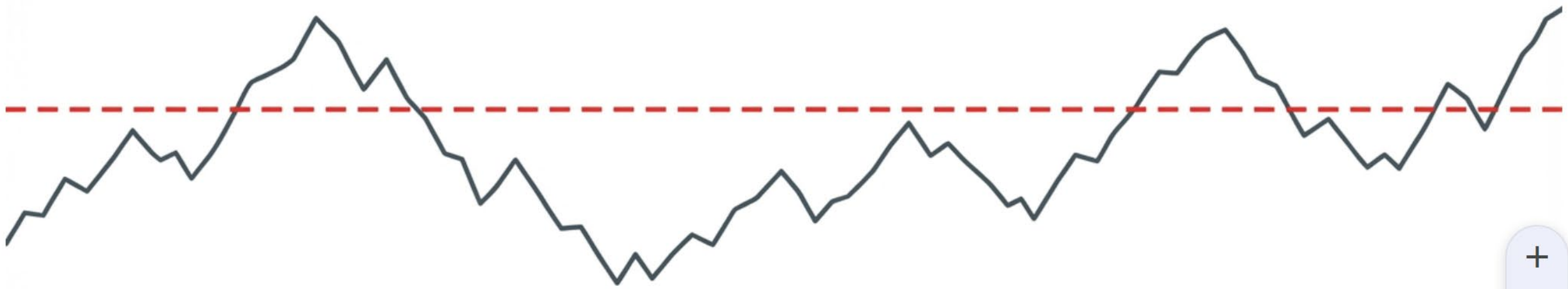


Engineering and Construction Surveying

ACBA4020

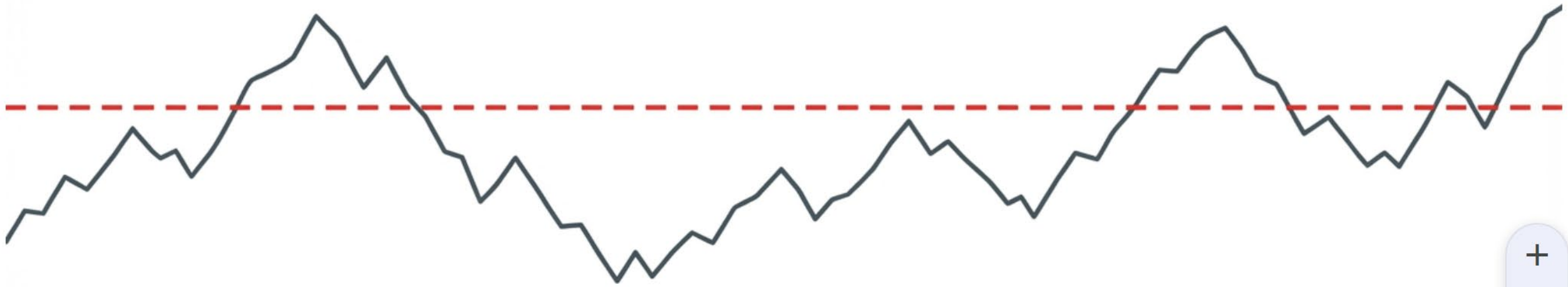


Levelling



Levelling

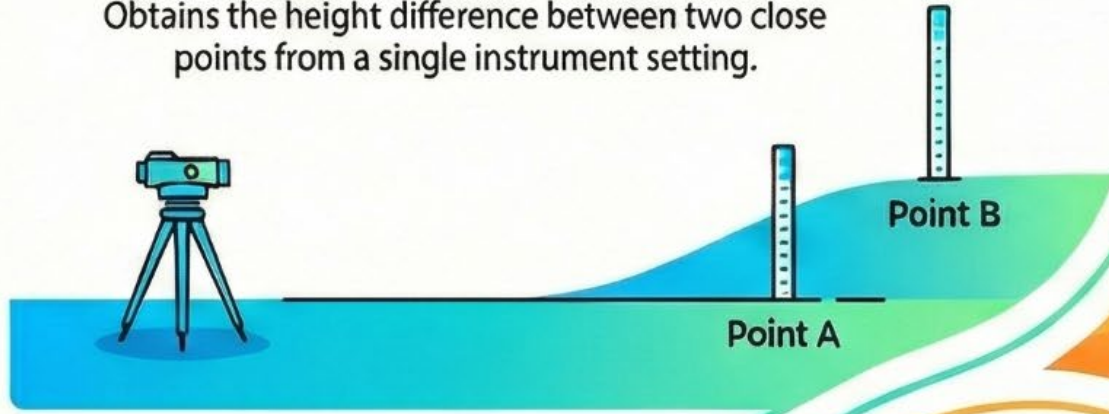
Levelling in surveying is the process of determining the height of one level relative to another.



DISTANCE-BASED LEVELING

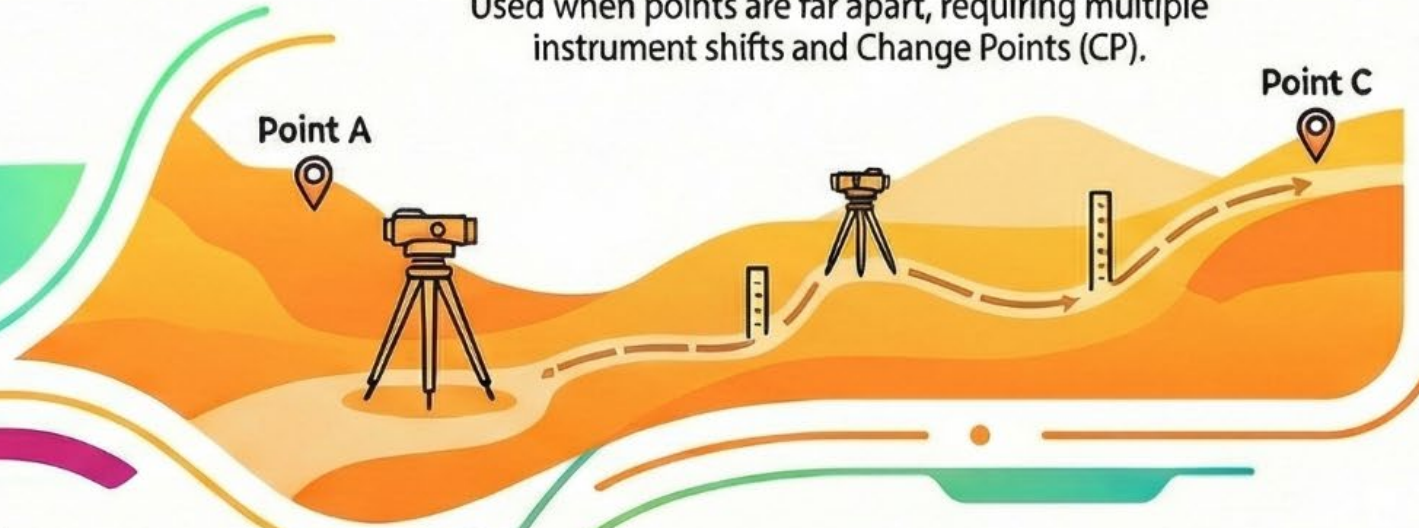
Simple Leveling for Nearby Points

Obtains the height difference between two close points from a single instrument setting.



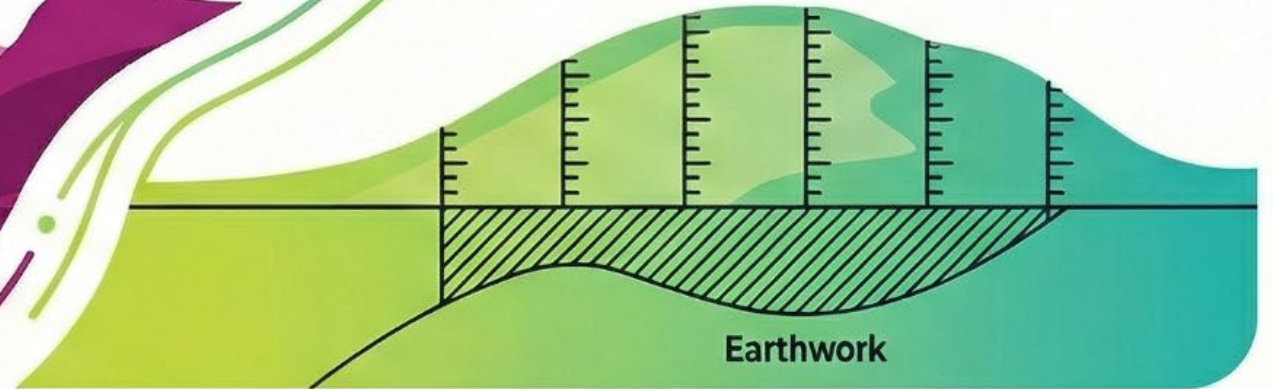
Differential Leveling for Large Distances

Used when points are far apart, requiring multiple instrument shifts and Change Points (CP).



Fly Leveling for Benchmarking

Carries levels toward a temporary benchmark in a convenient direction using multiple Change Points.



Cross-sectioning for Earthwork

Measurements taken at regular intervals to calculate ground volume for engineering projects.

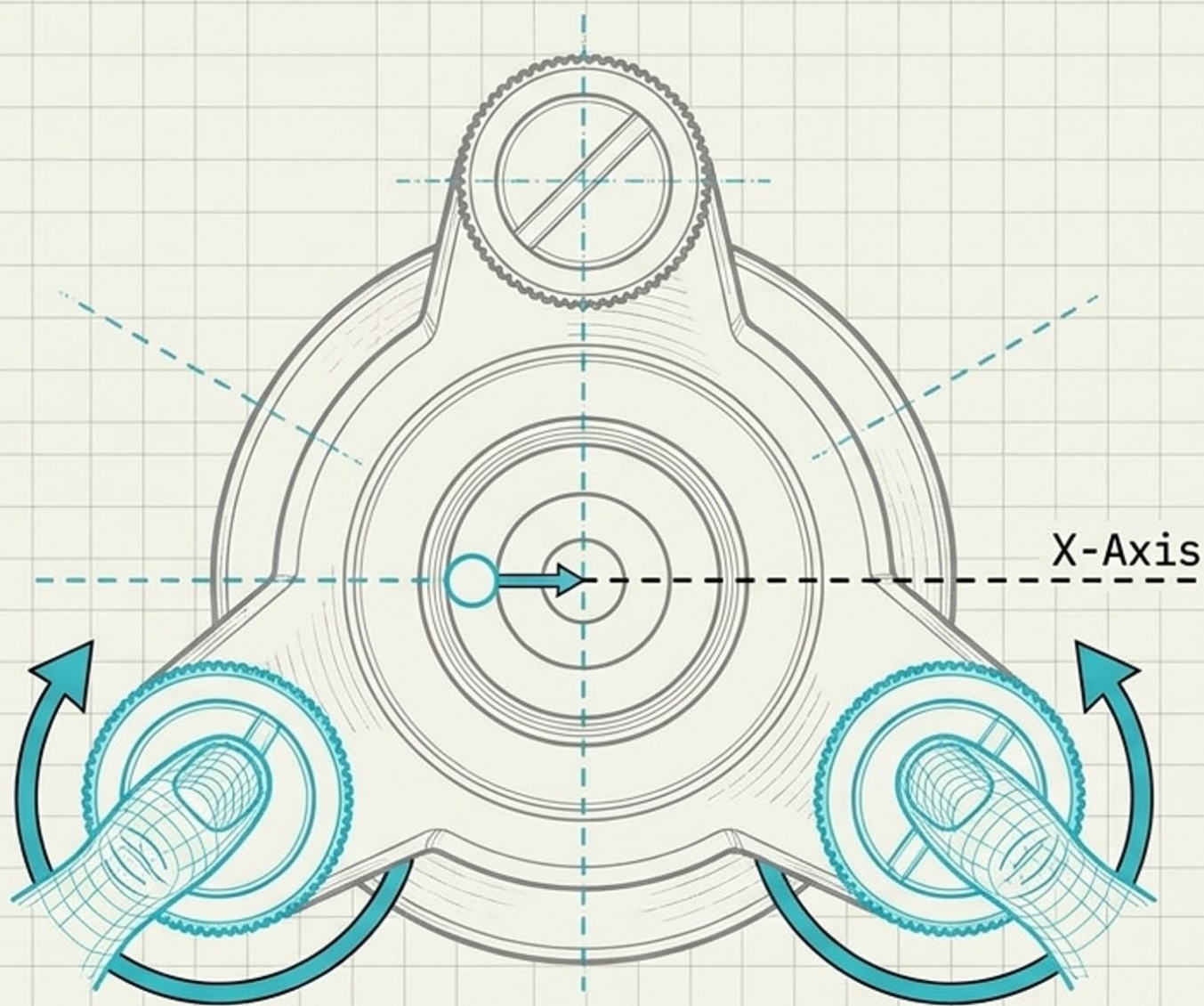
PROJECT-SPECIFIC LEVELING



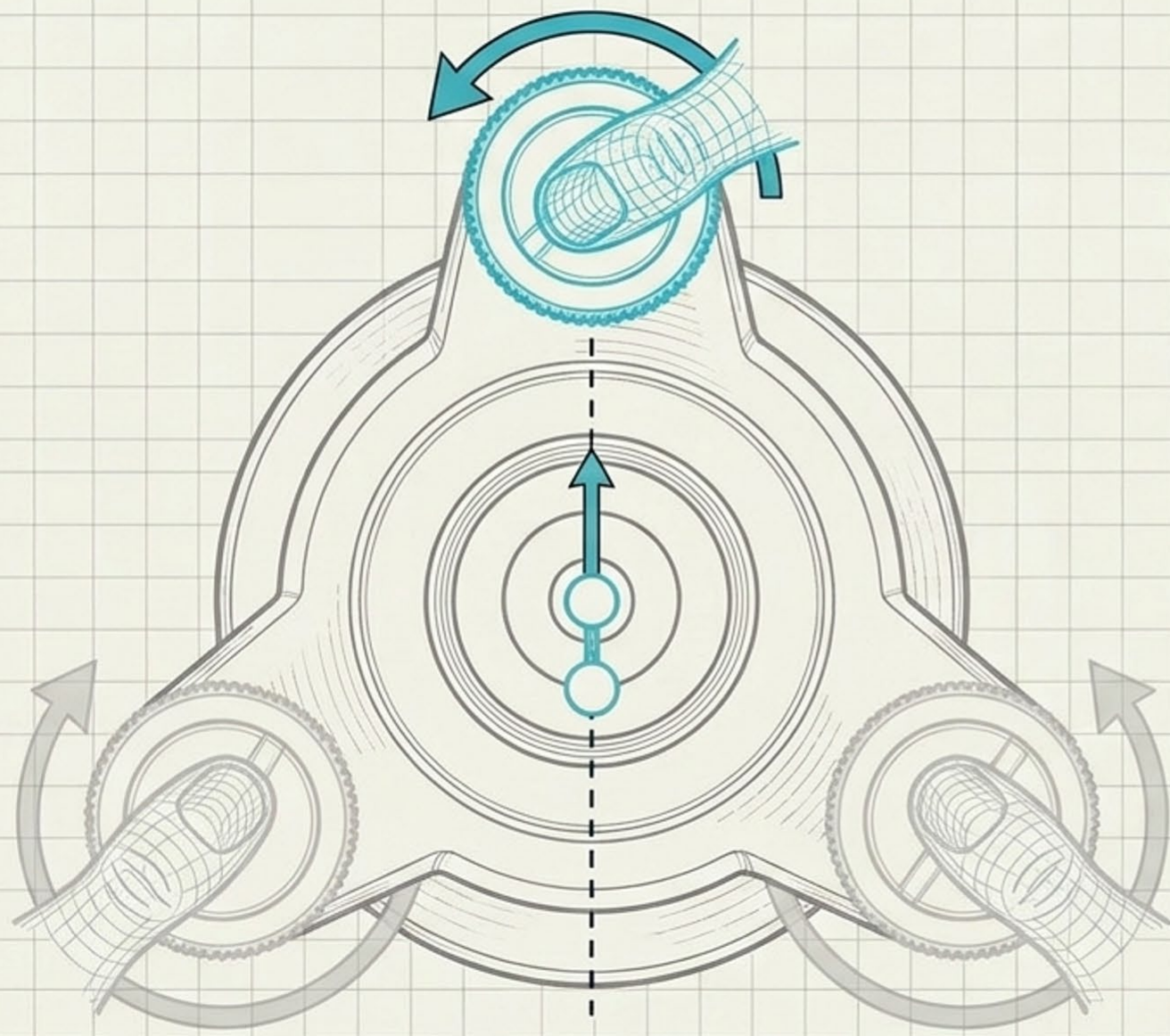


Phase 3: Leveling Calibration (X-Axis)

Step 1: X-Axis Alignment
Manipulate any two adjacent screws simultaneously. Rotate equally in opposite directions to drive the bubble along the lateral axis.

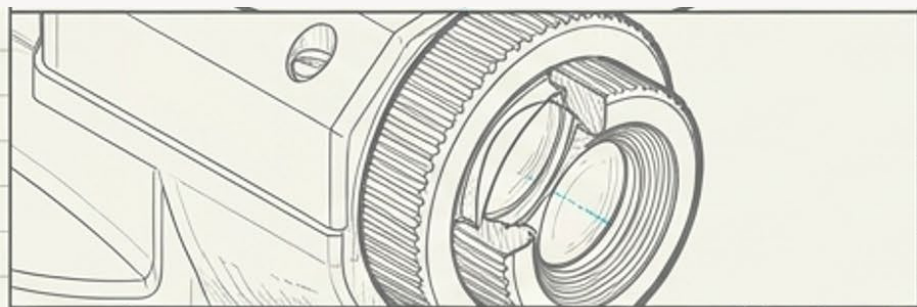
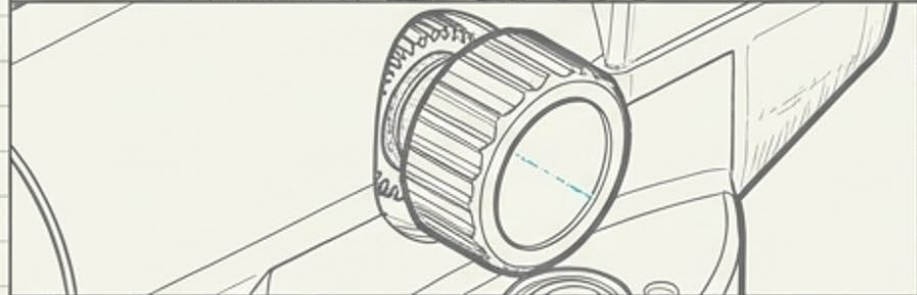
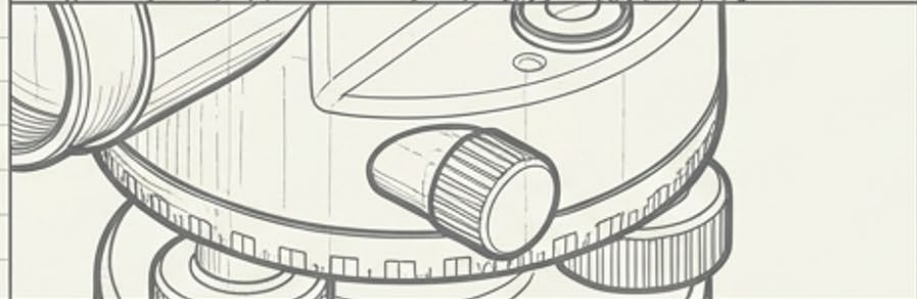


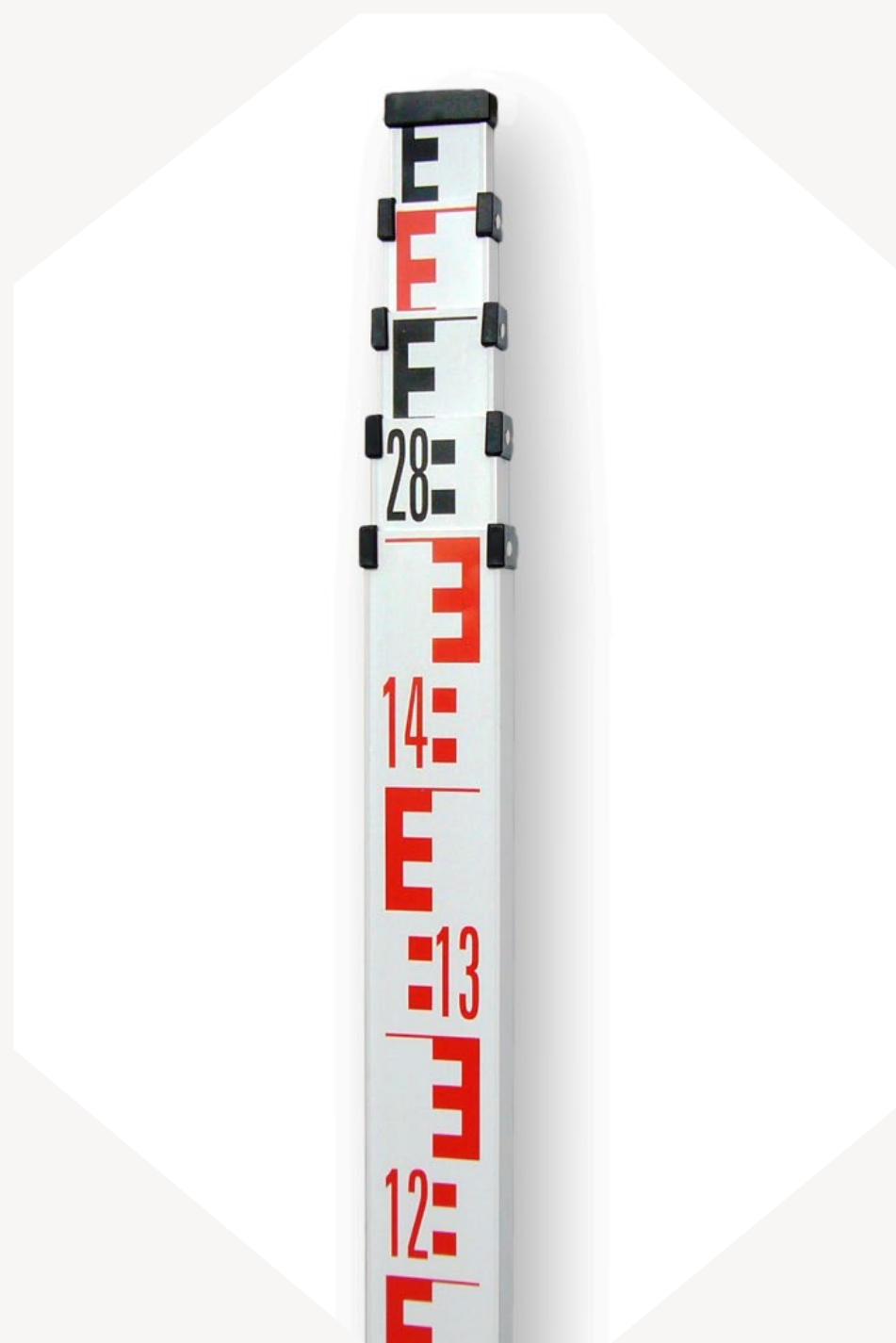
Phase 3: Leveling Calibration (Y-Axis)



Step 2: Y-Axis Alignment

Utilize the remaining single screw independently. Rotate to drive the bubble along the longitudinal axis into the absolute center of the bullseye.

	Micro-Focus	Sharpens internal reticle (crosshairs).
	Macro-Focus	Sharpens external distant objects (staff).
	Micro-Targeting	Precise left/right pans to center crosshairs on staff.





E1.0



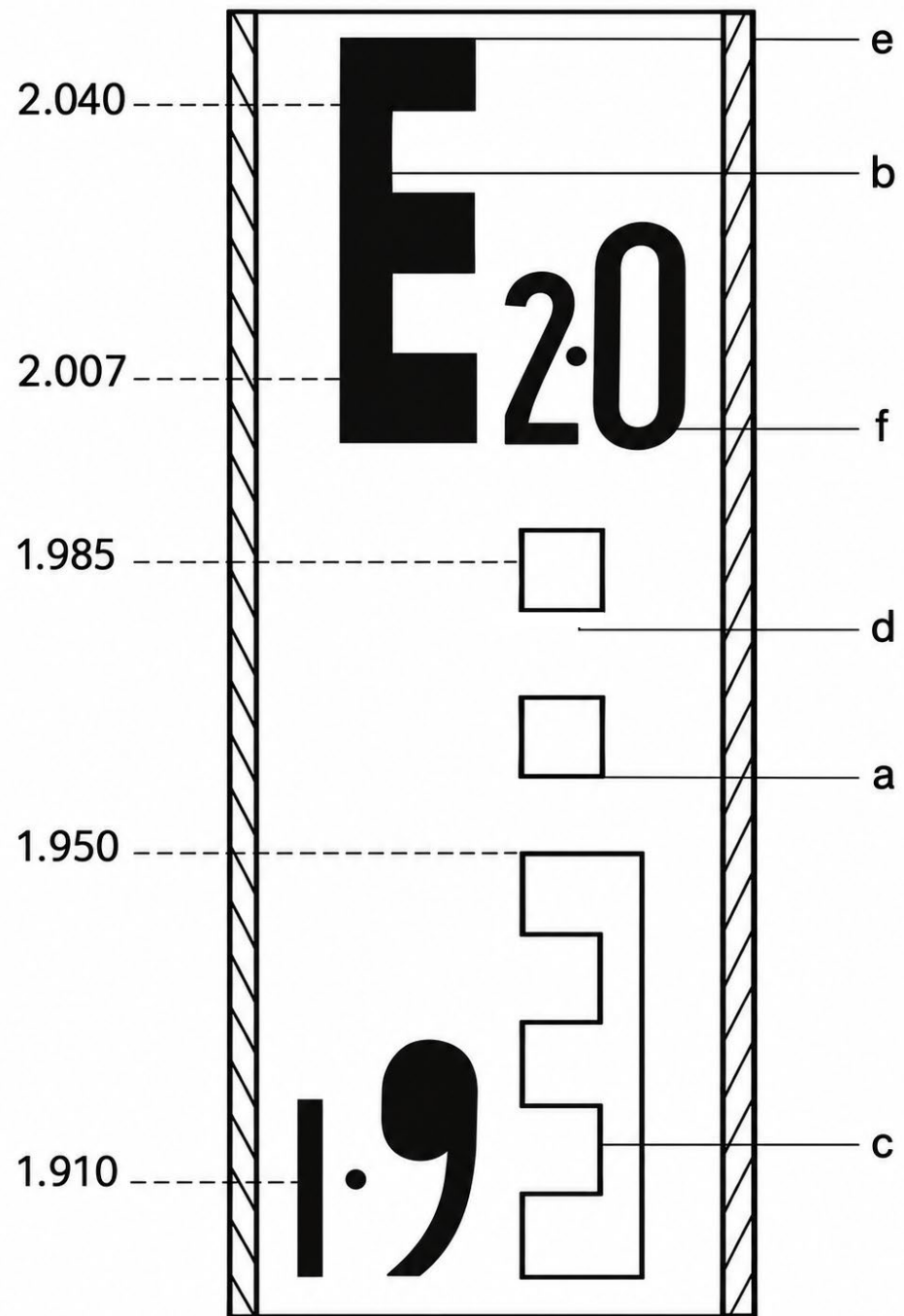
1.068

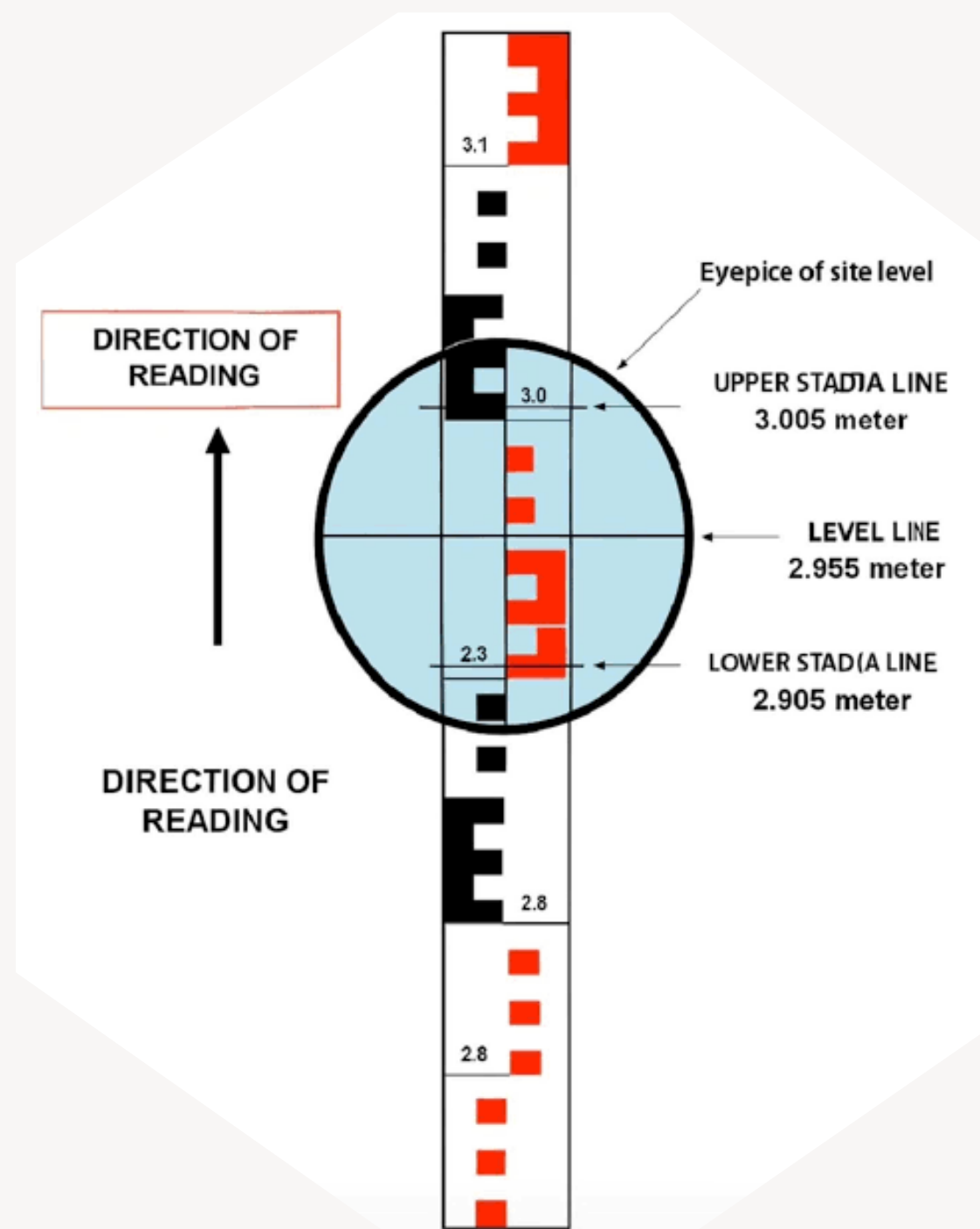
1.050

1.031

1.000

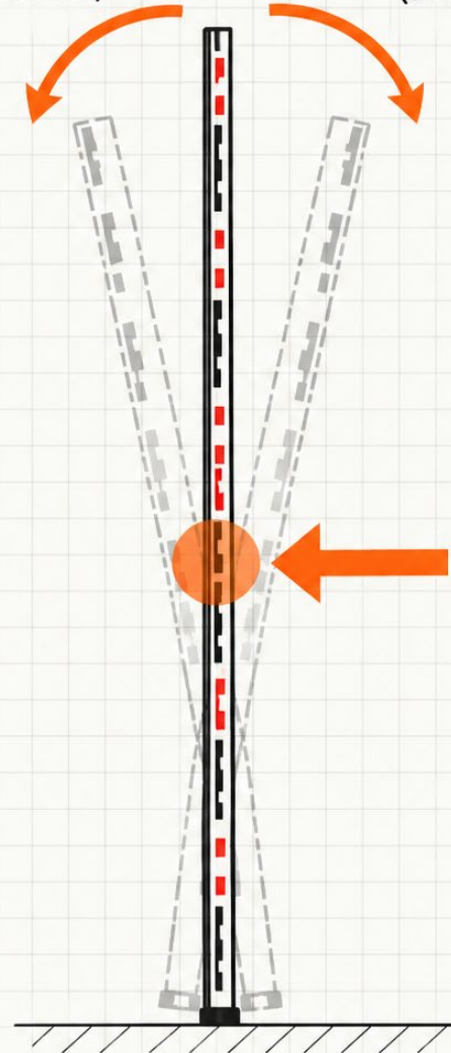
0.972





Rocking forwards
(towards the instrument)

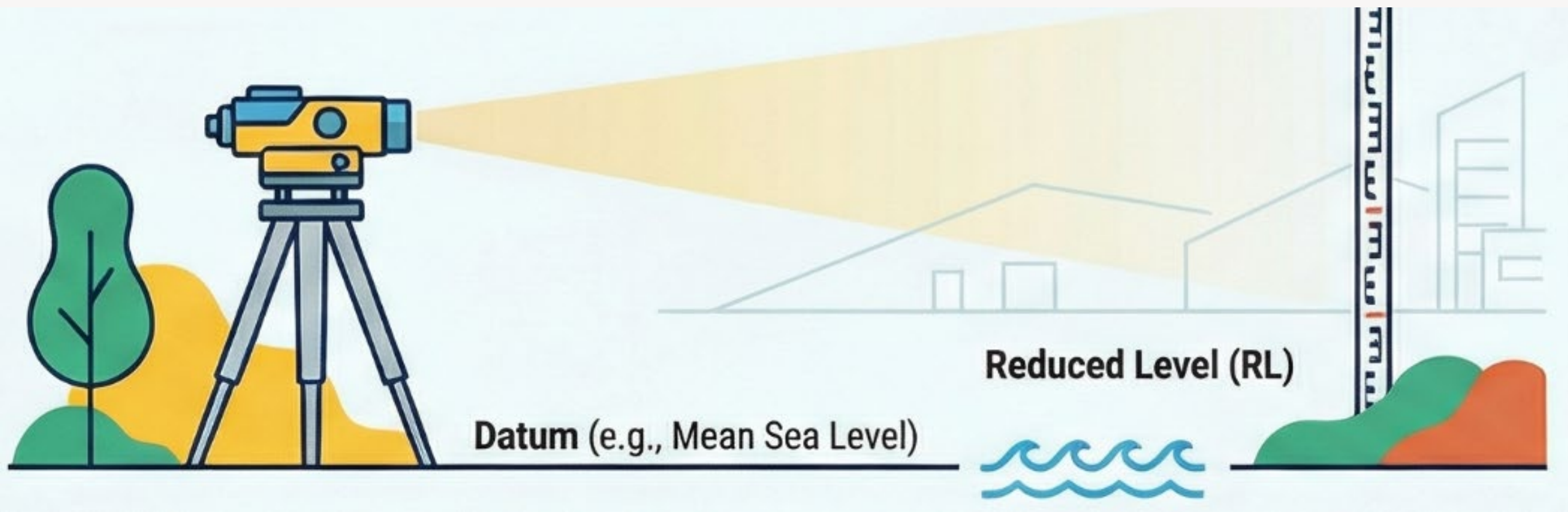
Rocking backwards
(away from the instrument)



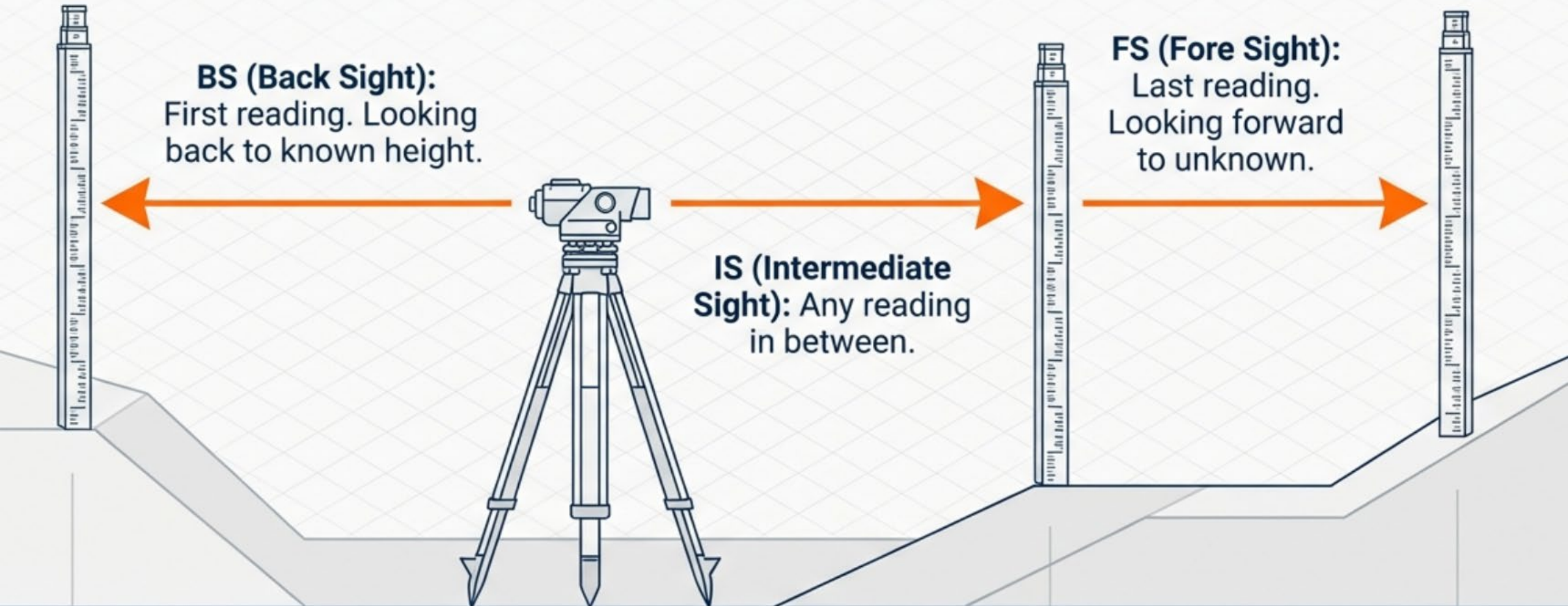
Record the **LOWEST**
reading observed.

This indicates the staff is
perpendicular to the line
of sight.

Side view of staff rocking
forwards and backwards



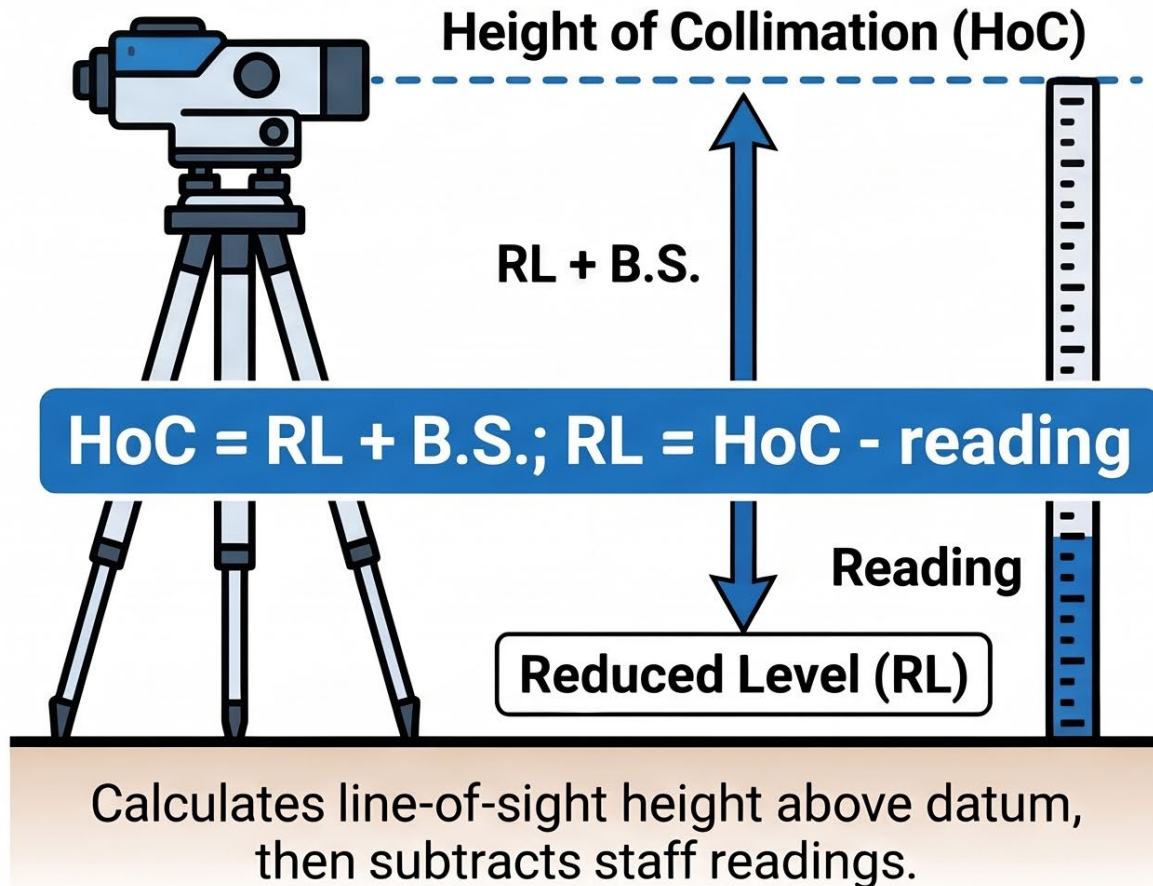
THE SURVEYOR'S JOURNEY: BS, FS, AND IS



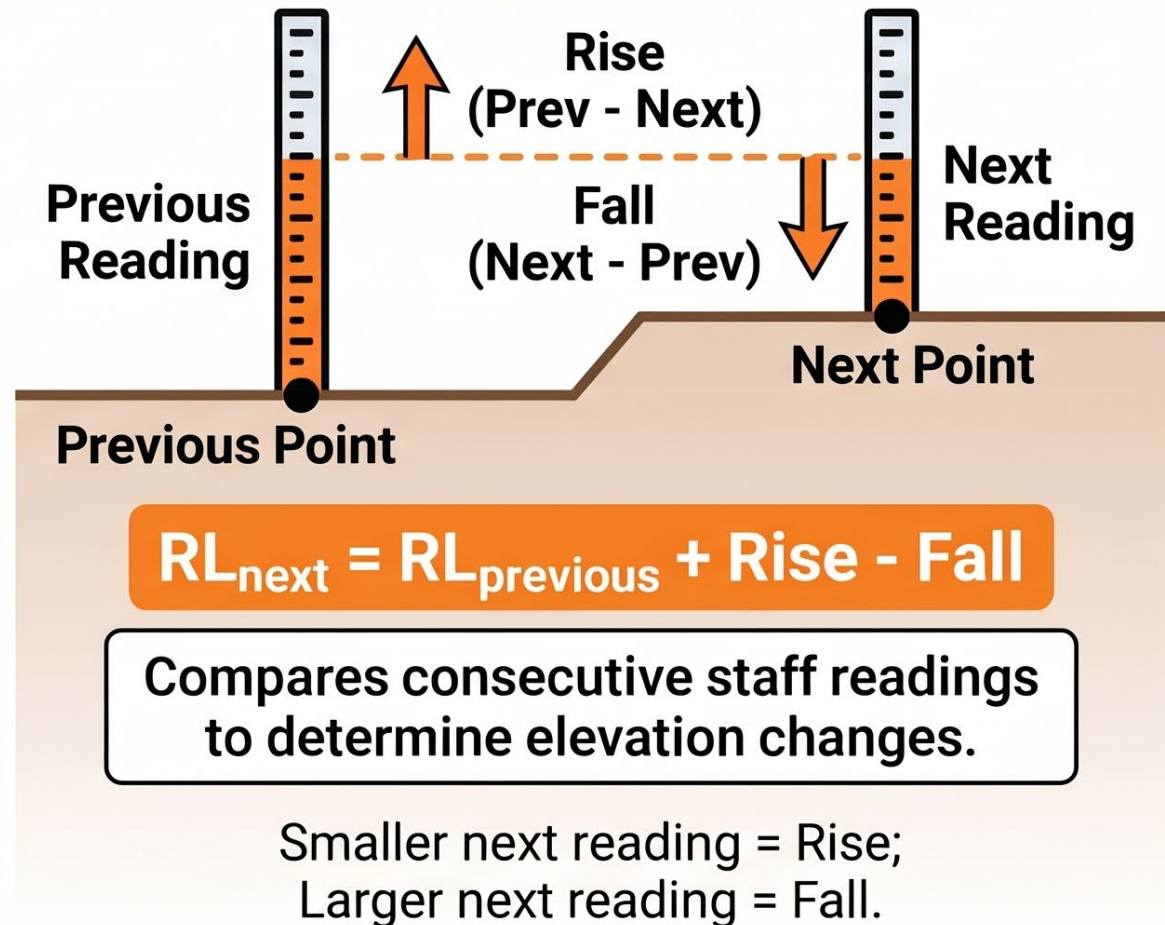
Levelling Methods: HoC vs. Rise & Fall

Both methods determine ground elevation (RL) from staff readings, but HoC **uses instrument height** while Rise & Fall compares consecutive points.

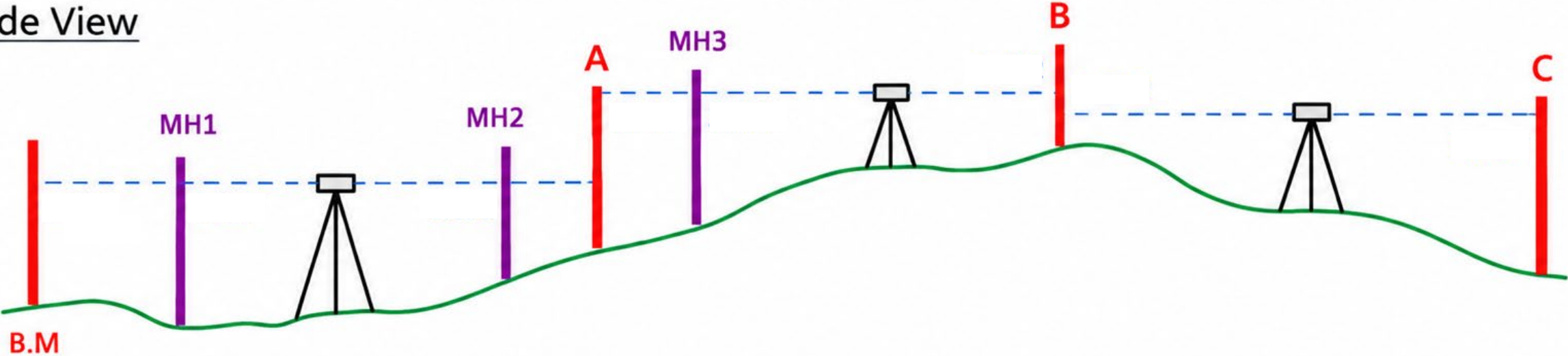
Height of Collimation (HoC) Method



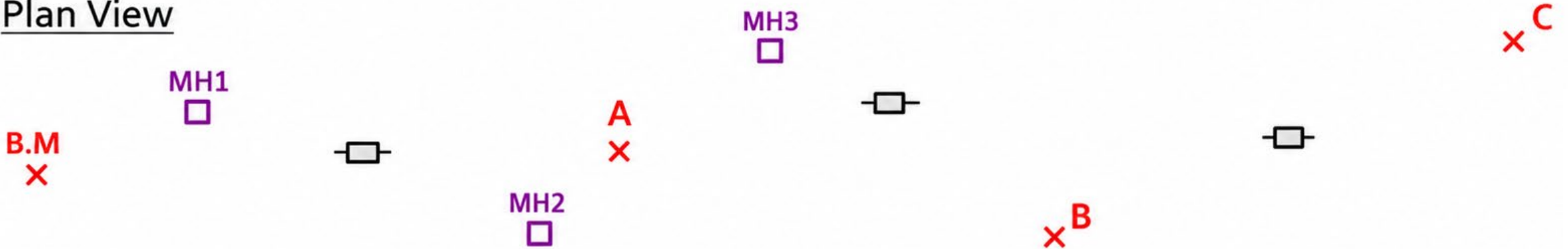
Rise and Fall Method



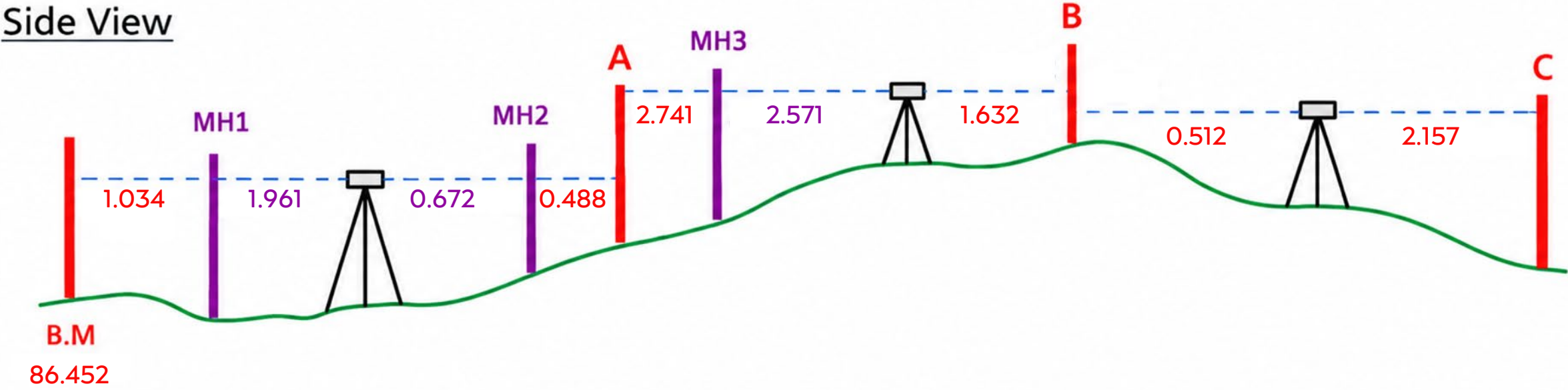
Side View



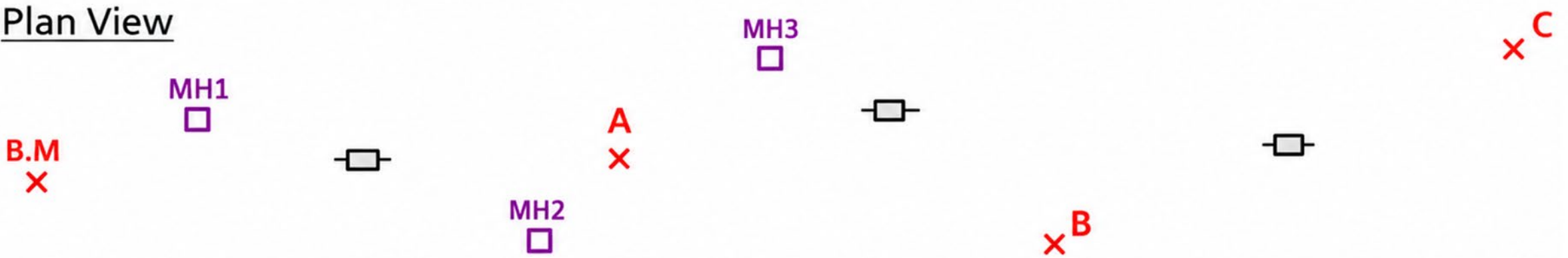
Plan View



Side View



Plan View



Arithmetic Check

$$\sum B.S - \sum FS = \textit{Last R.L} - \textit{First R.L}$$

Rise and Fall Method

Concept: Instead of an absolute plane, we calculate the relative slope between steps.

Logic Rule:

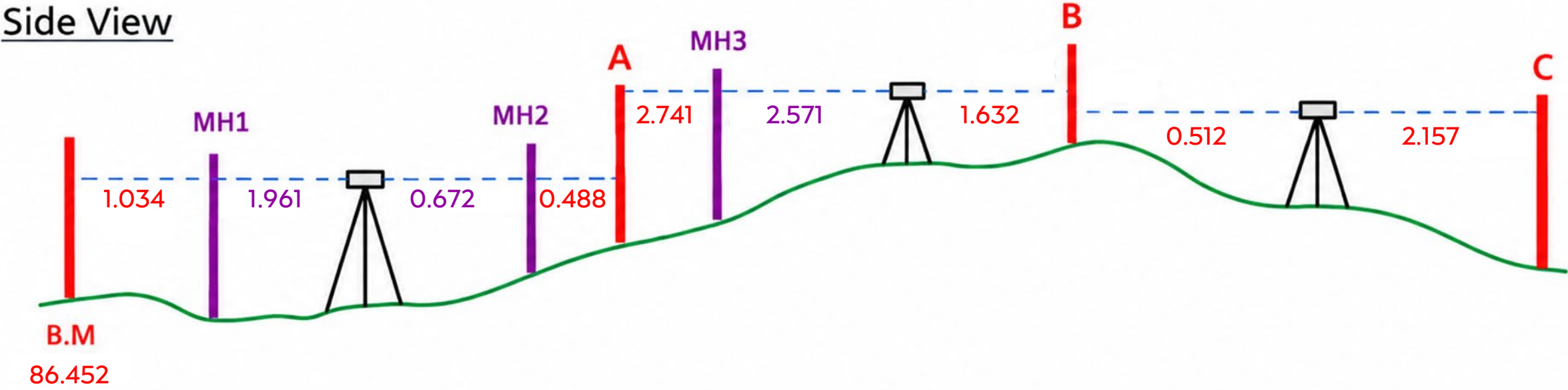


- Reading **Decreases** = Ground Goes **Up** (Rise Column)

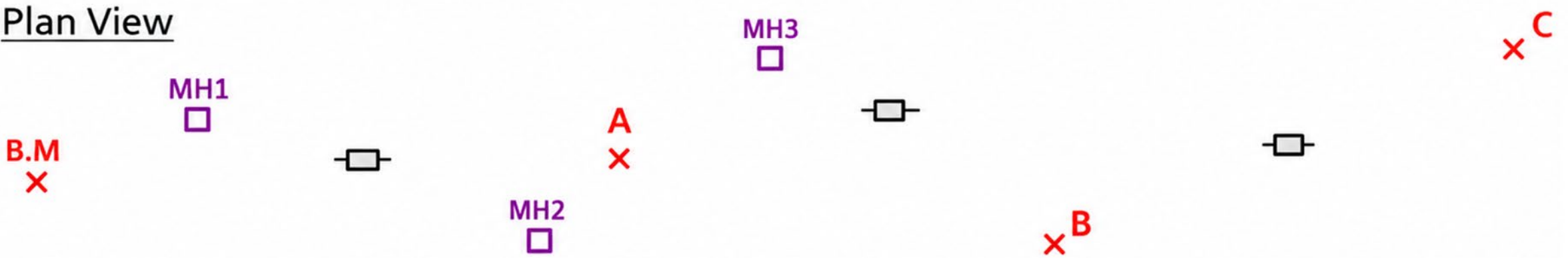


- Reading **Increases** = Ground Goes **Down** (Fall Column)

Side View



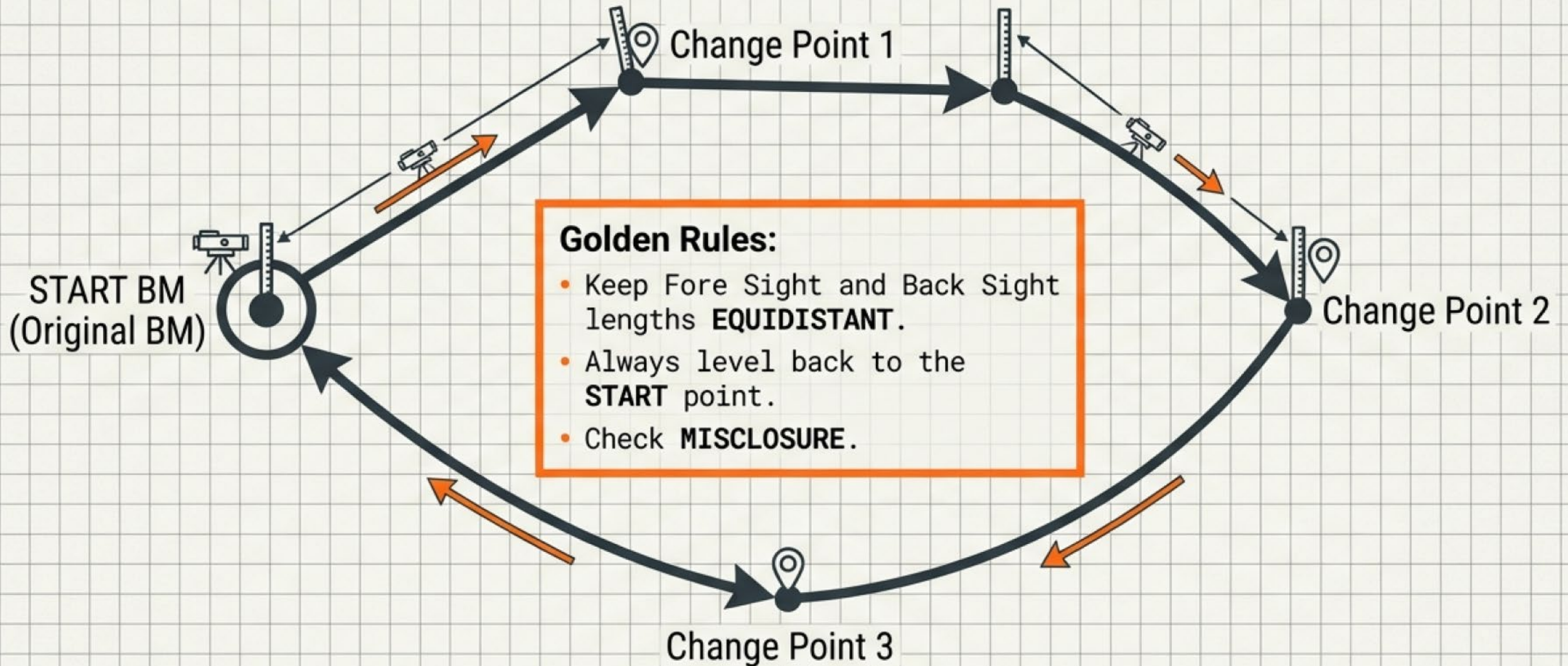
Plan View



Arithmetic Check

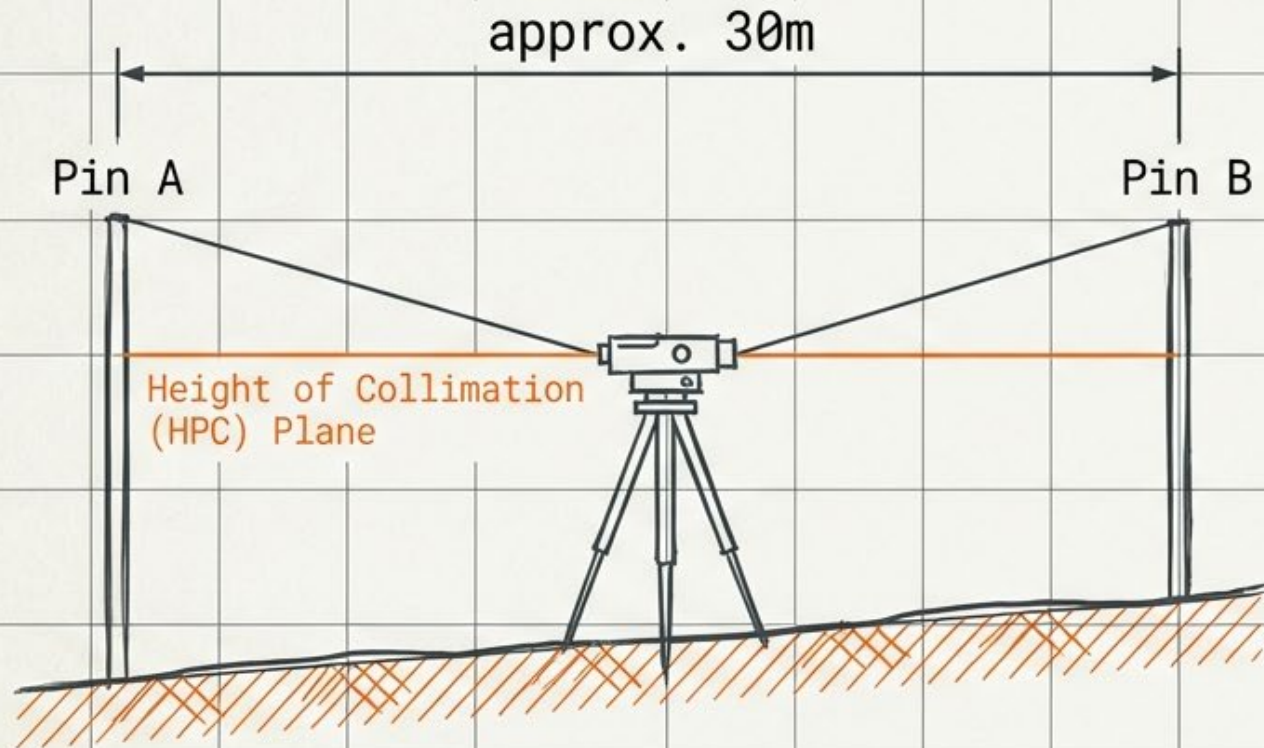
$$\sum Rises - \sum Falls = Last\ R.L - First\ R.L$$

PROTOCOL: CLOSING THE LOOP



Tolerance: A few millimeters is expected. Adjust acceptable error in proportion to loop lengths.

CALIBRATION: THE TWO PEG TEST (STEP 1)

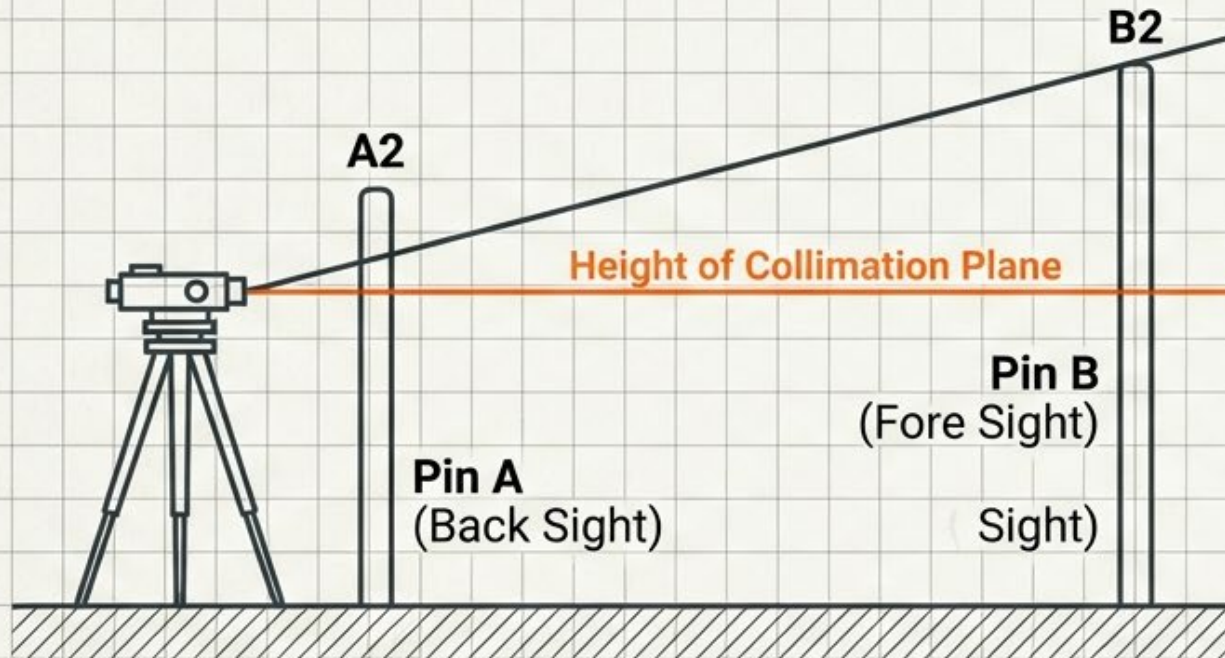


GOAL: Determine if the line of collimation is diverging from horizontal.

ACTION: Setup exactly midway. Measure difference between A and B.

LOGIC: Because distance is equal, errors cancel out. We now possess the TRUE difference in level.

CALIBRATION: THE TWO PEG TEST (STEP 2)



ACTION:

Move level adjacent to Pin A.
Retake readings.

THE CHECK:

Recalculate the difference.

VERDICT:

$$(A1 - B1) = (A2 - B2)$$

If equal: Instrument is ADJUSTED.
If unequal: Instrument requires SERVICE.