC GPS/GNSS HEIGHT FORMULA

$$H = h - N$$

Where:

- $H$  = Orthometric Height
- $h$  = Corrected Ellipsoidal Height
- $N$  = Geoid Height (MyGEOID)

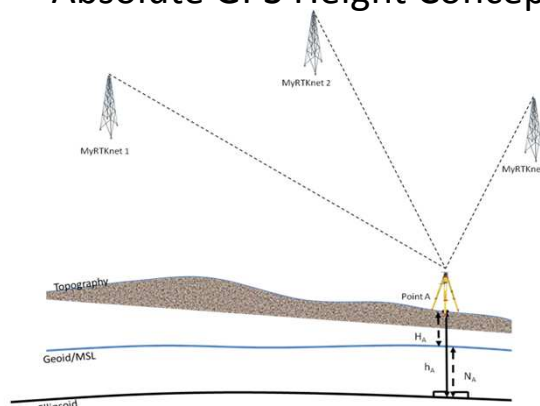



**FIG** ABSOLUTE AND RELATIVE GPS HEIGHT

- Absolute GPS Height Concept

$$H_A = h_A - N_A$$

- $H_A$  = Orthometric Height of point A
- $h_A$  = Corrected Ellipsoidal Height of point A
- $N_A$  = Geoid Height (MyGEOID) of point A

**FIG ABSOLUTE AND RELATIVE GPS HEIGHT**

- Relative GPS Height Concept


$$H_A = h_A - N_A \pm \varepsilon$$

Where:

- $H_A$  = Orthometric Height of Point A
- $h_A$  = Corrected Ellipsoidal Height at Point A
- $N_A$  = Geoid Height of Point A
- $\varepsilon = H_{SBM(GPS)} - H_{SBM(Leveling)}$

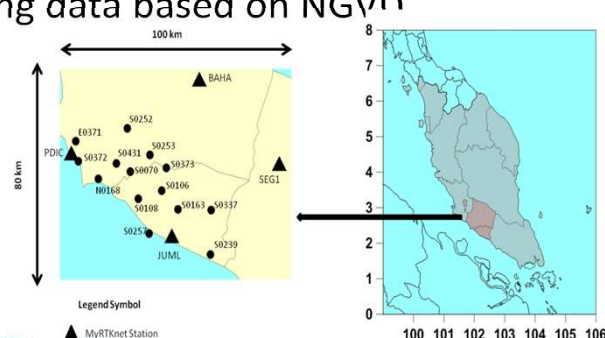

Where:


- $H_{SBM(GPS)}$  = Computed Orthometric Height of Point SBM
- $H_{SBM(leveling)}$  = Orthometric Height of Point SBM by leveling




**FIG STUDY AREA AND DATASET**

- Consists of 8000km<sup>2</sup> (Negeri Sembilan and Melaka)
- 14 randomly selected standard benchmark
- Leveling data based on NGVD










## FIELD OBSERVATION AND PROCESSING




- Field Observation Parameter

Items	Parameter
Equipment	Trimble R8 – Geodetic grade
Tripod	2 meter fixed pole
Elevation Mask	0°
Mode Observation	Static
Period of Observation	min 3 Hours
Record Interval	15 sec
Observation Datum	WGS84










## FIELD OBSERVATION AND PROCESSING




- Processing Parameter

Items	Parameter
General Procedure	Prescribed procedures as provided in manufacturer manual must be followed
Datum	GDM2000
Elevation Mask	15°
Ephemerides	Short baseline of less than 30 km: Broadcast Long baseline: Precise
Baseline Processing	RMSE less than 3 cm
Quality	Maximum data rejection - less than 10 % Ambiguity fixed solution
Adjustment	Least square adjustment should be used
Minimally Constrained Adjustment	One control station fixed in GDM2000 coordinates
Quality Indicator	Pass Chi-squares test at 95% confident region All baselines must pass the local test
Over-Constrained Adjustment	At least 2 control stations must be fixed in the final adjustment









# RESULT AND ANALYSIS




$$\text{Different} = H_{\text{GPS}} - H_{\text{BM/SBM}}$$


Where :

- $H_{\text{GPS}}$  = Height Derived Based GPS Observation (H= h-N)
- $H_{\text{BM/SBM}}$  = Height from Leveling Network









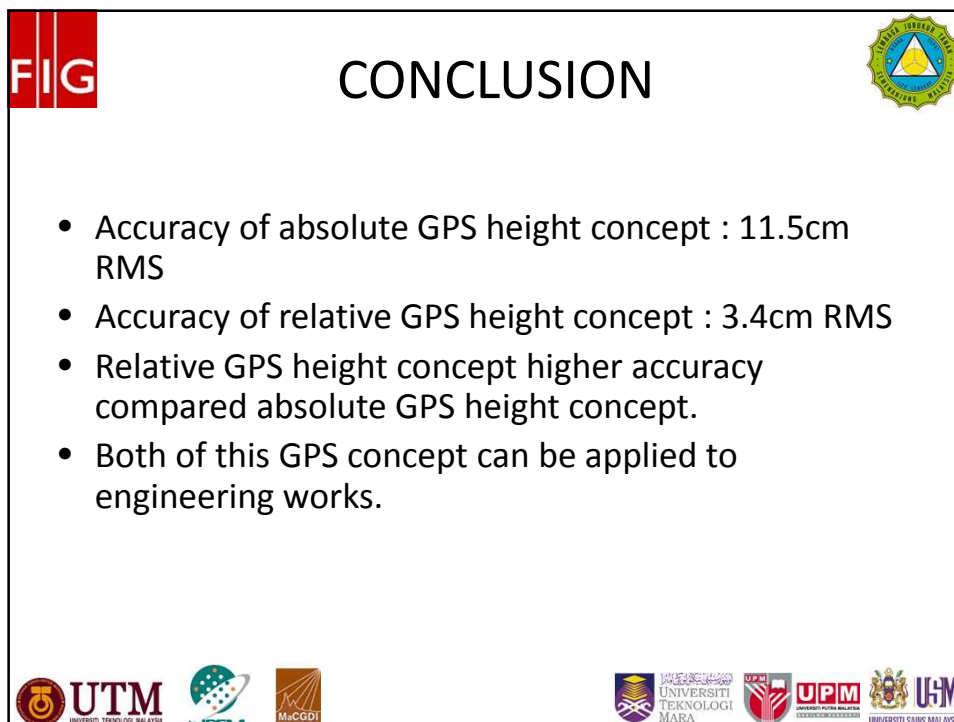
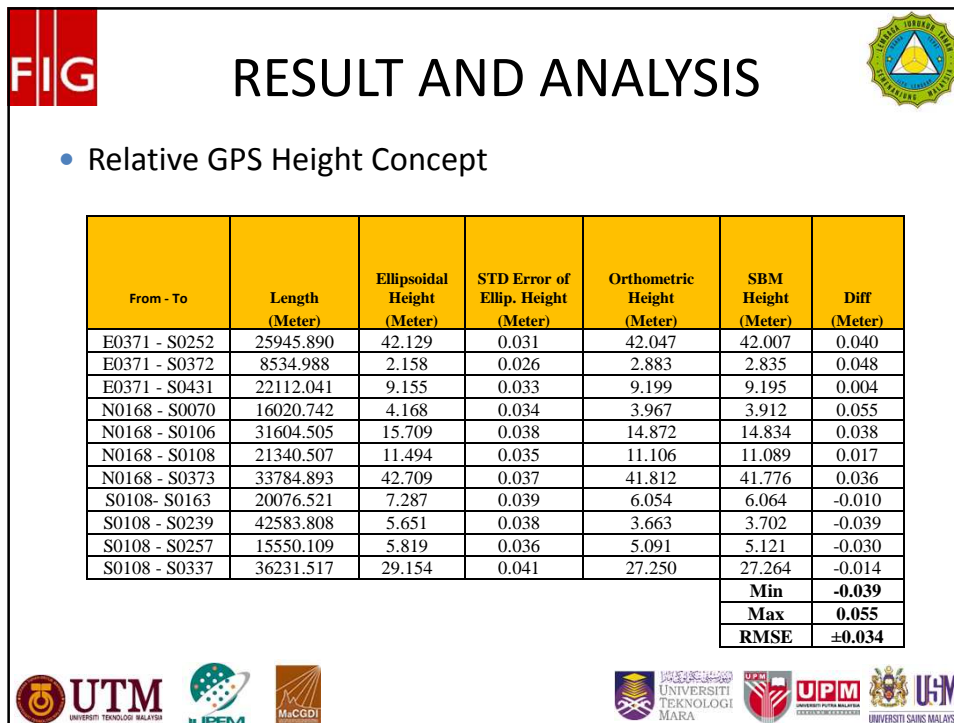
# RESULT AND ANALYSIS





- Absolute GPS Height Concept

Point ID	Ellipsoidal Height (Meter)	STD Error of Ellip. Height (Meter)	Orthometric Height (Meter)	SBM Height (Meter)	Diff (Meter)
E0371	4.728	0.040	5.679	5.569	-0.110
N0168	2.445	0.049	2.881	2.835	-0.046
S0070	4.158	0.047	4.076	3.912	-0.164
S0106	15.733	0.058	14.948	14.834	-0.114
S0108	11.517	0.049	11.21	11.089	-0.121
S0163	7.256	0.058	6.156	6.064	-0.092
S0239	5.620	0.059	3.707	3.702	-0.005
S0252	42.108	0.049	42.178	42.007	-0.171
S0253	31.812	0.058	31.39	31.188	-0.202
S0257	5.815	0.046	5.178	5.121	-0.057
S0337	29.139	0.069	27.327	27.264	-0.063
S0372	2.156	0.039	3.021	2.835	-0.028
S0373	42.695	0.050	41.895	41.776	-0.119
S0431	9.126	0.052	9.314	9.195	-0.119
<b>Min</b>					<b>-0.202</b>
<b>Max</b>					<b>-0.005</b>
<b>RMS</b>					<b>0.115</b>















## Acknowledgement

- Financial assistance from Malaysian Land Surveyors Board (LJT).
- Department of Survey and Mapping Malaysia-
- Universiti Teknologi MARA, Malaysia




## Thank you for your attention!

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