

# Comparative Study of Double Level use in Fly Levelling to Minimize the Personal Error

Mr. Mohd. Rafiullah  
Civil Engineering Department  
Anjuman Polytechnic, Nagpur, India  
*principalanjumanpoly@yahoo.com*

**Abstract**— The proposed permanent bench mark may be located far away from the known bench mark. In the existing system the bench mark connection work has been carried out by single instrument & to know the R.L. of new permanent B.M. is require high precise and accurate work. Hence to obtained proper planning and design the fly levelling should be done by two instruments (level) simultaneously, which minimize personal error upto an extent to zero. Hence in this investigation an effort has been made to compare the result of Fly levelling by single level and double level conducted with one staff in terms of accuracy and percentage of error.

**Keywords**- Error in fly levelling, minimize errors in fly levelling.

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## I. INTRODUCTION

The art of determining the relative heights of different point on the surface of earth is known as levelling. The vertical distance of a point above the datum line is known as reduced level (R.L.) of that point. The R.L. of a point may be positive or negative according to the point above or below the datum. The following are the different sources of error in levelling (1) instrumental errors (2) Personal errors (3) error due to natural causes.

First type of error can be minimize by keeping instrument in adjustment (permanent adjustment) & third type of error can be minimize by applying the correction of earth's curvature and refraction to the levelling but unknowingly personal error can be eliminate by proper levelling and proper observation & it is too difficult to maintain in high precise work. So to obtain proper planning & accuracy in fly levelling we have to adopt the use of double instrument (level)

## II. FOLLOWING ARE THE PERSONAL ERRORS

- The instrument may not be levelled perfectly
- The focusing of the eye piece and object glass may not be perfect and the parallax may not be eliminated entirely.
- The reading of the stadia hair rather than the central collimation hair may be taken by mistake
- A wrong entry may be made in the level book.
- The staff may not be properly vertical and fully extended

## III. OBJECTIVES & SCOPE

The objectives of this study are to:

- To minimize the personal error upto & extent to zero.
- To obtained precise fly levelling data (Accurate data)
- To obtained proper planning and result oriented design.

## IV. METHODOLOGY

A systematic case study has been taken to determine the R.L. of new bench mark by using fly levelling (differential levelling) with two instrument for more precise, accurate and well planned work.

Fly levelling from B.M. no. 1 to proposed (New B.M. no. 2) by single level has been carried out and observation were recorded in following table 1.

Table 1.

station	BS	I S	FS	Rise (+)	Fall (-)	RL	Remark
BM 1	0.955					100.00	On B.M. no 1
A	1.250		2.150		1.195	98.805	C.P 1
B	0.785		1.760		0.510	98.295	C.P 2
C	1.535		2.055		1.270	97.025	C.P 3
D	1.260		0.835	0.700		97.725	C.P 4
E	0.675		0.955	0.305		98.030	C.P 5
F	1.275		1.505		0.830	97.200	C.P 6
G	1.655		2.050		0.775	96.425	C.P 7
H	0.450		2.160		0.505	95.920	C.P 8
BM 2	1.005		1.005		0.555	95.365	F.S. ON BM 2
1	2.200		0.500	0.505		95.870	} Back fly
2	2.150		1.650	0.550		96.420	
3	1.510		1.285	0.865		97.285	
4	1.300		0.675	0.835		98.120	}
5	1.665		0.600	0.700		98.820	
6			0.425	1.240		100.060	Closed on BM no 1
	19.670		19.610	5.700	5.640		

$$\text{Check : } \sum \text{BS} - \sum \text{FS} = 19.670 - 19.610 = 0.06\text{m}$$

$$\sum \text{Rise} - \sum \text{Fall} = 5.700 - 5.640 = 0.06\text{m}$$

$$\text{Last RL} - 1^{\text{st}} \text{RL} = 100.060 - 100.00 = 0.06\text{m}$$

From the above observation it is shown that the closing error is 0.09 m (i.e. 9 cm).

Now the same experiment to be revised and carried out by double instrument (level) with single staff and the observations are shown as follow in the respective table. Observation by instrument (A).

Table 2.

station	BS	I S	FS	Rise (+)	Fall (-)	RL	Remark
BM 1	1.055					100.00	On B.M. no 1
A	1.350		2.250		1.195	98.805	C.P 1
B	0.885		1.860		0.510	98.295	C.P 2
C	1.635		2.155		1.270	97.025	C.P 3
D	1.360		0.935	0.700		97.725	C.P 4
E	0.775		1.055	0.305		98.030	C.P 5
F	1.375		1.605		0.830	97.200	C.P 6
G	1.755		2.150		0.775	96.425	C.P 7
H	0.550		2.260		0.505	95.920	C.P 8
BM 2	1.105		1.105		0.555	95.365	F.S. ON BM 2
1	2.300		0.600	0.505		95.870	Back fly
2	2.250		1.750	0.550		96.420	
3	1.610		1.385	0.865		97.285	
4	1.400		0.775	0.835		98.120	
5	1.765		0.700	0.700		98.820	
6			0.595	1.170		99.990	
	21.170		21.180	5.630	5.640		

$$\text{Check : } \sum \text{BS} - \sum \text{FS} = 21.170 - 21.180 = - 0.01\text{m}$$

$$\sum \text{Rise} - \sum \text{Fall} = 5.630 - 5.640 = - 0.01\text{m}$$

$$\text{Last RL} - 1^{\text{st}} \text{RL} = 99.99 - 100.00 = - 0.01\text{m}$$

Observation by instrument (B)

Table 3.

station	BS	I S	FS	Rise (+)	Fall (-)	RL	Remark
BM 1	1.455					100.00	On B.M. no 1
A	1.750		2.650		1.195	98.805	C.P 1
B	1.285		2.260		0.510	98.295	C.P 2
C	2.035		2.555		1.270	97.025	C.P 3
D	1.760		1.335	0.700		97.725	C.P 4
E	1.175		1.455	0.305		98.030	C.P 5
F	1.775		2.005		0.830	97.200	C.P 6
G	2.155		2.550		0.775	96.425	C.P 7
H	0.950		2.660		0.505	95.920	C.P 8
BM 2	1.505		1.505		0.555	95.365	F.S. ON

						BM 2
1	2.700		1.000	0.505		95.870
2	2.650		2.150	0.550		96.420
3	2.010		1.785	0.865		97.285
4	1.800		1.175	0.835		98.120
5	2.165		1.100	0.700		98.820
6			0.995	1.170		99.990
	27.170		27.180	5.630	5.640	

$$\text{Check : } \sum \text{BS} - \sum \text{FS} = 27.170 - 27.180 = - 0.01\text{m}$$

$$\sum \text{Rise} - \sum \text{Fall} = 5.630 - 5.640 = - 0.01\text{m}$$

$$\text{Last RL} - 1^{\text{st}} \text{RL} = 99.99 - 100.00 = - 0.01\text{m}$$

From the above observations of two simultaneous use of instruments, the closing error is 0.01 m (10cm)

### V. RESULT & CONCLUSION

From the above comparison it is concluded that the closing error by single instrument is 0.090 (i.e 9 cm) whereas the same experiment carried out by double instrument simultaneously with a single staff, in such way that the difference of each back sight & fore sight should be same with the difference of FS & BS respectively and it is noted that the closing error by double instrument is 0.010 (i.e 1 cm), and similarly for ten (10) stations reading, further observations has been taken and the comparative study shown by the following tables (a), (b).

(a) Observation by single instrument (level) use

Observation No.	Closing error in mm.
1	60 mm
2	50 mm
3	40 mm

(b) Observation by double instruments(level)use

Observation No.	Closing error in mm.
1	15 mm
2	10 mm
3	05 mm

Hence it is shown that to minimize the personal error, cross checking by double instrument at each successive F.S & B.S is must which comes to result of accurate work which gives well design proposed planning for result oriented, quality work and project designed.

### REFERENCES

- [1] Dr. A.M. Chandra "Surveying", Publisher : New Age International, 2005.
- [2] Prof. N.N. Basak "Surveying and Levelling" Publisher : Mc Graw Hill Publication New Delhi, 1994.
- [3] Prof. R. Subramanian "Surveying and levelling" Second edition Oxford University Press, 2012.
- [4] Prof. B.C. Punmia "Surveying and levelling" Vol. 01, 2006.
- [5] Kanetkar T.P & Kukarni S.V, Surveying & Levelling, Pune Vidharti Garah, 2005.