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THE MILITARY LAND SURVEYOR IN AN OPERATIONAL ENVIRONMENT, EAST TIMOR

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ABSTRACT

The Australian Defence Force (ADF) employs surveyors in a number of highly challenging and diverse disciplines; extending from hydrographic surveying to the more traditional roles of the engineer and land surveyors. Every surveyor has work in extreme environments at one time or another throughout their careers, however the military surveyor has one additional obligation and that is they are soldiers first and surveyors second.

The 1st Topographical Survey Squadron (1Topo Svy Sqn) is the only unit in the Australian Defence Force (ADF) that is capable of providing unique geomatic support to ADF headquarters and units in the battlefield. In 1999, the Squadron deployed a Geomatic Support Group with a geodetic section as part of the ADF's commitment to the International Force in East Timor (INTERFET) on Operation Warden.

This paper is an overview of the work carried out by the geodetic section and discusses the tasking and environmental issues, which had to be resolved in order to provide geodetic control within the Area of Operation.

KEYWORDS: Geodetic Survey, Geomatic Technician, GPS, and Military Surveyors

Background

The Portuguese, closely followed by the Spaniards in 1522, first settled Timor in 1520. The Dutch and the Portuguese fought for supremacy over Timor until Portuguese sovereignty over East Timor was settled by treaties in 1859 and 1893 (this one did not take effect until 1914). During World War II the Japanese forces occupied the island of Timor (although as a Portuguese colony was officially neutral) until repelled by Australian and Dutch Soldiers.

In 1974, Portugal was declared a democracy and independence was given to all Portuguese colonies. East Timor declared itself as independent on the 28th November 1975 as the Democratic Republic of East Timor. Within nine days it was invaded and occupied by Indonesian Forces and subsequently declared as the 27th Province of the Republic of Indonesia, the United Nations disputed the legality of this.

During the course of 1999 International pressure on Indonesia to grant independence to East Timor increased significantly, resulting in a United Nations sanctioned ballot on the 30th August 1999. The ballot returned the result of an overwhelming majority of 78% in favor of independence from Indonesia.

The Indonesian Government to declare a state of emergency and invoke martial law in the troubled province on 7th September 1999. Non-essential United Nations staff and other expatriate civilians were evacuated from the country by the Australian Defence Force.

On the 12th September 1999 an international peace keeping force was invited by the Indonesian President, Mr. Habibie to assist in restoring security. The International Force In East Timor (INTERFET) was established on 15th September 1999 with Australia as the lead nation.

On the morning of the 20th September 1999, the first sorties of INTERFET Troops arrive in East Timor. This was to be the start of the largest Australian military operation since World War II and would see a total of 5700 Australian Troops deployed to the theatre of operations.

As the lead nation for INTERFET, the Australian Defence Force was responsible for the provision of Military Geospatial Information (MGI) and MGI Support. This was achieved by deploying a Geomatic Support Group (GSG) consisting of elements of the 1st Topographical Survey Squadron. The Squadron deployed its advance parties into East Timor on 22nd September 1999 with the main body deploying 5 days later. The GSG was to provide all geomatic support to INTERFET for the duration of the operation.

The GSG consisted of a total 42 personnel manning the following:

- A Headquarters element (consisting of 3 officers and 5 soldiers);
- A Reprographic Cell (consisting of 2 soldiers);
- An MGI support Cell (consisting of 18 soldiers);
- A Product Distribution Point (consisting of 4 soldiers);

- An Imagery Acquisition Cell (consisting of 4 soldiers); and
- A Geodetic Survey Cell (consisting of 6 soldiers).

Geomatic support to the ADF, as provided by 1 Topo Svy Sqn, includes the provision of:

- Geodetic and Topographic Surveys.
- Terrain Analysis and Visualisation.
- Image Acquisition and Exploitation.
- In-Theatre Map Updates and Advice.

The provision of Geodetic and Topographic Survey involved the establishment of a Geodetic Control Network, the conduct site surveys and provision of geomatic advice. The establishment of a Geodetic Control Network involves the provision of position and azimuth information on a common geodetic datum (usually WGS 84 and Local MSL) and grid reference system (usually UTM).

The primary purpose for having a common datum within a military environment is to enable all related military forces to be operating off a common base for the coordination of weapons systems, tracking the locations of all deployed elements and for navigation purposes.

Upon the arrival of the INTERFET forces, the Militia Forces disbanded and fled to West Timor, leaving a trail of destruction. The number of Indonesian Military Forces in East Timor had been greatly reduced, although a number of military compounds in Dili were still occupied. Initial searches conducted by INTERFET and Non Government Organisations (NGO's) personnel revealed that the majority of the civilian administrative infrastructure had been looted and in most cases burnt. All government offices and communication networks seem to be primary targets. As such the availability of geodetic control information was very poor.

Of benefit, however, was the fact that Australia had copies of most of the Indonesian maps of East Timor that had been originally printed in Australia as part of the Defence Cooperation Program in the late 1970's. These proved valuable for the provision of initial mapping support to INTERFET, but provided little help for the establishment of the geodetic control network required for the control of VMAP Level 1 and DTM construction from remote sensing sources as well as for the revision of base mapping.

Arriving In Country

Selected members of the GSG (including the Geodetic Survey Cell) arrived in Darwin on the 21st September 1999 by C130 Hercules. An advanced party was identified to fly into Dili the next day, less than 72 hours after the first INTERFET troops. All members were issued live rounds; little did they know at the time that the same number of rounds issued would be returned to the logistics personnel prior to their departure some four months later.

The advance party landed at Dili Airport at dusk. As the rear doors of the C130 Hercules been open, all occupants were hustled on to waiting transport for the quick dash to the Dili Library (the future site of the INTERFET HQ). On the arrival members were brief on security of arrangements and allocated sleeping places. The next morning everybody is hands-on cleaning up the Library, which had been ransacked and burnt in a number of areas by attempts to fully destroy the building.

Just before lunch members of GSG found themselves patrolling out of the Library compound to secure the Indonesian Army (TNI) Barracks, located approximately 500 metres east. The purpose of this patrol was to ensure that the Indonesian soldiers that were waiting for transport out of East Timor did not further destroy the limited facilities of the barracks. Security patrols were maintained throughout the night, next morning clean up of the barracks begun. The pattern of securing, patrolling and cleaning up was to continue for the next week until the remaining members of the GSG and their equipment arrived. The GSG setup its operational base with an American Communication Contingent in the Dili Campus of the Timor University, just across the road from the Library.

Establishing a Geodetic Network

Planning for the establishment of a Geodetic Control Network had to include all of the three areas of East Timor, including the eastern half of the island of Timor, the Island of Atauro and the small enclave of Ocussi. The disconnection between these areas were to cause a number of logistical and security concerns for the survey teams.



(Encyclopaedia Britannica)

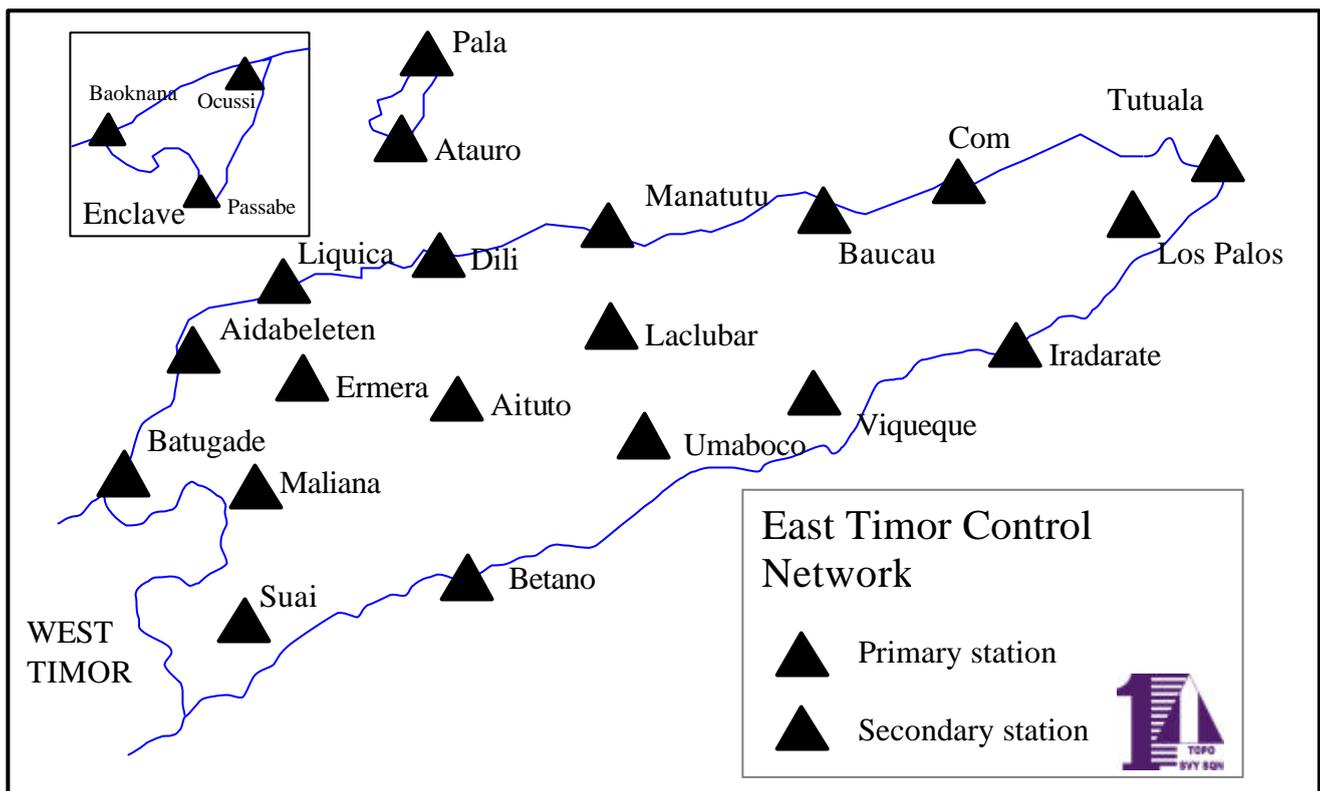
Horizontal Control

To determine a start point for the Control Network a baseline was established between an existing monumented station at Dili Airport and a newly established point in the Tennis Courts at the Baucau Airstrip. These locations were selected to due to their separation of

90km (which was close to the optimal distance of 100km), their central location to the island and the availability of security forces for protection for the extended observation periods. A third point was also positioned on the roof of the University to provide a reference point for differential point positioning to support Topographical Surveys around Dili.

All points were observed over a 24-hour period with a collection rate of 30 seconds. Due to travel restrictions and security concerns the observations were taken over a period of 16 days. The University Station was observed on the 2nd October 1999, 10 days after the arrival of the GSG advanced party. The Dili Airport Station was observed on the 5th October 1999 and the Baucau Station on the 18th October 1999.

Prior to departure to East Timor arrangements had been put in place to secure support from Australian Surveying and Land Information Group (AUSLIG) to post-process the data with the Australian Regional GPS Network (ARGN) and the International GPS Service (IGS). Data for the 24-hour occupations was post-processed by two means to determine absolute coordinates. This resulted from lack good communication lines to the supporting elements in Australia.



The initial post-processing was achieved in country using the Darwin, Ceduna and Karratha ARGN station data downloaded from the AUSLIG Internet Site. Final coordinates for the stations were provided by the Space Geodesy Analysis Centre, Geodesy Program, AUSLIG, with an estimated accuracy of better than 5cm in the East, North and Up components in ITRF96. All data was processed by AUSLIG and received by the

deployed forces within 3 weeks of the initial observation date. This was an excellent result considering the delays experienced in the delivery of the data to and from AUSLIG.

From the initial baseline a further 10 primary control points were established. These included 3 points in the Ocuasi Enclave, 2 points on the Island of Atauro and an additional 5 point within the mainland. These points would then serve as a basis for the further densification of the Secondary Control Network. The selection of the locations for all the survey stations was based on the security of the survey teams and being readily identifiable on remotely sensed image. Some consideration was given to the geometry requirements of the network.

All GPS observations were conducted using three Trimble 4000SSE Dual Frequency Geodetic Receivers. All stations were occupied at least twice with 90% having 3 occupations. Each occupation consisted of a minimum observation time of 2 hours and a 15 second collection rate.

Vertical Control

In order to determine geoidal heights for the Geodetic Control Network was adjusted using the Geoid Model WW15GH (Id No.3). This model was selected because the AusGeoid Model did not have sufficient coverage to include East Timor.

In order to supplement the height determination a comparison was conducted between sea level connections that were performed at a number of locations around the Island. Sea level observations using spirit leveling were achieved at Batugade, Aidabeleten, Dili, Com, Iradarate and Betano on the East Timor Mainland; Pala and Atauro on Atauro Island; and Boaknana in Ocuasi Enclave.

Initial calculations for the sea level connections were performed using the Australian Hydrographic Office (AHO) tidal predictions based on old tidal charts and tidal data. On the 15th November 1999, Lieutenant Ross Bowden, Royal Australian Navy visited the GSG and requested GPS support. This was the first indication that the Geodetic Section knew of the work being carried out by the Hydrographic Office's Detached Survey Unit (HODSU). HODSU had been conducting Beach Surveys and had established temporary tidal gauges at Suai, Dili and Com Ports.

A return visit on the 28th November 1999, enable them to provide more accurate data for the tidal predictions for the observed sea level connections. The HODSU and Geodetic Survey Cell also conducted simultaneous GPS observations to connect the Dili Tide Gauge to the Geodetic Control Network, thus assisting in the determination of the block shift between the local datum and WGS84.

Adjustment Results

The adjustment of the network achieved a very satisfactory result, with all points within the network having error ellipses of less than +/- 10cm in horizontal and +/- 25cm in vertical. The procedures used in East Timor to establish the survey control network were undertaken in accordance with a Class 2A survey as defined in the *Standards and Practices for Control Surveys (Special Publications 1) Vers 1.3* produced by the Intergovernmental Committee on Surveying and Mapping (ICSM).

Geodetic Station Summaries for all stations were produced using Microsoft Access. Each station summary contains adjusted coordinates (both UTM and Geographical Coordinates), Control Net Diagram, Location Map (1:25 000), Aerial Image, Terrestrial Station Photo and Station Recovery Sketch. Coordinates were provided for the eastern end of the island in both UTM Zone 51 and 52, as previously the whole island had been mapped within zone 51. The furthestmost point coordinated was at a Longitude of 127° 16'.

Motaain

On Monday the 11th October 1999, the Australian newspapers reported the exchanged of fire between UN-backed intervention forces and the Indonesian Security Forces. The incident involved a mixed up over the border between East and West Timor near the border post of Motaain, located approximately 3 km West of Batugade on the North Coast. Indonesian forces had fired first and the subsequent return of fire killed an Indonesian Policeman.

The Geodetic Survey Cell was placed on a *30 Minutes Notice To Move* on the 12th October 1999. Two days later the Survey Team was airlifted to a creek bed 900 metres East of Batugade, where they were escort to within 800 metres of the Motaain border post. After a short wait the team was invited forward to complete site survey over the 500 by 300 metres incident site. On approaching the border post, the survey team was faced with approximately 300 on lookers and 30 photographers, both civilian and military, on the western side of the border post.

An initial baseline was established using GPS connected to the Dili Airport Geodetic Station. Site information was collected using a Total Station, with all observations be manually recorded for the one off occasion. After 3 ½ hours of the survey teams arrival, they were politely informed that time was up. Within 2 hours the survey team had been returned to Dili.

As the coordinates for the Dili Airport Geodetic Station had not been received from AUSLIG. It was be 3 days before the final plan would be presented to INTERFET HQ. The coordinates for the Motaain baseline were determined using data downloaded from the AUSLIG website. These coordinates were later re-calculated using AUSLIG coordinates for Dili Airport and the difference between the results were in the order of 60cm. A local arbitrary height was adopted for the Vertical Control of the Site Plan.

It was later reported that the incident did occur within East Timor however the Indonesians suggested that the Australian Soldiers were only 100 metres from the border and not, as they believed, 800 metres.

Closing

The Geodetic Survey Cell achieved excellent results on all tasks. They established a three dimensional geodetic network in East Timor at a level of accuracy suitable for all military operations, and for subsequent densification and mapping. They also provided timely Topographic Survey products and advice to INTERFET HQ.

All members of the GSG were re-deployed to Brisbane prior to the successful transfer of operations from the Australian led INTERFET to the United Nations Transition Assistance – East Timor (UNTAET) peacekeeping force.

Currently 1st Topographical Survey Squadron maintains a two-person detachment Balibo in support of Australian Forces deployed in East Timor.

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