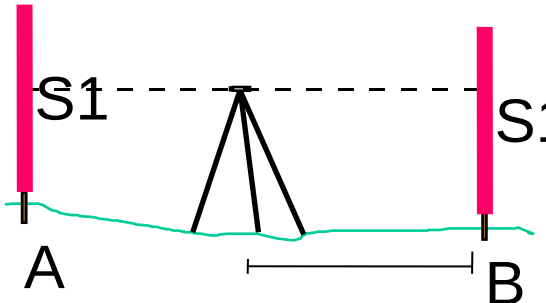
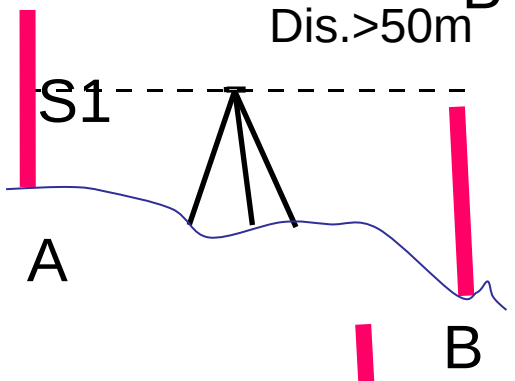
Levelling 2

The cases to change the level position are :

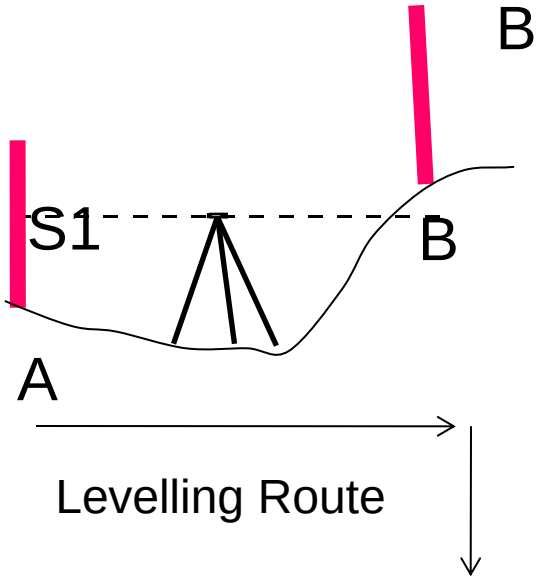
- The distance between level and staff exceeds 50m.



- The staff is below line of sight due to depression in ground surface.



- The staff is above line of sight due to elevated ground surface.



- The direction of levelling is changed.

Examples

B.S	I.S.	F.S.	RISE	FALL	REDUCED LEVEL	ADJ.	FINAL LEVEL	REMARKS
			Or	HPC				

Arrange the following data in standard levelling table format if underlined readings are foresights:
1.52, <u>1.73</u>, 1.34, 1.75,<u>1.25</u>, 1.82,1.67,1.28

Arrange the following data in standard levelling table format if points number 3, 5,6 are intermediates
1.22, 1.67, 139, 1.92, 2.04, 1.85, 2.23, 2.74, 2.11, 1.63, 1.90

Arrange the following data in standard levelling table format if points number 3,5,6 are change points:
1.52, 1.65, 1.82, 1.75, 1.43, 1.93, 2.12, 1.79, 1.34, 1.45, 1.60

- Levelling Loop

Starting from T.B.M. to define RL of some of fixed points, and closing loop again to the same T.B.M.

Compute Loop closing error, and decide whether it is acceptable or not.

Determine Final corrected RL for each point.

B.S	I.S.	F.S.	RISE	FALL	REDUCED LEVEL	ADJ.	FINAL LEVEL	REMARKS
1.215					21.754	0	21.754	BM1
	1.648			0.433 1.215-1.648	21.321 21.754-0.433	0	21.321	2
1.482		1.813		0.165 1.648-1.813	21.156 21.321-0.165	0.003	21.159	3
0.945		1.171	0.311 1.482-1.171		21.467 21.156+0.311	0.006	21.473	4
	1.51			0.565 0.945-1.51	20.902 21.467-0.565	0.006	20.908	5
		0.664	0.846 1.51-0.664		21.748 20.902+0.846	0.006	21.754	BM1

∑BS=3.642 ∑FS=3.648 ∑Rise=1.157 ∑Fall=1.163

check

Closure error

B.S	I.S.	F.S.	HPC منسوب سطح الميزان	REDUCED LEVEL	ADJ.	FINAL LEVEL	REMARKS
1.215			22.969 21.754+1.215	21.754	0	21.754	BM1
	1.648			21.321 22.969-1.648	0	21.321	2
1.482		1.813	22.638 21.156+1.482	21.156 22.969-1.813	0.003	21.159	3
0.945		1.171	22.412 21.467+0.945	21.467 22.638-1.171	0.006	21.473	4
	1.51			20.902 22.412-1.51	0.006	20.908	
		0.664		21.748 22.412-0.664	0.006	21.754	BM1

∑BS=3.642 ∑FS=3.648

check

Closure error

$$\sum_{all} BS - \sum_{all} FS = \text{Total rise} - \text{total fall} = \text{Last RL} - \text{first RL}$$

i. Equalities checked in last row.

ii. Any discrepancy is due to arithmetic mistake(s), but has nothing to do with accuracy of measurements.

$$\sum_{all} BS - \sum_{all} FS = 3.642 - 3.648 = -0.006 \text{ m}$$

$$\text{Total rise} - \text{total fall} = 1.157 - 1.163 = -0.006 \text{ m}$$

$$\text{Last RL} - \text{first RL} = 21.748 - 21.754 = -0.006 \text{ m}$$

Closure Error

- Definition of misclosure & allowable values
  - Whenever possible: close on either starting benchmark or another benchmark to check accuracy & detect blunders. Misclosure (evaluated at closing BM):

  c.e.= measured RL of BM – correct RL of BM

  If c.e. acceptable: then corrected so that closing BM has correct known RL

  - Max. acceptable misclosure (in *mm*): $E = \pm C\sqrt{K}$
  - where K = total distance of leveling route (in number of kilometers)

  C = a constant: typically between 3 mm (precise leveling work of highest standards) & 12 mm (ordinary engineering leveling)

Construction levelling: often involves relatively short distances yet a large number (*n*) of instrument stations. In this case, an alternative criterion for *E* can be used:

$$E = \pm 5mm\sqrt{n}$$

n=3

$E = \pm 5mm\sqrt{n} = \pm 8.7mm$

c.e.= measured RL of BM – correct RL of BM= 21.748 -21.754=-0.006m

Correction=- c.e./no. of TP= - (-0.006/2)=0.003 m

B.S	I.S.	F.S.	RISE	FALL	REDUCED LEVEL	ADJ.	FINAL LEVEL	REMARKS
1.215					21.754	0	21.754	BM1
	1.648			0.433 1.215-1.648	21.321 21.754-0.433	0	21.321	2
1.482		1.813		0.165 1.648-1.813	21.156 21.321-0.165	0.002	21.158	3
0.945		1.171	0.311 1.482-1.171		21.467 21.156+0.311	0.004	21.471	4
	1.51			0.565 0.945-1.51	20.902 21.467-0.565	0.004	20.906	5
2.956		2.432		0.922 1.51-2.432	19.980 20.902-0.922	0.006	21.321	6
	1.833		1.123 2.956-1.833		21.103 19.98+1.123	0.006	21.109	7
0.847		1.652	0.181 1.833-1.652		21.284 21.103+0.181	0.008	21.292	8
		1.164		0.317 1.51-2.432	20.967 21.284-0.317	0.008	20.975	BM2

∑BS=7.445 ∑FS=8.232 ∑Rise=1.615 ∑Fall=2.402

check

Closure error

B.S	I.S.	F.S.	HPC منسوب سطح الميزان	REDUCED LEVEL	ADJ.	FINAL LEVEL	REMARKS
1.215			22.969 21.754+1.215	21.754	0	21.754	BM1
	1.648			21.321 22.969-1.648	0	21.321	2
1.482		1.813	22.638 21.156+1.482	21.156 22.969-1.813	0.002	21.158	3
0.945		1.171	22.412 21.467+0.945	21.467 22.638-1.171	0.004	21.471	4
	1.51			20.902 22.412-1.51	0.004	20.906	5
2.956		2.432	22.936 19.980+2.956	19.980 22.412-2.432	0.006	21.321	6
	1.833			21.103 22.936-1.833	0.006	21.109	7
0.847		1.652	22.131 21.284+0.847	21.284 22.936-1.652	0.008	21.292	8
		1.164		20.967 22.131-1.164	0.008	20.975	BM2

∑BS=7.445 ∑FS=8.232

check

Closure error

$$\sum_{all} BS - \sum_{all} FS = \text{Total rise} - \text{total fall} = \text{Last RL} - \text{first RL}$$

i. Equalities checked in last row.

ii. Any discrepancy is due to arithmetic mistake(s), but has nothing to do with accuracy of measurements.

$$\sum_{all} BS - \sum_{all} FS = 7.445 - 8.232 = -0.787 \text{ m}$$

$$\text{Total rise} - \text{total fall} = 1.615 - 2.402 = -0.787 \text{ m}$$

$$\text{Last RL} - \text{first RL} = 20.967 - 21.754 = -0.787 \text{ m}$$

Closure Error

- Definition of misclosure & allowable values
  - Whenever possible: close on either starting benchmark or another benchmark to check accuracy & detect blunders. Misclosure (evaluated at closing BM):

  c.e.= measured RL of BM – correct RL of BM

  If c.e. acceptable: then corrected so that closing BM has correct known RL

  - Max. acceptable misclosure (in *mm*): $E = \pm C\sqrt{K}$
  - where K = total distance of leveling route (in number of kilometers)

  C = a constant: typically between 3 mm (precise leveling work of highest standards) & 12 mm (ordinary engineering leveling)

Construction levelling: often involves relatively short distances yet a large number (*n*) of instrument stations. In this case, an alternative criterion for *E* can be used:

$$E = \pm 5mm\sqrt{n}$$

n=5

$E = \pm 5mm\sqrt{n} = \pm 11mm$

c.e.= measured RL of BM – correct RL of BM= 20.967-20.975=-0.008m

Correction=- c.e./no. of TP= - (-0.008/4)=0.002 m