

# Control Point Surveying

Presentation

14 February, 2003

Yangon

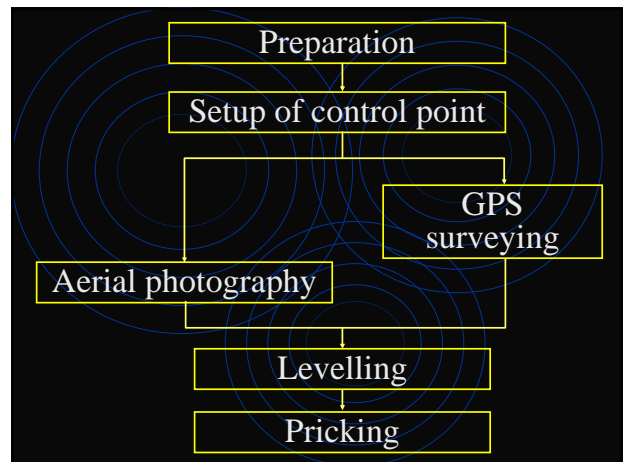
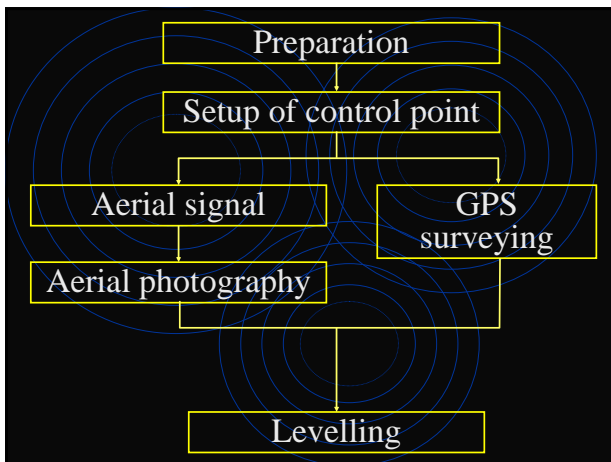
## The Establishment of Geographic Database for National Rehabilitation and Development Programme in The Union of Myanmar



JICA STUDY TEAM



SURVEY DEPARTMENT



### Work Schedule

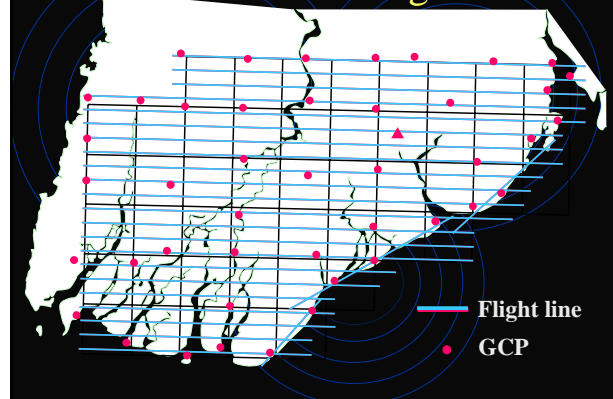
	2002			
	Jan	Feb	Mar	Apr
Preparation	█			
AP Signal		█		
A Photo		█		
GPS		█		
Levelling			█	
Pricking				█

## Control Point Surveying by GPS

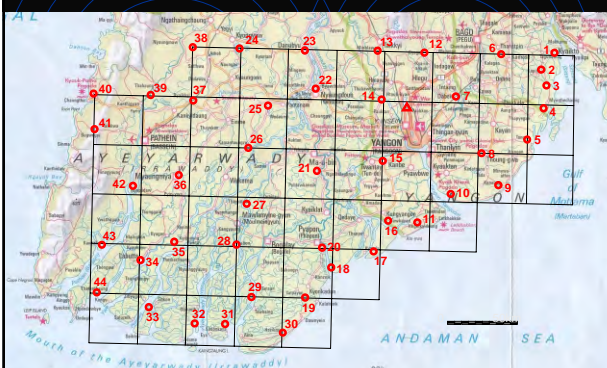
## Distribution of Control Points

- To establish more than necessary points is not economical.
- To establish less than necessary points may cause low accuracy.

## GCP Planning



## Ground Control Point (GCP)



## GPS Observation Planning

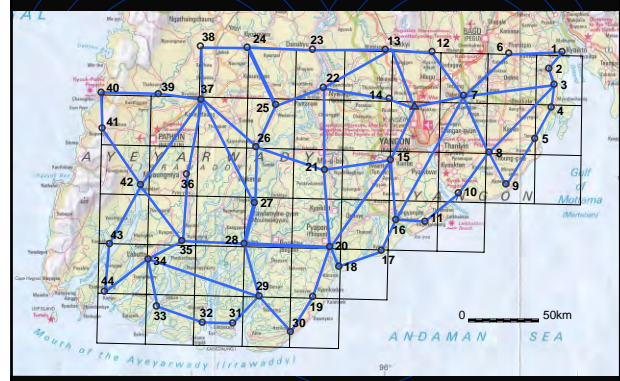
Depends on

- Number of receivers
- Network adjustment plan

## Observation Session

- Session is simultaneous observation with more than two receivers at different points.
- In this project, 15 sessions were observed.
- Five receivers were used for each session.

## Observation Session



## Spec. of Observation

- Receiver : Ashtech Z12
- Method : Static Observation
- Obs. time : 3 hours
- Mask :  $15^\circ$
- Epoch : 30 seconds
- Satellites : More than 4

## Ashtech Z12 at work



## Computation

Baseline Analysis

Network Adjustment

## Quality Control

### Baseline Analysis

- Closure Check
- Redundant observation

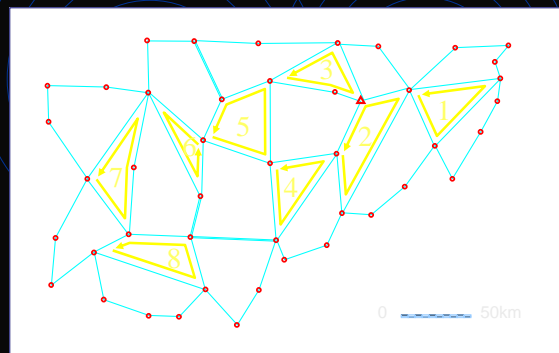
### Network Adjustment

- Residual of baseline vector

## Closure Check

- Loops to be checked should be composed of baselines from different sessions.
- 8 loops were checked.

## Closure Check



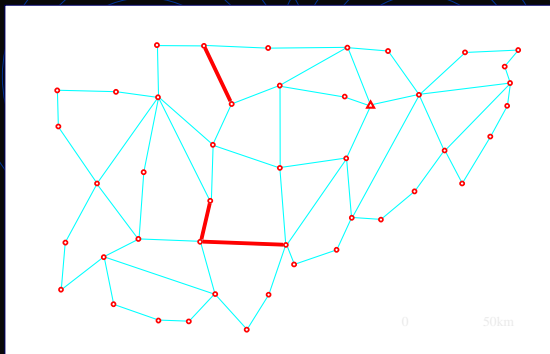
## Results

No.	Length (m)	DX (m)	DY (m)	DZ (m)	ppm
1	133,250	0.001	0.012	0.075	0.6
2	171,920	-0.044	0.004	0.010	0.3
3	130,921	0.021	-0.003	-0.029	0.3
4	143,150	-0.008	0.002	-0.126	0.9
5	137,317	-0.051	0.004	0.129	1.0
6	134,593	0.052	-0.027	-0.044	0.5
7	166,412	-0.043	-0.044	-0.097	0.7
8	148,497	0.011	0.029	-0.006	0.2

## Redundant Observation

- Some baselines shall be observed in different sessions.
- In this project, 3 baselines were observed in different session.

## Redundant Observation



## Results

Baseline (from→to)	Session Name	Baseline (m)	Difference (mm, ppm)		
			DX	DY	DZ
GCP24 → GCP25	9	35,256	3mm	2mm	4mm
	10		0.1ppm	0.1ppm	0.1ppm
GCP27 → GCP28	8	23,634	1 mm	18mm	24mm
	11		0.0ppm	0.8ppm	1.0ppm
GCP20 → GCP28	7	46,785	4mm	37mm	9mm
	8		0.1ppm	0.8ppm	0.2ppm

## Network Adjustment

- Three dimensional adjustment is carried out to determine the coordinates of control points.
- The result of baseline analysis is applied for this computation.

## Results

- This network is composed of 98 baselines.
- Mean of residuals is 0.4 ppm.
- This result is sufficiently accurate for photogrammetric work.

## Transformation of Coordinates

- Firstly the coordinates on the WGS-84 were computed.
- Then those coordinates were transformed to the Myanmar Datum 2000.

## Ellipsoid Elements

- |                       |                         |
|-----------------------|-------------------------|
| • WGS-84              | • Myanmar-2000          |
| WGS-84                | Everest 1830            |
| $a=6378137.0\text{m}$ | $a=6377276.345\text{m}$ |
| $f=1/298.2572$        | $f=1/300.8017$          |

## Conversion to the UTM

Geographic Coordinates  
(Latitude and Longitude)

↓  
UTM Coordinates  
(Northing and Easting)  
(Zone 46 and 47)

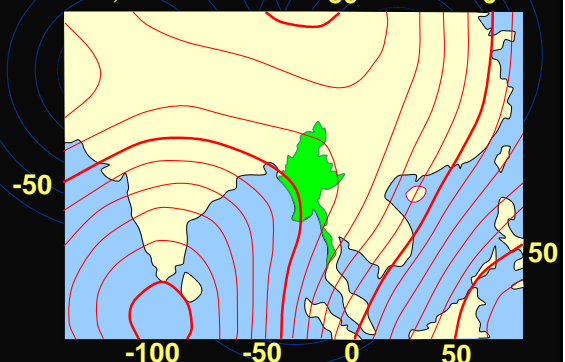
## Elevation

- Elevation acquired by GPS is ellipsoidal height.
- The elevation we need is orthometric height.
- Geoid height shall be corrected to the ellipsoidal height.

## What is the Geoid?

- Geoid is the figure of the earth considered as a sea-level surface extended continuously through the continents.
- It is an undulating surface.

## Geoid Map around Myanmar (WGS-84)



## Calculation of Orthometric Height

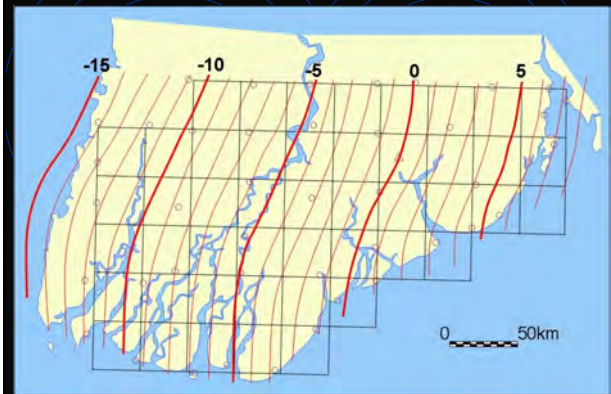
GPS Survey (Ellipsoidal height)

↓  
Direct levelling for some GCP

↓  
Preparation of Geoid map

↓  
Geoid height correction for all GCP

## Geoid map (Myanmar 2000)



## Levelling

- Levelling is necessary to acquire the elevation of GCP.
- It is also necessary to produce geoid map.

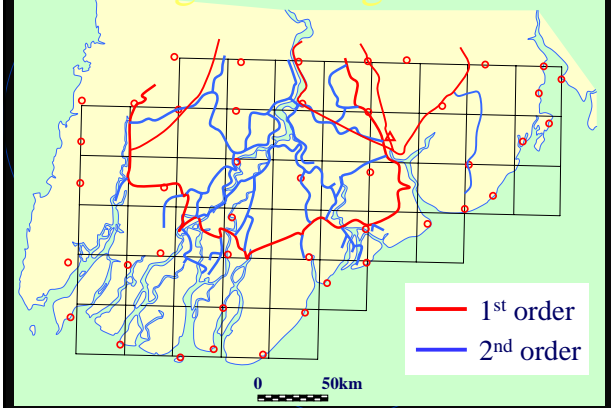
## Spec. of Levelling

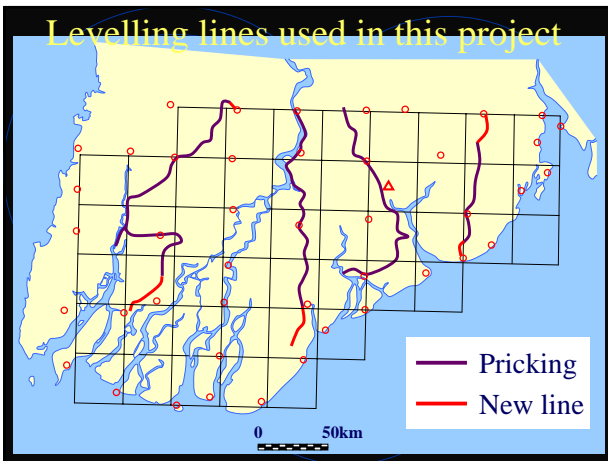
- Level : Leica NA3003
- Obs. Distance : Less than 80m
- Estimation : 1 mm
- Tolerance :  $50\text{mm}\sqrt{S}$

## Leica NA3003 and Staff



## Existing Levelling Route





## Quality Control

- All the observations were double run.
- Accuracy is checked by the discrepancy between forward and backward.
- All results were less than the tolerance  $50\text{mm} \sqrt{S}$ .

## Final Result

- All information is described in the form of “Description of Point”.

## Final Result

### Description of Point

DESCRIPTION OF PRICKING POINT			
Station No.:	UTM Zone:	Operated by:	Tim Wai
BM/MS:	47	Checked by:	Manna Manna Son
		Date:	20-Mar-2003
Coordinates and Elevation			
Point Name:	M (m)	E (m)	H (m)
Main Point:	1,892,251.477	26,9304,568	3,791
Secondary Point:	1,892,215,349	26,9330,074	3,776
Supplementary Point:			
Sketch Map		Field Photograph of Station	
Stereo-pair Aerial Photograph Pair			

## Evaluation

- This project is a photogrammetric project.
- The result is sufficiently accurate for the photogrammetric work.

## Technology Transfer

- Preparation
  - Planning of GCP distribution
  - Planning of GPS observation
- Quality Control
  - QC of GPS surveying
  - QC of Levelling

## Operation Manual and Specification

- “Operation Manual” and “Specification for Topographic Mapping” shall be prepared at the end of the project.

Thank you  
for  
your attention.