

Birzeit University
Faculty of Engineering and Technology
Civil Engineering Department
SURVEYING Lab ENCE316

Experiment no.3 : Closed Link Levelling

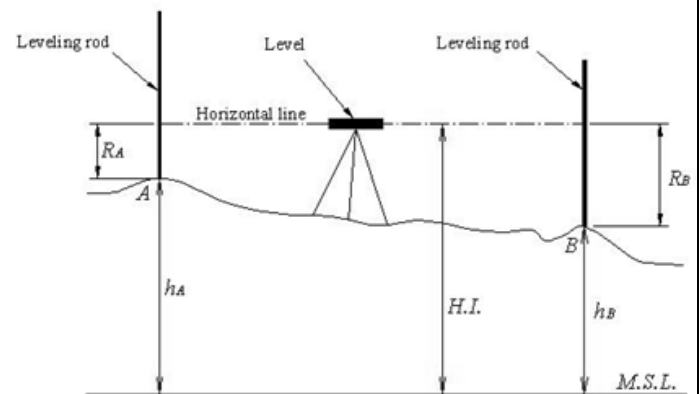
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❖ Closed Levelling concept

Leveling: the process of determining the height of points with respect to certain level called datum which is usually used to be the MSL.

$$HI = H_A + R_A$$

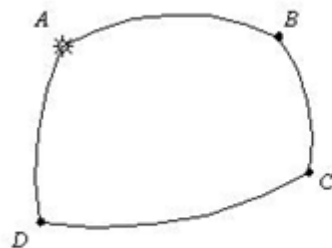
$$H_B = HI - R_B$$



In this Lab we will focus on closed Leveling which starts from a point of known elevation and ends at a point of known elevation.

Closed leveling has two types:

1. Polygon type: where the start point is the same as the end point.
2. Link type : where the start point is different from the end point (As in this Lab)



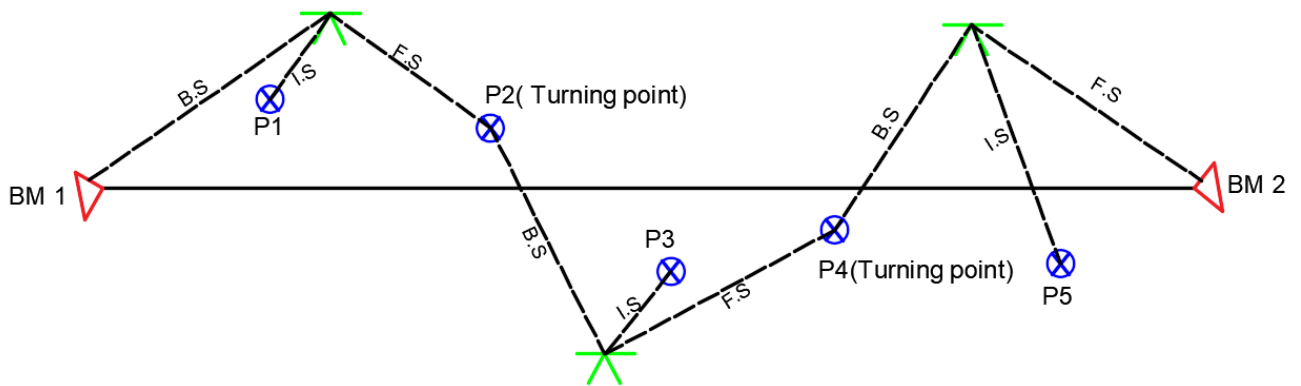
Polygon Type



Link Type

❖ Data Arrangement

This table filled for 3 setups, it may differs for your experiment based on the number of setups you need to measure the staff reading at all points (2 bench marks (BM) and other 5 point)



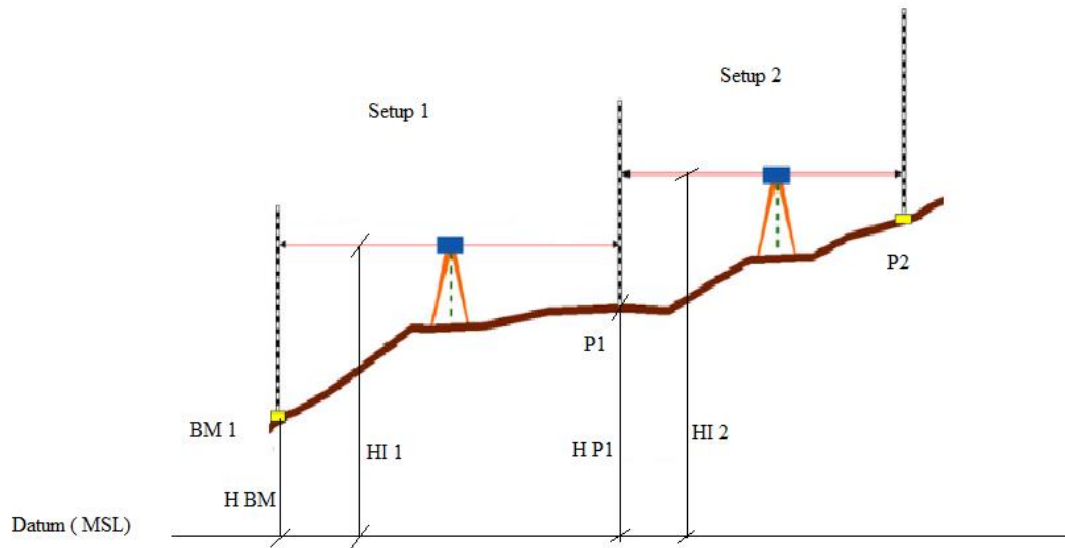
Point	B.S	I.S	F.S	HI (m)	H(m)	Remark
BM ₁	√			HI ₁	Known	
P ₁		√				
P ₂	√		√	HI ₂		Turning point
P ₃		√				
P ₄	√		√	HI ₃		Turning point
P ₅		√				
BM ₂			√			
Σ						

√ : staff reading at each point (r₂)

But to check your reading, you have to measure (r₁ , r₂ , r₃) for both benchmarks BM₁ & BM₂

Since $\frac{r_1+r_3}{2} \approx r_2$ with difference = 2 mm

❖ Levelling calculations



$$HI_1 = \text{elevation of } BM_1 + BS_1$$

$$HI_2 = \text{elevation of } P_2 + BS_2$$

$$HI_3 = \text{elevation of } P_4 + BS_4$$

$$H \text{ (for any point)} = HI_{\text{for that setup}} - \text{staff reading at that point}$$

(Note, these equations are correct for the previous table arrangement, but it may differ for your case, BE CAREFUL)

After you find the elevation for all point, there are some computational checks must be carried out to check the calculations as followed:

1. No. of setups= No. of T.P. +1
2. No. of B.S = No. of F.S
3. $\sum B.S - \sum F.S = \text{Elev. of the last point} - \text{Elev. of the first point}$
4. $\sum \text{Elev. for all points} - \text{Elev. Of } BM_1 = [\sum (HI_i * (\# \text{ of IS} + \# \text{ of FS}))] - \sum IS - \sum FS$

Since we have an exercise for closed link levelling (that's end with point with known elevation BM_2) , misclosure error can be calculated then compare it with allowable error as followed:

Misclosure error (ϵ) = BM_2 computed elevation (from leveling) – known elevation for BM_2

Tolerance error (mm) = $C \sqrt{K}$ where $\rightarrow C$: constant

K: loop length (Km)

Take $C = 30$ and $K = 160$ m for this experiment.

If :

Misclosure error < Tolerance error	(O.K.) field work is accepted
Misclosure error > Tolerance error	(not O.K.) field work should be checked for mistakes (may repeat it)

You have to submit data & Calculations for Closed link levelling (individually).