NATIONAL MAPPING BUREAU AIRPORT SURVEY

FOR

OFFICE of CIVIL AVIATION

ROBERT ROSA

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Robert Rosa

Abstract

In 1997 the Office of Civil Aviation contracted the geodetic section of the National Mapping Bureau to undertake a positioning survey of all airstrips in Papua New Guinea – a formidable challenge. GPS technology was employed for the purpose. This paper provides an overview and comparison of the expertise, manpower and capabilities of the National Mapping Bureau in the application of modern surveying and mapping technology.

1.0 Background

The Office of Civil Aviation (OCA), under Papua New Guinea Government's Free Air Space Policy, was required to adopt an international universal system of coordination for all airport locations throughout PNG. The geodetic section of the National Mapping Bureau (NMB) was instructed to carry out the required surveys.

WGS 84 was adopted as the agreed coordinate system for use by PNG and all countries using the same Free Air Space Policy. Satellite positioning was the agreed method of coordination.

2.0 Program & Planning

The size of the project and the operational cost involved warranted very detailed planning and programming. Details of each airstrip, manpower involved and period of survey were included in a planning chart to optimize the utilization of staff, time and transport expenses.

2.1.Objectives

The objectives of the project program were;

- To serve and satisfy our client (OCA) to the best of our ability.
- To ensure the project span is within the agreed time, by way of clear project plan and,
- Ensure all points required for coordination by OCA staff are positioned, including the navigational aid points.

Secondary aims were to:

- Expose NMB staff to the operation of GPS receivers and the associated GPS software for data processing,
- Facilitate on the job training for staff to gain confidence,
- Facilitate open dialogue and teamwork with other parties involved
- Facilitate some means of assessment of individual staff capability with the use of modern technology within NMB.

2.2 Project Plan

The project was divided into two Categories.
Category One was the country's major airstrips. Category Two was the minor airstrips
Transport to Category One airstrips was by commercial airlines.
For transport to the Category Two airstrips a third party, Summer Institute of Linguistics (SIL), of Ukarumpa was employed to provide fixed wing aircraft, helicopters and pilots.
A fourth party, Unitech's Surveying & Land Studies Department, was requested to provide base GPS data from Lae base station.

2.3 Project Program

The geodetic section of NMB's 1997 project program put more emphasis on this project. Strict planning of all field trips, Prism GPS processing and least squares adjustment(Newgan) made demands on all staff involved. Category One was programmed to commence early while SIL was still developing flight programs, involving more than four hundred airstrips around the country, for Category Two airstrips.

3.0 Methodology

Rapid static GPS data collection was used on this project in order to minimize time yet achieve the accuracy required while maximizing production on both Categories of airstrips. Two known coordinate base stations and a supporting 3rd base station were allowed for on all phases of the project, although two base stations are sufficient to provide coordination and a degree of check.

3.1 GPS Receivers

Five (5) Z-12 Geodetic Accuracy Ashtech receivers with all GPS observables were used. Three of the receivers were deployed in the field while two base stations continuously tracked satellites simultaneously, one based at NMB Moresby base and one at Lae Unitech base station.

3.2 Survey Application

Category One -Phase 1 & II

Specified points of coordination for all airstrips were threshold points, runway end points, reference points and navigational aid points. On each of the Category One airstrips, 26 across the country, three GPS receivers were used. Two were recording continuously to provide base coordinates, while the third was employed as a rapid static rover. To determine the coordinates of the specified points required that a GPS rover receiver was set up and observation periods of 10 to 15 minutes were made.

Category Two - Phase III

Specified points to be coordinated of serviceable strips (more than 400 country wide) was the position of the windsock. The pilot and the GPS operator visited all the strips along a flight program route. Positions as close to the windsocks as possible were obtained and radiation with compass and tape were used in order to compute the true position of the windsocks. One NMB officer would fly to a town/city within the area of work to occupy a base station with known Geodetic coordinates. The other would fly with the rover, visiting all the planned strips and setting up the GPS to collect data. Rapid Static methods were again employed with 15 minutes of GPS data being recorded for each point.

4.0 Computations & Output Analyses

All individual members of the field party had some input in the computation of GPS data and the final Newgan least squares adjustment.

4.1 Prism Processing

The processing of satellite data was undertaken using Ashtech Prism version 2.0 software. Three techniques of processing in Prism were used depending on the data;

- Static wide lane – for longer baselines, especially from Port Moresby and Lae.
- StaticL1 only – for connection to nearby towns (less than 30 kilometres)
- PNAV – kinematic software – for Rapid Static reduction.

Not all of the data resolved easily to give good solutions, so many processing options were employed. Changing atmospheric corrections, elevation masks, omitting satellite (SV's) and cutting off raw data where cycle slips appeared, was undertaken to obtain optimal processed data.

4.2 Newgan Least Squares Adjustment

Newgan offered the true assessment of Prism processed data. The best processed GPS data with good **RMS** and shift on **X, Y & Z** does not necessarily fit on triple baseline in **REFORM**. The reformed data is tested again in **MAXIMUM**, and if it does not pass the test reprocessing in Prism was required.

The output results indicates error ellipses (measure of accuracy) or standard deviation on all the points i.e. PNG94 Latitude, Longitude and the Height on the Geoid (Kearsley model).

The final output of all the coordinated airstrips for the whole country includes 26 in Category One and 110 in Category Two.

5.0 Assessment of NMB's Capabilities.

The project itself enabled some means of assessment of our geodetic section staff and capabilities with modern technology.

5.1 Manpower

The geodetic section comprises 50% graduate surveyors and 50% survey technicians. Of the graduate surveyors, none was a recent formal graduate from Unitech's present GPS courses introduced in Surveying & Lands Studies.

5.2 GPS and Modern Surveying Technology in NMB

Satellite positioning technology was first introduced to PNG in NMB. First with the Doris satellite positioning system, then Transit Doppler , which utilized WGS 72. In 1993 NMB obtained Ashtech GPS receivers from the Australian Government through the ACLMP program, becoming the first Government organization in PNG to introduce the modern surveying technology. The introduction of this technology enabled substantial projects to be undertaken. Some of these were the geodetic network strengthening for PNG, crustal motion studies, border mapping etc.

6.0 Conclusion

This paper is a report on the project and presents my analyses of the capabilities of the geodetic section of the National Mapping Bureau. The section performed very well on this extremely challenging project, providing very satisfactory data within the required time period.

Taking into consideration the manpower and the level of technical expertise (5.1), with modern technology (5.2), in the National Mapping Bureau, I am more than satisfied to see high degree of achievement. NMB has achieved very good results on large and complex projects.

Improvements could be achieved with the recruitment of recent University graduates who have already received significant training in GPS surveying and other modern mapping technology.

The OCA project was a great success for SIL, Unitech and NMB staff, through collective team effort, dedication and commitment.