

Survey for Proposed New Station Site in Antarctica

S.P. Kestwal and Arun Kumar

Survey of India, Dehradun

Introduction

The Survey of India has been associated with the Indian Antarctic Research Programme since X expedition to carry out mapping task in Antarctica. During X expedition geodetic control points had been established in Schirmacher Oasis. In XI & XII expeditions the original plane table (PT) survey work had been carried out on 1:5,000 scale with 5 m contour interval using the control points established by the SOI team of X expedition. During these two expeditions, an area of 3.2 sq. km. was covered by survey teams.

From XIII expedition onwards (except XVII) SOI teams have been doing original PT. survey on 1: 1,000 scale with 1 m contour interval.

During XVII expedition study of Antarctica plate movements with reference to other plates, had been carried out.

Objectives

The scientific team of Survey of India during the XXI Indian scientific expedition, Austral Summer 2002, reached Antarctica with the objectives to prepare a large scale map covering an area of 500m x 400m on scale 1:1,000 with 1m contour interval, for establishing the new Indian Research Station. One site was already surveyed by survey team during XX Expedition. This site, which was about 5 Km west of Maitri has undergone physiographical changes, was not found suitable for the proposed station. A new site which is adjacent to the Priyadarshini Lake was finally selected jointly by Director, NCAOR, Goa, who was an observer of DOD and by the team leader of XX ISEA.

Data Used

SI. No.	Station	Easting (in metres)	Northing (in metres)	Height (in metres)	Remarks
1.	MAITRI S	1000000.00	500000.00	117.0	-
2.	TRACKS	1000131.92	499530.64	126.1	-

Instrument Used

- (i) E.D.M. instrument DI 3000S
- (ii) Theodolite Wild T-2
- (iii) Prismatic Reflector
- (iv) Traverse Staves
- (v) Plane-Table with stand & level
- (vi) Clinometer
- (vii) Sight Rule
- (viii) Thermometer
- (ix) Barometer
- (x) Clinopole

Reconnaissance

A reconnaissance was carried out of whole area and some old points were traced out. New stations and offsets were marked on the ground to fulfil the requirements of plane table surveying. Traverse stations are named as 21E1, 21E2....etc. and offsets were marked as 2101, 2102 ...etc., to avoid confusion between other old points.

Despite of bad weather it was felt necessary by SOI team, to increase the length of survey area from 500m, to 600m, so as to cover the whole area, for new upcoming station.

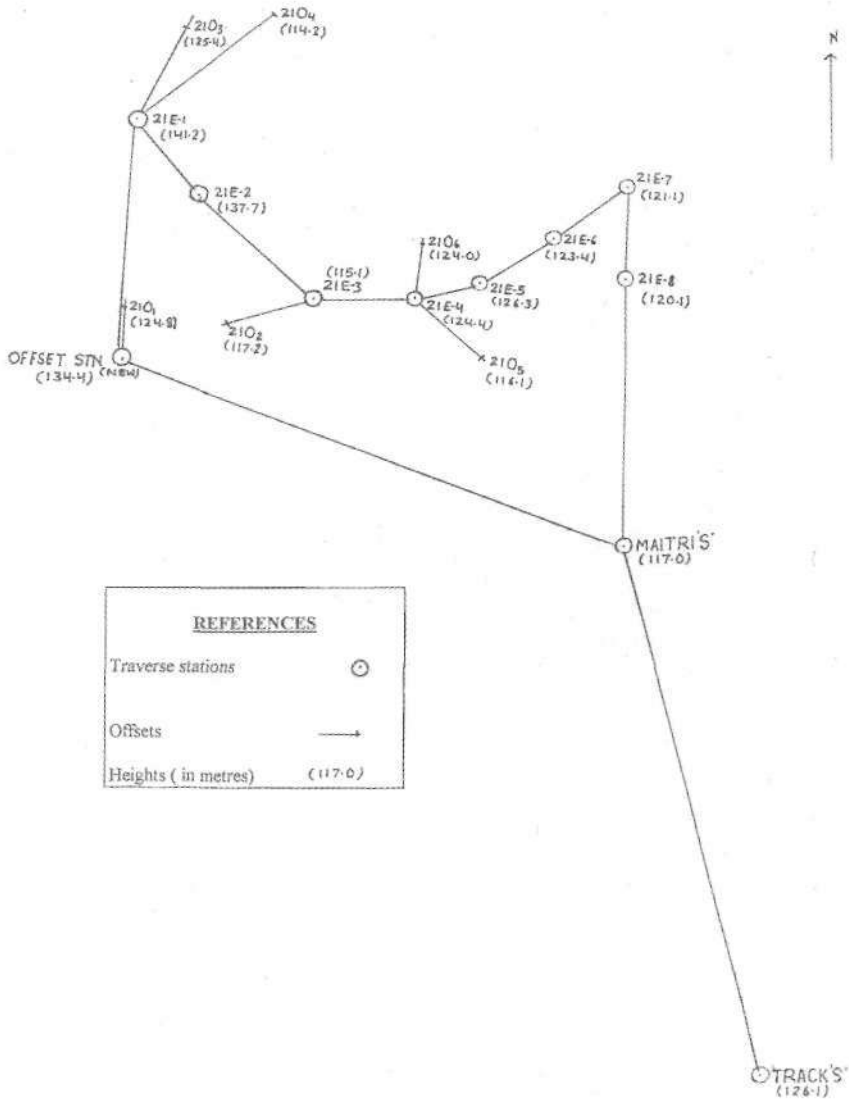
E.D.M. Traverse

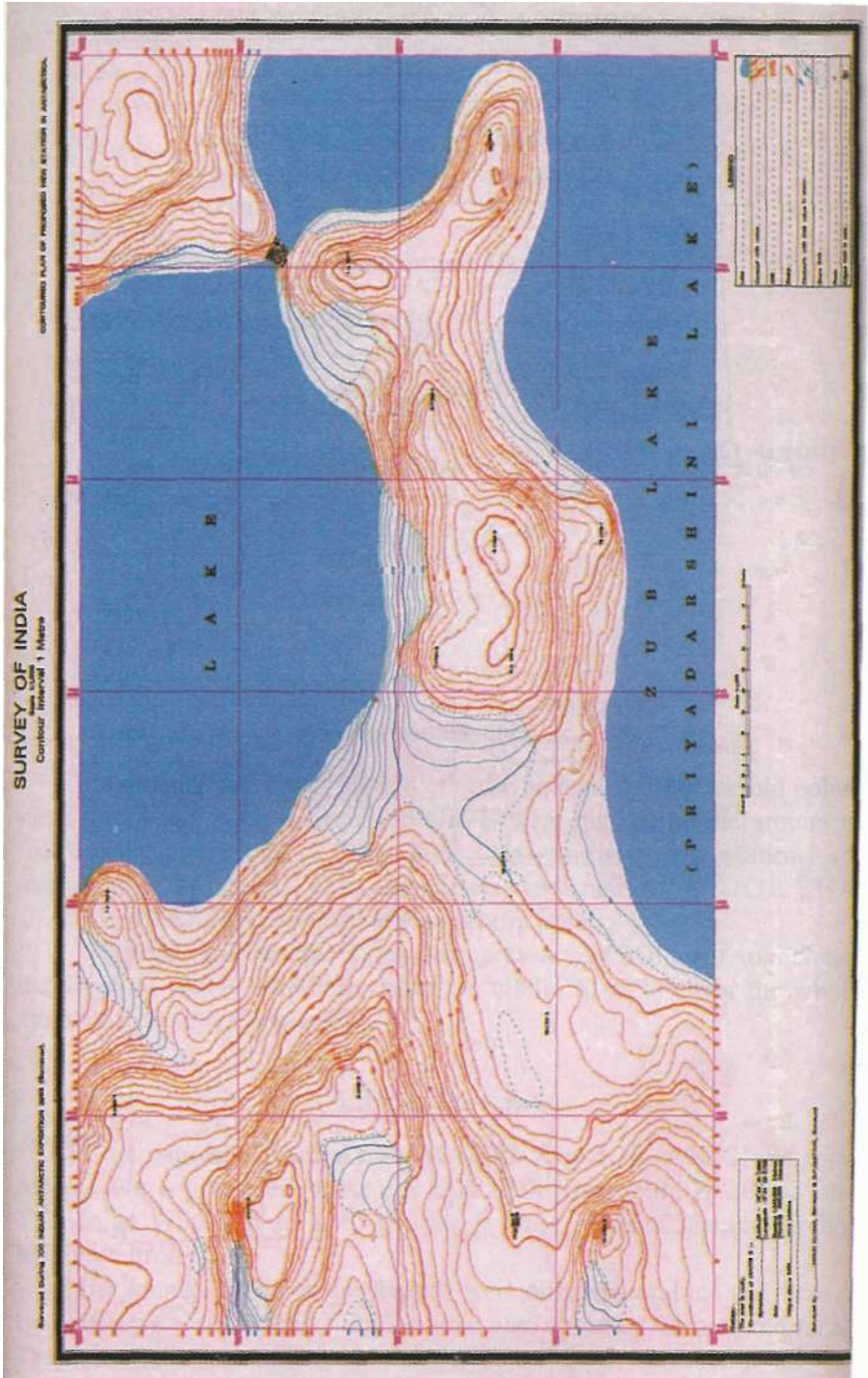
A main traverse was run from MAITRI'S' and TRACK 'S' and some offsets were provided by using E.D.M. Instrument DI 3000S and Theodolite Wild T-2, so as to provide a dense mesh of planimetric and height control.

Horizontal Angles to the stations were observed on both the faces at two different zeros. Vertical angles were also observed on both the faces. Traverse legs were measured with calibrated E.D.M. instrument.

CHART SHOWING E. D. M. TRAVERSE IN ANTARCTICA

Scale 1: 000





Computations

In angular observations, mean of both faces were accepted for computations. Similarly mean of reciprocal vertical angles had been accepted for computing heights; whereas in linear measurements mean of six measurements had been taken. Mutual computed known bearing of starting and closing stations were used for computing co-ordinates of stations.

Computations were carried out in the field itself on appropriate departmental forms using scientific calculator.

Contour Survey

An arbitrary grid mesh of 5cm projected on the cloth mounted blank P.T. section. Co-ordinates of all traverse stations and offsets were plotted on this P.T.section. The positional accuracy of all traverse stations and offsets, plotted on PT were confirmed before commencing the detail survey. The control points were used as fixing to intersect the existing details and to chase contours at 1m interval. The contours were chased on the ground with the help of clinopole and clinometer. Heights of 384 points had been computed for this purpose.

Fair Drawing

Inking of details and contours were completed in field itself. All Survey of India standard symbology were used in fair drawing. Necessary records were maintained as per the departmental procedure. As there was no cultural detail, hence only height trace was maintained.

Results

(i) Closing error in bearing	-22"
(ii) Closing error in Easting	+ 0.28m.
(iii) Closing error in Northing	+ 0.17m.
(iv) Closing error in Heights	+0.35m.
(v) No. of Traverse stations	11
(vi) No. of Offsets	6
(vii) No. of heights determine by clinometer	384
(viii) Area surveyed on 1:1,000 scale with 1m C.I.	0.24 sq. km

Conclusion

Expedition faced very bad weather condition since beginning. Snowfalls, blizzards and high speed chilled wind marred many days. Hardly 15 good working days were available for carrying the job assigned. Even in these good working days wind-chill factors never gone up above -20° C. Holding clinopole and carrying P.T. work in such chilled windy climate was very challenging job. We feel proud that we had accepted this challenge keeping national interest in mind and completed more than assigned field job successfully. In addition to this, considering urgency of NCAOR regarding map, we had digitised the map in record time. Two hard copies of this were already sent to NCAOR with the preliminary report.

Few Suggestions for Future

(i) Mapping of whole Schirmacher Oasis: Surveying of whole Schirmacher Oasis (Area approx. 34 sq. km.) should be done either on 1:5,000 or on 1:10,000. It will fulfil requirement of scientist community. By surveying on 1:5,000 with 5m contour interval, the map of Schirmacher Oasis can be prepared on three different scales i.e. on 1:5,000, 1:10,000 and 1:25,000.

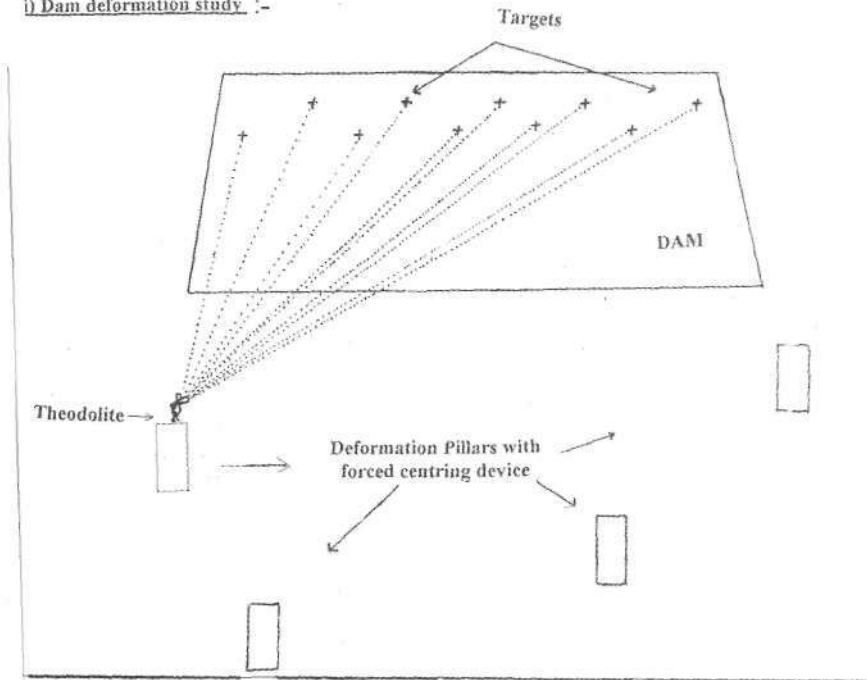
(ii) Mapping of whole Antarctica: Director, NCAOR, Goa had informed SOI team at Maitri that aerial photographs are available at NCAOR. Model control points can be provided on the ground and can be post- pointed. These photographs can be make used for preparing of Air Survey Section. As the area is not having any cultural details; only contouring can be verified and corrected. It may take two to three years to complete the mapping of Schirmacher Oasis. So , if aerial photographs are available then a map of whole Antarctica can also be prepared quickly , because SOI has very advance technique of making maps by using aerial photographs.

(iii) GPS convey-route survey: A convey-route chart is always felt necessary for logistic team of expedition. A GPS route survey chart may be prepared to help them. This exercise can be done in single expedition with only two GPS sets. Satellite unit of Geodetic & Research Branch is doing GPS work since more than a decade. It has developed its own methodology for accurate output.

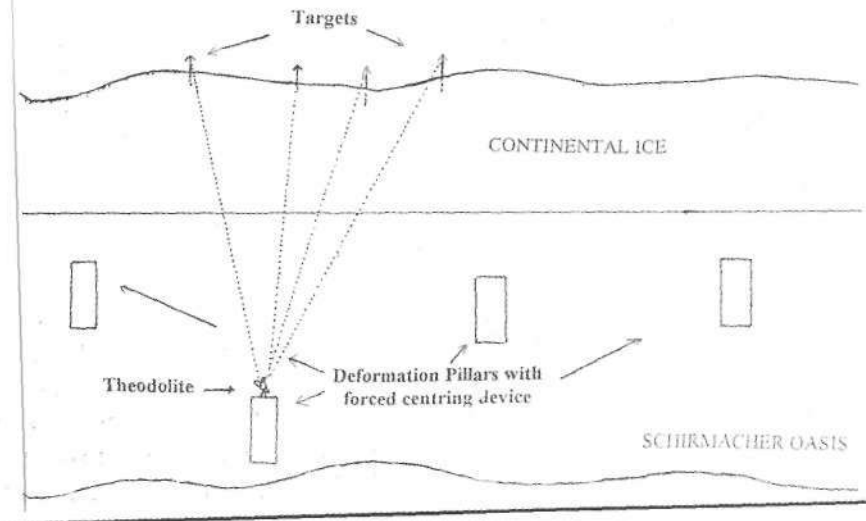
(iv) Glacier movement study: Geodetic & Research Branch of Survey of India has been playing important role in various national/ international Hydro-Electric Project where high order of accuracy required.

GLACIER MOVEMENT STUDY ON THE PATTERN OF DAM DEFORMATION STUDY

i) Dam deformation study :-



ii) Glacier movement study :



Dam Stream Deformation Study is such type of work in which some points, marked on dam Axes/Down Stream face are observed at a regular interval, with Theodolite Wild T-3 by taking utmost care. It was felt by the SOI team that almost similar technique can be adopted to observe three dimensional shifts in glacier. (Illustration is being attached here with this report)

(v) Geophysical survey work: To determine Geoidal Separation* in Antarctica, deflection exercise of astronomy may be carried out. There is a separate unit in Geodetic & Research Branch, which is doing this type of Geophysical work.

(vi) Tidal observation: Height of Maitri 'S', which was determined by SOI participants of X expedition, was based on Instantaneous observation of mean sea level (IMSL). Though this is adequately accurate for purpose of mapping in Schirmacher Oasis, but in future, for various research works based on level, necessity of precise mean sea level net may be required by scientific community. The precise level net will be based on long term observation of tide-gauge. Tidal unit of Geodetic & Research Branch had established tidal observatories at almost all the major ports of country. It is the only organization of India which is doing the systematic observations of tides. It has authorized by the Govt, of India to publish National Tide Prediction Tables. So, for precise MSL heights the feasibility for tidal observations, using tide gauge, may be discussed with DOD.

So, it is clear from above that Survey of India is not only the oldest scientific department of India but also the only scientific department of India which has interference in so many fields apart from mapping such as crustal movement studies astronomy, gravity, magnetic, tidal etc. So in future importance of SOI cannot be ignored in Antarctica Research Programme.

Acknowledgment

Participants are thankful to Surveyor General of India for providing us the opportunity to participate in XXI Indian Scientific Expedition to Antarctica and are also thankful to Director, G&RB for recommending the names for the expedition. We acknowledge the encouragement and guidance of Brig.(Dr.) B. Nagarajan. Dy. Director (Sel. Gde.), G&RB. We are also thankful to O.C. No. 82 Party (G&RB) for providing us technical, logistic and administrative support.

*Geoidal separation: It is the difference between geoid and spheroid.

We are thankful to Dr. P.C. Pandey, Director, NCAOR, who happened to be with our team, for keeping our morale high during our voyage and stay in Maitri. Special thanks to Mr. Bhaskar Rao, Director, Logistic, NCAOR, for his caring attitude, who was always in touch with our families in India through his letters.

Shri. R.R Lai, leader of XXI Indian Antarctica Expedition, and his logistic team also deserve our thanks for providing us logistic support during work.

POINT -LIST

Sl.No.	Stations	Easting (In metres)	Northing (In metres)	Height (In metres)	Remarks
1.	MAITRI 'S'	1000000.0	500000.0	117.0	Old stn.
2.	TRACK 'S'	1000131.9	499530.6	126.1	...Do...
3.	Offset Stn.	999544.1	500168.0	134.4	
4.	21 E-1	999554.0	500393.7	141.2	
5.	21 E-2	999611.5	500324.5	137.7	
6.	21 E-3	999718.5	500234.2	115.1	
7.	21 E-4	999812.2	500228.9	124.4	
8.	21 E-5	999869.6	500239.8	126.3	
9.	21 E-6	999936.6	500279.6	123.4	
10.	21 E-7	1000000.5	500332.8	121.1	
11.	21 E-8	1000057.9	500243.7	120.1	

OFFSETS

1.	21 0-1	999545.9	500225.7	124.8	
2.	21 0-2	999642.5	500205.5	117.2	
3.	21 0-3	999602.5	500477.2	125.4	
4.	21 0-4	999698.8	500482.7	114.2	
5.	21 0-5	999873.1	500171.3	116.1	
6.	21 0-6	999814.0	500276.9	124.0	

Descriptions of Traverse Stations

A. MAIN STATIONS:

OFFSET STATION (NEW) : O cut on a rock in situ on a small hill , NW of Maitri station, it is about 200m south of summer convey route and about 100m west of Priyadarshini lake.

21E-1: O cut on a rock on a hill about 750 m NW of Maitri station, about 200m west of a lake.

21E-2: O cut on a rock in situ on the west end of east-west running hill top. It is about 700m NW of Maitri station, about 150m SW of a lake and about 250m NW of Priadarshini lake.

21E-3: O cut on a flat rock in situ on the plane ground about 125m NW of west end of Priyadarshini lake, about 180m south of another lake. It is about 125 meter west of a flat hill top.

21E-4: O cut on a stone in situ on the west end of a flat top just 500 m north of Maitri base . It is about 70 m south of Priyadarshini Lake.

21E-5: O cut on a rock in situ on the top 500 m north of Maitri station. The station lies in between two lakes.

21E-6i O cut on a big boulder at the NE end of a low top. The station is about 500 m north of maitri. The top (station) lies in between two lakes.

21E-7: O cut on a stone at the north end of a low flat top. It is about 600 m NE of another small top which is surrounded from three sides by Priyadarshini lake.

21E-8: O cut on a rock in situ near East end of a small top which is about 500 m NE of Maitri station. The top is surrounded by Priyadarshini from three sides.

B. OLD STATIONS:

MAITRI S: O Cut on a sheet rock which is surrounded by a concrete circular platform of 1.5 m diameter. The point is situated on the south edge of Priyadarshini Lake. It is situated about 250 m north of Maitri station about 50 m NNW of kitchen hut (Annapurna) at Maitri.

TRACK S: O inscribed on a round shaped rock which is located in a very small elevated top south of lake and nearby the track connecting Russian station and Maitri. The station is about 400 m East of Maitri hut.

C. OFFSETS:

210-1: O painted in red on a boulder about 1 m height, about 550 m NW of Maitri S.

210-2: O painted in red on a rock 100 m north of Priyadarshini lake and 150 m SW of another lake.

210-3: O painted in red on a rock, about 800 m NW of Maitri and 100 m west of a lake.

210-4: O painted in red on a rock, situated on the low mount on western edge of a lake.

210-5: O painted in red on a rock on low mount situated on the north and west edge of Priyadarshini lake, about 400 m north of Matiri.

210-6: O painted in red, on a rock on low the northern side of hill, which is situated on southern side of lake, it is about 125 m of Priyadarshini lake.