

GEODETIC SURVEYING IN NEPAL

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ABSTRACT

In 1980, one quadrilateral base line and two levelling lines were set at Dana and Kerabari, central Nepal. For the determination of fault movements along M.C.T. and M.B.F. repeated surveying was planned. In this paper, dispositions of surveyed points and the results of the first survey are reported. The next survey is scheduled in 1984.

INTRODUCTION

This geodetic surveying program was carried out in the central part of Nepal, as a subproject of the study project entitled "Studies on The Crustal Movement in the Nepal Himalayas". This surveying program was executed especially to estimate the uplifting rate of the Himalayas in the present days.

As known well, there are two big fault systems stretching along the Himalayas; the northern one is Main Central Thrust (M.C.T.) and the southern one is Main Boundary Fault (M.B.F.).

For the study of the fault movements the method of repeated surveying was adopted. In November and December 1980, the stations were set and the first survey was carried out.

The next survey is scheduled in 1984.

METHOD AND INSTRUMENTS

1) Stations

The stations had to be fixed to the ground. Stainless-steel poles with cross mark on its head, with a diameter of 15mm and 180mm long, were used for the marks of the stations.

They were buried in the hole digged in the bedrock and were fixed with cement. These poles were used for quadrilateral base line and levelling lines in common.

2) Quadrilateral Base Line

A quadrilateral base line was set to estimate the horizontal fault movement of M.C.T.. Each distance between two stations was measured with the electro-optical distance meter and the prismatic reflectors. At the same time, vertical angles for distance correction were observed with the precision theodolite. Meteorological measurements for correction were done at the point where distance meter was set and at its diagonally opposite point. The measurements were carried out in the night; 6times for each side (but 8times for D2-D4).

In Table 1., D is the mean straight distance between two stations in m, M is the mean square error in mm, which is shown as the following;

$$M = \left\{ \frac{\sum (d_i - D)^2}{N(N-1)} \right\}^{1/2}$$

where d_i ($i = 1 \sim N$) is measured distance data, N is the number of data. Probability that most probable value is contained within $(D \pm 3.18 M)$ is more than 95%.

Electro-optical distance meter; AGA Geodimeter Model 6 No. 6733
Precision theodolite; WILD T2 No. 160912

3) Levelling Lines

Levelling lines were set to estimate the vertical displacement of M.C.T. and M.B.F.. The relative height between each neighbouring stations was measured by precision levelling.

The following items are common for Table 2. and 3..

Forward and backward measurements were carried out for each segment divided with neighbouring two stations to check the results. The permitted limit of the discrepancy is shown as the following;

$$E = 2.5 \sqrt{L}$$

where E is the permitted limit in mm and L is the segment length (or the distance between the stations) in km.

There are four relative heights for each segment because of two relative heights for each one way levelling. The mean square error is shown in the same way as the following;

$$M = \left\{ \frac{\sum (h_i - H)^2}{N(N-1)} \right\}^{1/2} \quad (i = 1 \sim 4)$$

where M is the mean square error, h_i is relative height data, H is the mean value of four relative heights and N is the number of data. In this levelling, $N = 4$. Probability that the most probable value is contained within $(H \pm 3.18 M)$ is more than 95%.

The ratio, D/E is a kind of index that shows whether the measurement is carried out successfully or not. Now D is the discrepancy and E is the above-mentioned limit of the discrepancy. If D/E does not exceed 100%, the levelling for the segment is considered to have been successfully.

Level; Carl Zeiss JENA Automatic Geodetic Level NI002 No. 426792

Staff; Carl Zeiss JENA Staff with Invar tape No. 54235, 54236

OBSERVATION SITES AND RESULTS

Two observation sites were selected in the central part of Nepal. One is DANA near M.C.T., and the other is KERABARI near M.B.F..

1) DANA

Dana is situated in lat. $28^{\circ}39'N$. and long. $83^{\circ}39'E$., on the way to JOMOSON.

Date; 15-18 Nov. 1980 [Quadrilateral Base Line]

21-28 Nov. 1980 [Levelling]

A levelling line of 3km, D5-D9 was also set across M.C.T.. It was subdivided into four segments by the stations.

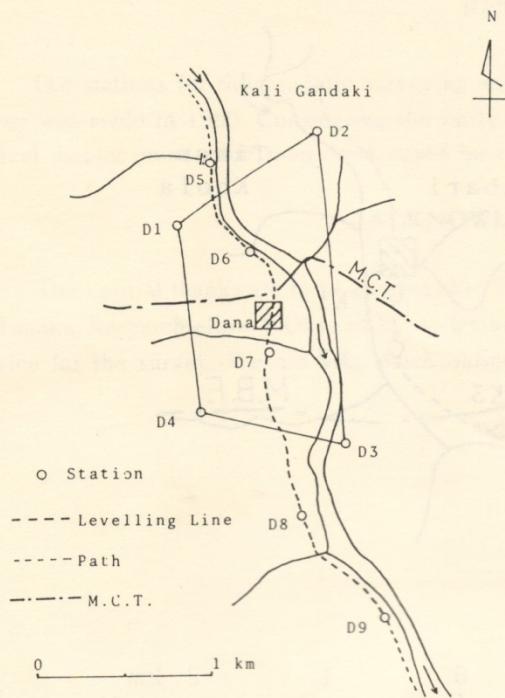


Fig.1 shows the stations in DANA, which were named as D1,2,3,...9. A quadrilateral base line composed of four stations (D1-D4) was set just over M.C.T.. The results are shown in Table 1.

Table. 1 Results of the measurements for quadrilateral base line at DANA. Items have been mentioned above.

Side	Distance(m)	M (mm)
D1-D2	985.667	2.5
D1-D3	1489.518	3.1
D1-D4	1012.439	2.7
D2-D3	1754.913	6.2
D2-D4	1718.921	4.7
D3-D4	815.057	0.9

Table. 2 Results of the levelling at DANA. M is the mean square error. D is the discrepancy. S is the segment length. Items have been mentioned above.

Station	Height(cm)	Relative Height(cm)	M (cm)	D (cm)	D/E(%)	S (m)
D5	8624.560					
D6	4820.250	3804.310	0.056	0.192	105	534
[M.C.T.] D7	5935.868	-1115.618	0.016	0.054	28	598
D8	990.249	4945.619	0.086	0.298	113	1118
D9	0.000	990.249	0.018	0.059	27	740

Table 2 is the result of the levelling. For two segments (D5-D6, D7-D8), D/E exceeded 100%, but the amount of excess was quite small value. So the resurvey was not made considering the restricted schedule.

2) KERABARI

Kerabari is situated in lat. 27°47' N. and long. 83°33' E.. Levelling line was set along the Siddhartha Highway near BUTWAL.

Date; 9-16 Dec. 1980

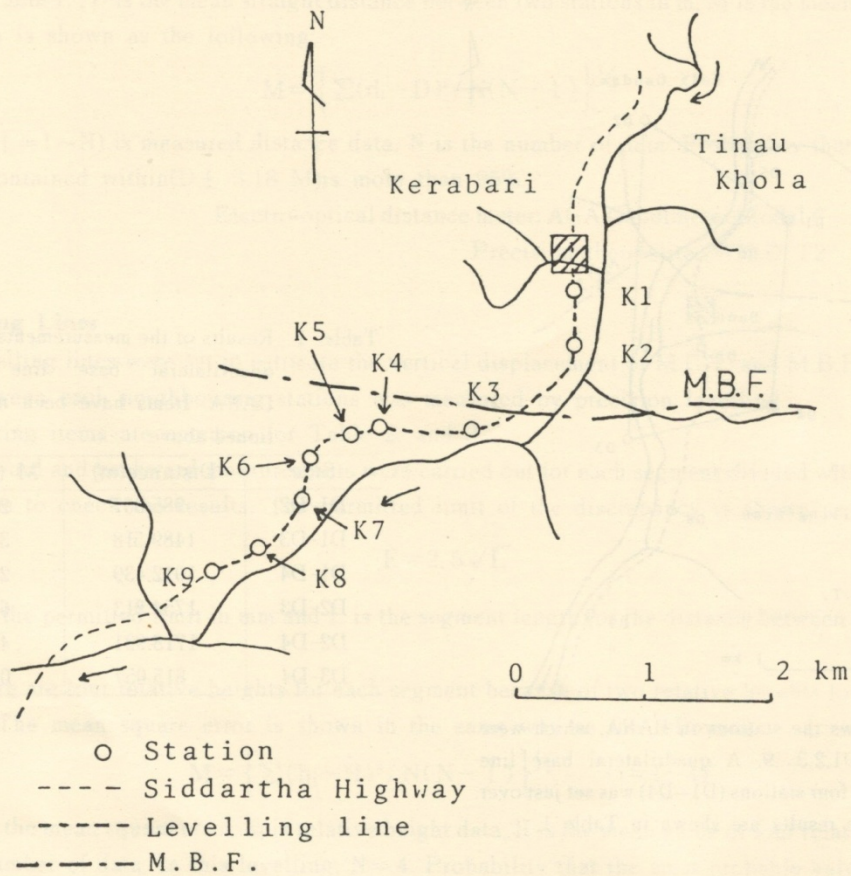


Fig.2 shows the stations in KERABARI, K1, 2, 3, ...9, which make up a levelling line of 5km subdivided into eight segments. It was set across M.B.F.along the Siddartha Highway (motor road).

Table 3 is the result of the levelling.

Levelling was carried out successfully for all segments.

Table 3. Results of the levelling at KERABARI. Items are the same as in Table 2.

Station	Height(cm)	Relative Height(cm)	M(cm)	D (cm)	D/E(%)	S (m)
K1	23390.533					
		2713.877	0.044	0.153	82	556
K2	20676.656					
[M.B.F.]		4543.748	0.042	0.144	53	1169
K3	16132.908					
		4303.134	0.033	0.114	44	1076
K4	11829.774					
		1009.181	0.006	0.021	20	174
K5	10820.593					
		2469.054	0.023	0.078	43	524
K6	8351.539					
		2086.557	0.018	0.062	37	441
K7	6264.982					
		2473.116	0.018	0.063	35	530
K8	3791.866					
		3791.866	0.018	0.063	30	686
K9	0.000					

