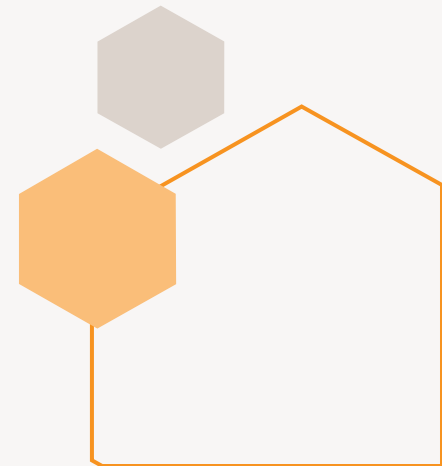


Engineering and Construction Surveying

ACBA4020

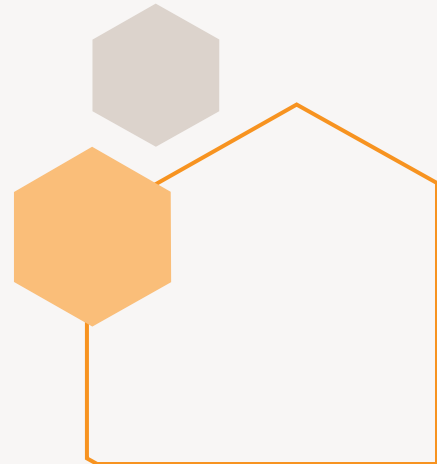


Latitude	Longitude
60°10'N	24°56'E
24°34'N	81°47'W





Latitude	Longitude
60°10'N	24°56'E
24°34'N	81°47'W



Question 2

A surveyor leaves **benchmark A** and walks **due South** for **60 m**, then **due East** for **25 m** to reach point **B**. The surveyor then returns directly to benchmark **A** by the shortest route.

- a) Calculate the **distance** of the direct route from B to A.
- b) Calculate the **bearing** of the direct route from B to A.

$$a^2 + b^2 = c^2$$

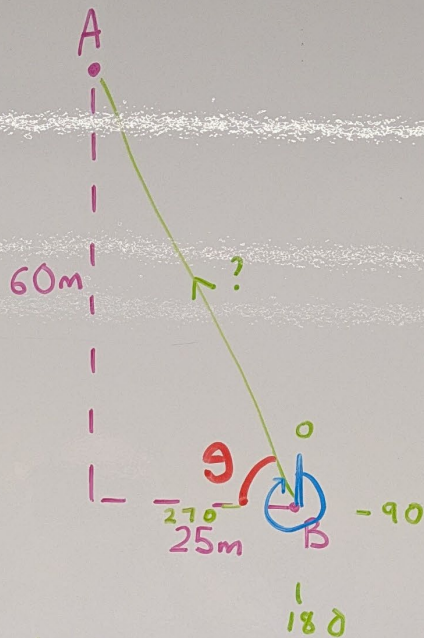
$$60^2 + 25^2 = c^2$$

$$c = \sqrt{60^2 + 25^2} = \underline{\underline{65m}}$$

$$\tan \theta = \frac{60}{25}$$

$$\theta = \tan^{-1} \left(\frac{60}{25} \right) = 67.4^\circ$$

$$WCB = 270 + 67.4 = \underline{\underline{337.4^\circ}}$$



Question 3

A surveyor sets out from **control point P** and measures **80 m due West**, then **30 m due North** to reach point **Q**.

The surveyor then observes point **P** directly from **Q**.

- a) Calculate the **distance** from Q to P.
- b) Calculate the **bearing** from Q to P.

Question 1

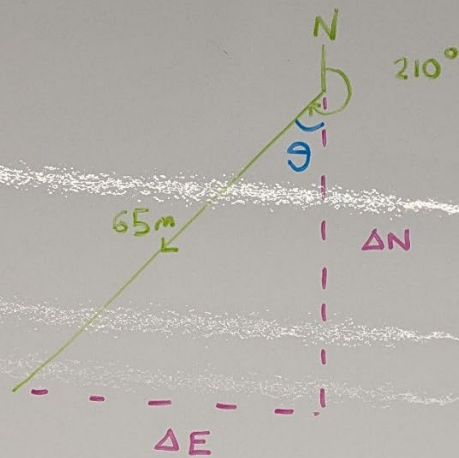
A surveyor measures a traverse leg from **station A** on a bearing of **045°** for a distance of **100 m**.

Calculate the **change in Easting (ΔE)** and **change in Northing (ΔN)**.

Question 2

A boundary line runs from **point B** on a bearing of **210°** for a distance of **65 m**.

Calculate the **change in Easting** and **change in Northing**.



$$210 - 180 = \underline{\underline{30^\circ}}$$

$$\sin 30 = \frac{\Delta E}{65} \Rightarrow \Delta E = 65 \times \sin 30$$

$$= \underline{\underline{32.5m}}$$

$$\cos 30 = \frac{\Delta N}{65} \Rightarrow \Delta N = 65 \times \cos 30$$

$$= \underline{\underline{56.3m}}$$

$$\underline{\underline{-32.5, -56.3}}$$



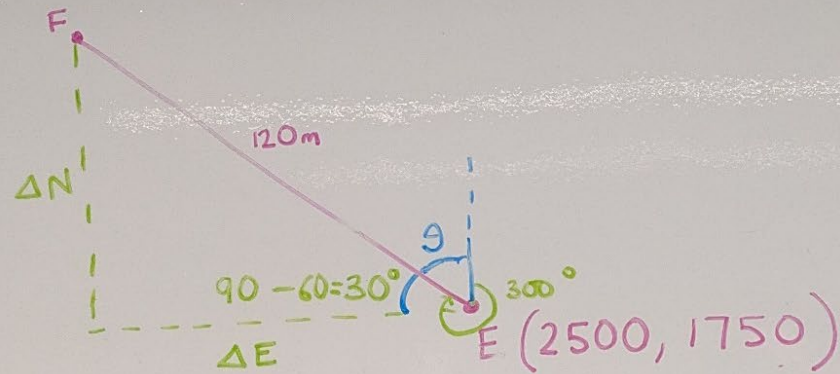
Question 3

A surveyor sets out from **control point E** with coordinates:

$$E = (E\ 2500.000, N\ 1750.000)$$

The surveyor travels on a bearing of 300° for a distance of **120 m**.

Calculate the **coordinates of point F**.



$$\theta = 360 - 300 = 60^\circ$$

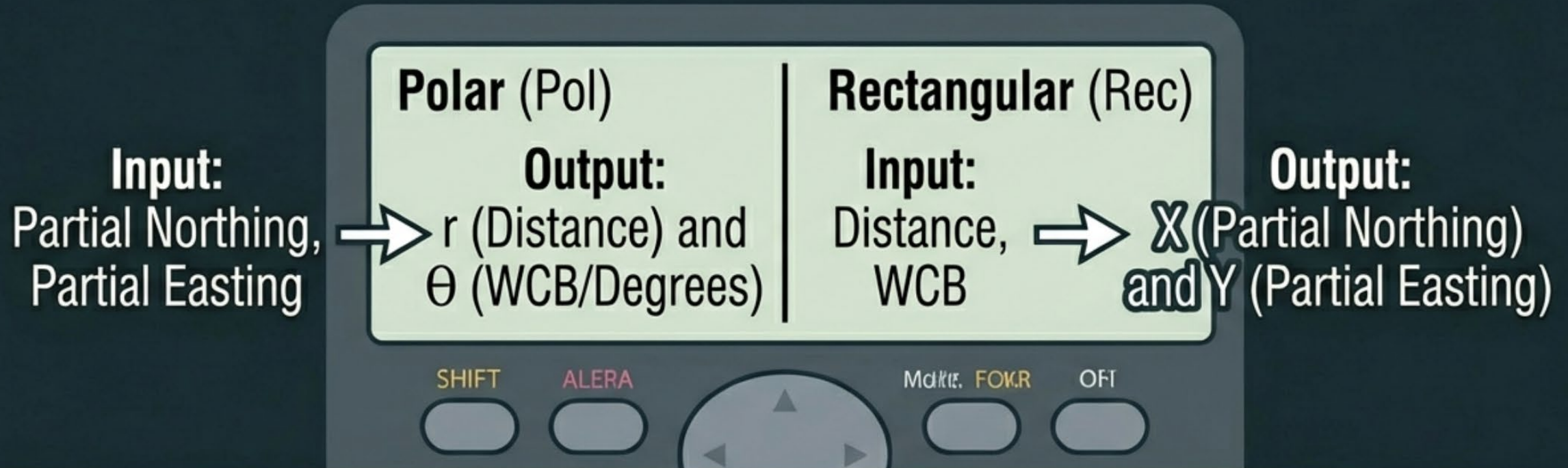
$$\cos 30 = \frac{\Delta E}{120} \Rightarrow \Delta E = 120 \times \cos 30 = \underline{\underline{103.9\text{m}}}$$

$$\sin 30 = \frac{\Delta N}{120} \Rightarrow \Delta N = 120 \sin 30 = \underline{\underline{60\text{m}}}$$

$$\begin{aligned} F &= (2500 - 104\text{E}, 1750 + 60\text{N}) \\ &= (2396\text{E}, 1810\text{N}) \end{aligned}$$

$$\underline{\underline{-32.5, -5}}$$

Modern scientific calculators offer Polar and Rectangular functions to speed up coordinate geometry.



Note: Once partials are calculated, simply add them to the known station coordinates to fix the new position (check signs for +/- direction).

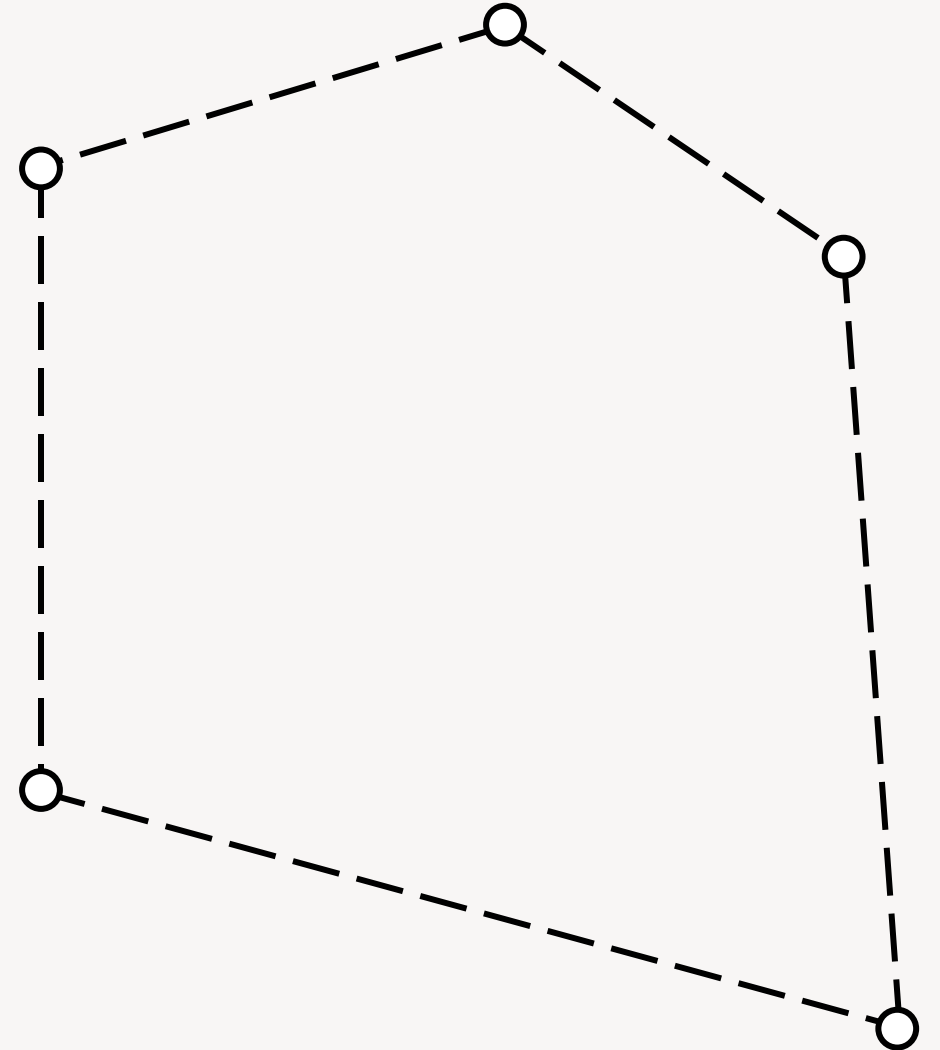
Whole to Part

- Surveyors must establish a framework of control points over the entire survey area first, before measuring smaller, detailed sections.



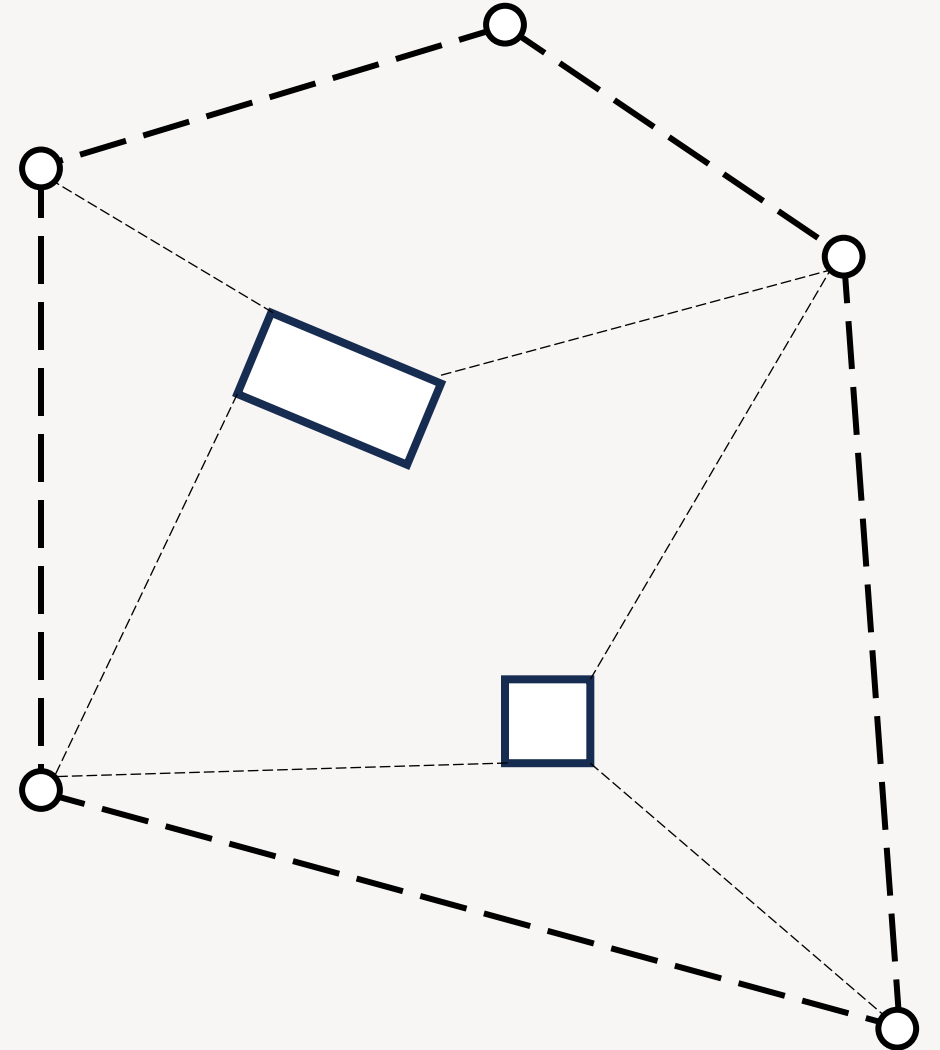
Whole to Part

- Establish main control points (like triangulation stations or traverse points).
- These points are measured very accurately.
- They form a strong reference network over the whole area.



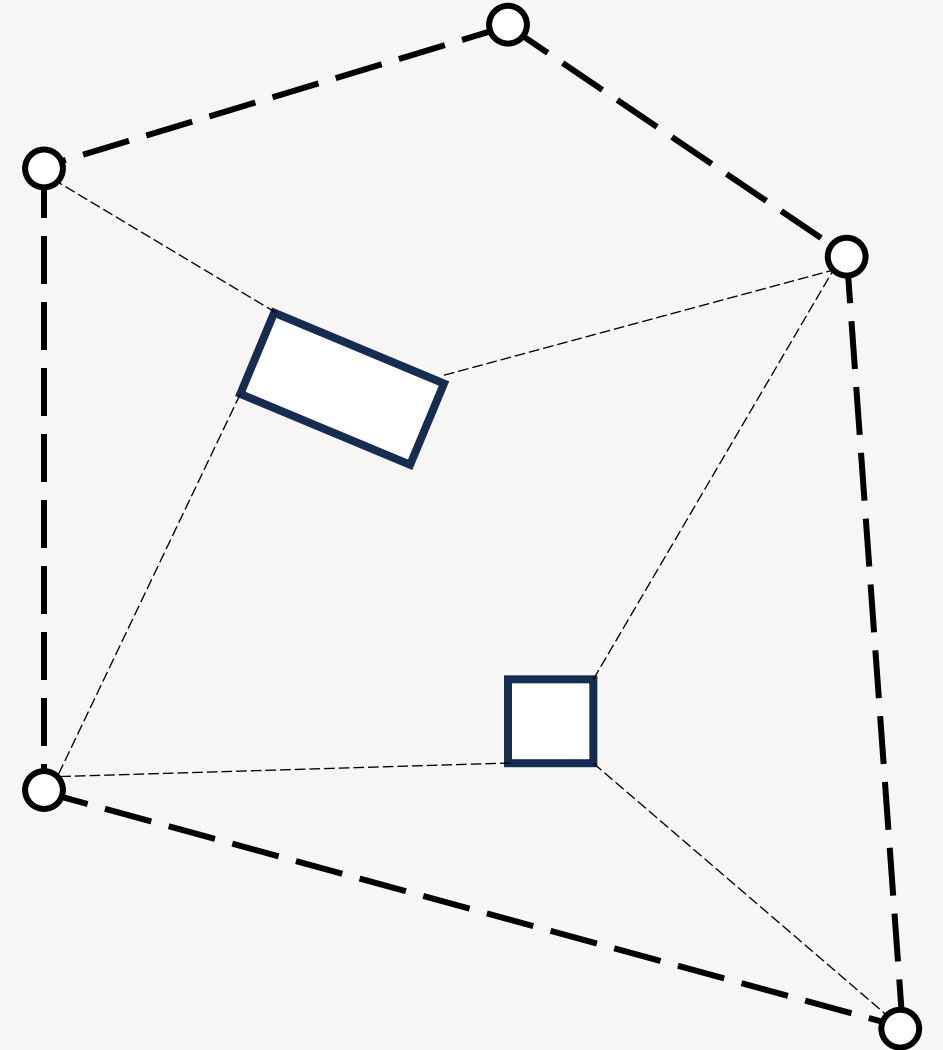
Whole to Part

- Smaller features (roads, buildings, boundaries, details) are measured.
- These are tied to the already-fixed control points.



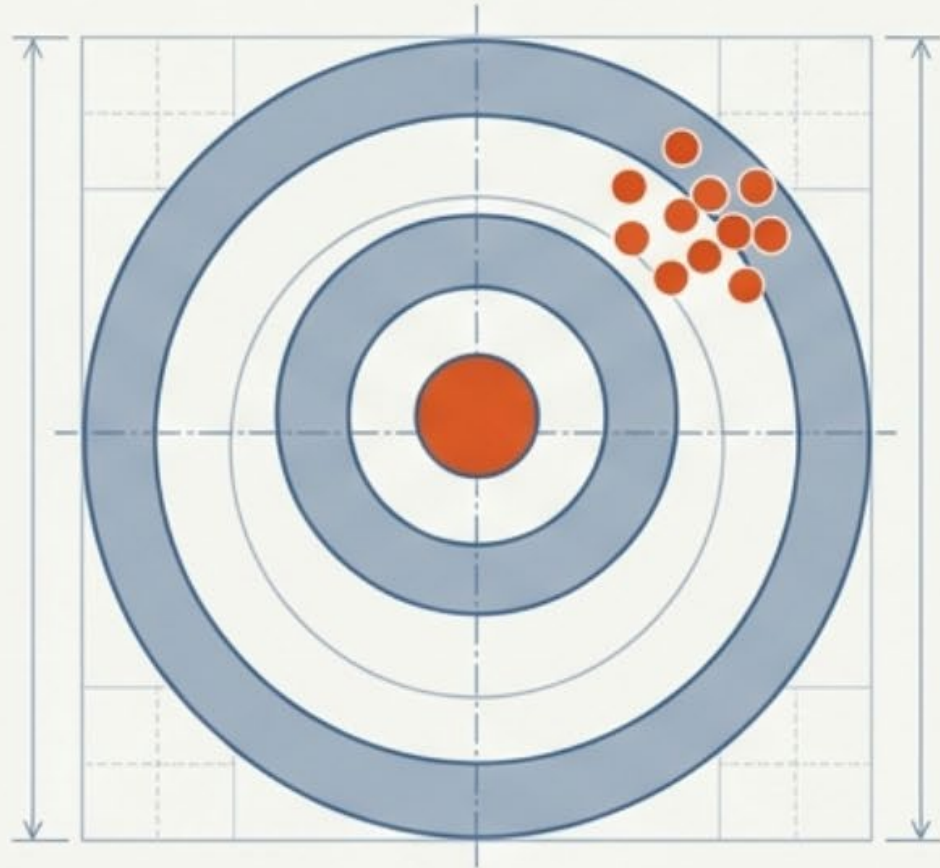
Whole to Part

- The goal is to minimise the accumulation of errors.
- If you work part to whole, small errors compound to large discrepancies.



Data Quality: Accuracy vs. Precision

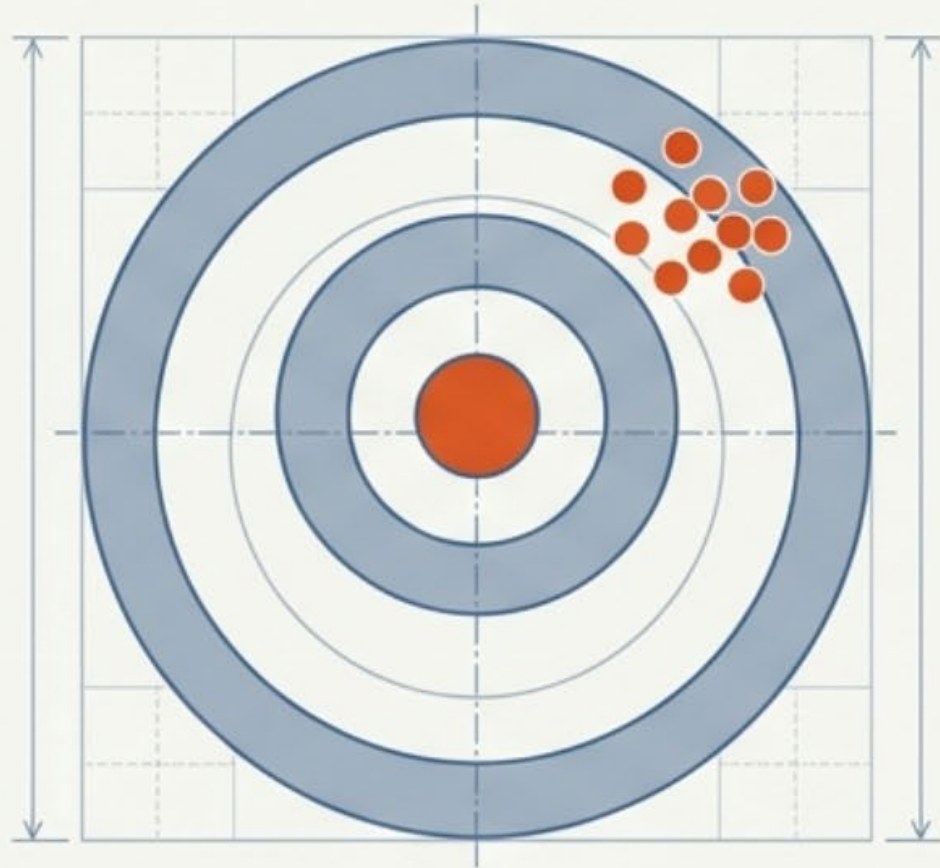
High Precision, Low Accuracy



Precision = Repeatability
(Minimizing variation)

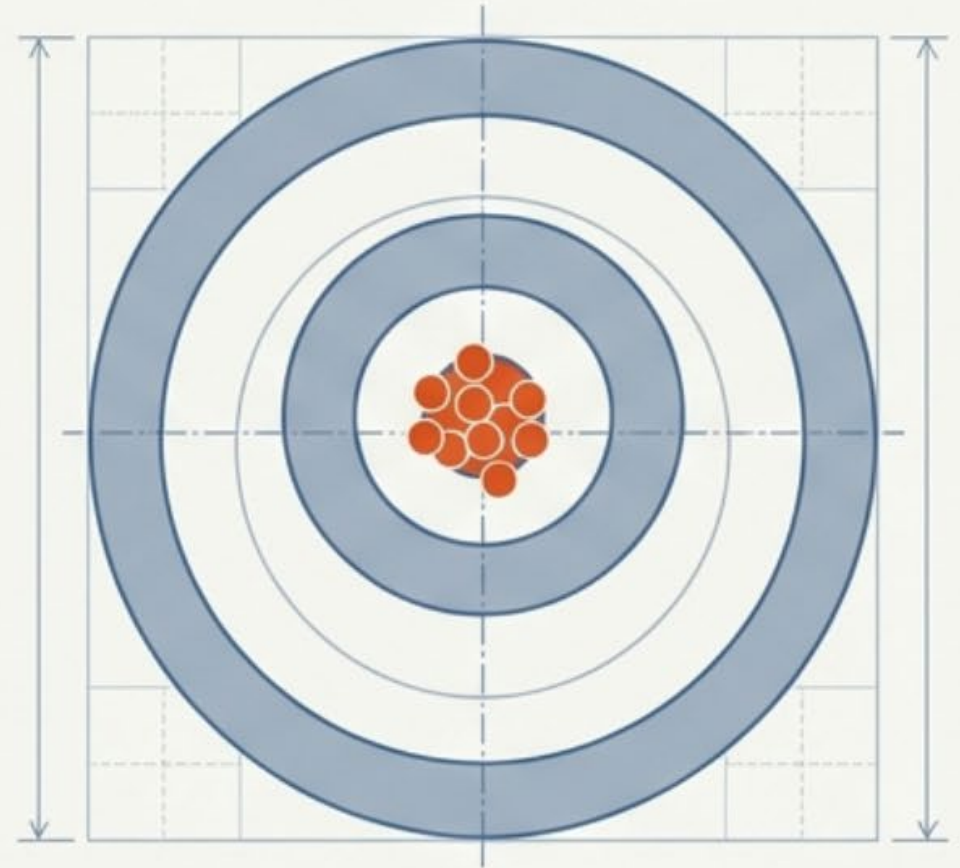
Data Quality: Accuracy vs. Precision

High Precision, Low Accuracy



Precision = Repeatability
(Minimizing variation)

High Accuracy, High Precision



Accuracy = Closeness to truth
(Minimizing error)

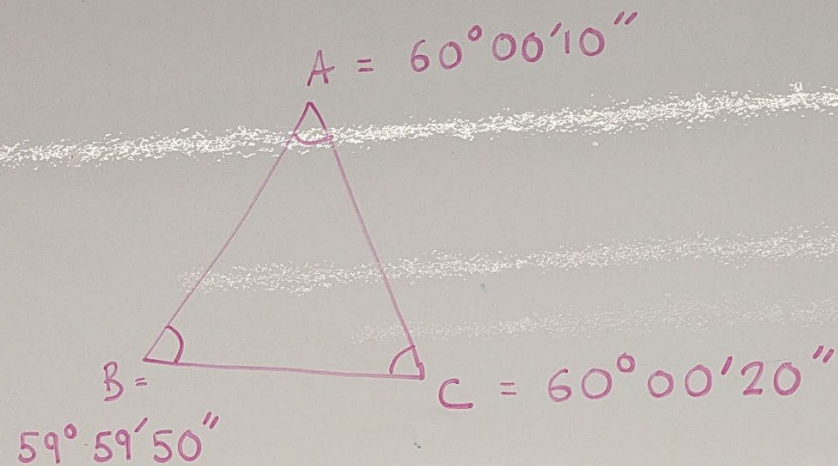
Instrument
Calibration

Careful
Observation

Minimising
Errors

Repeat
Measurements

Error Checking
and Adjustment



$$\sum \text{angles} = 180^{\circ} 00' 20''$$

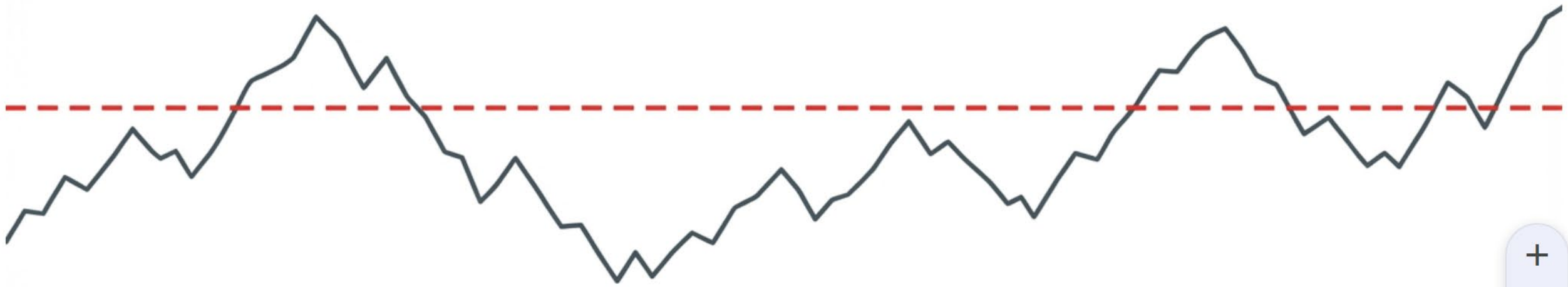
$$\frac{20}{3} = 6.7''$$

$$A = 60^{\circ} 00' 10'' - 6.7'' = 60^{\circ} 00' 33''$$

$$B = 59^{\circ} 59' 50'' - 6.7'' = 59^{\circ} 59' 43.3''$$

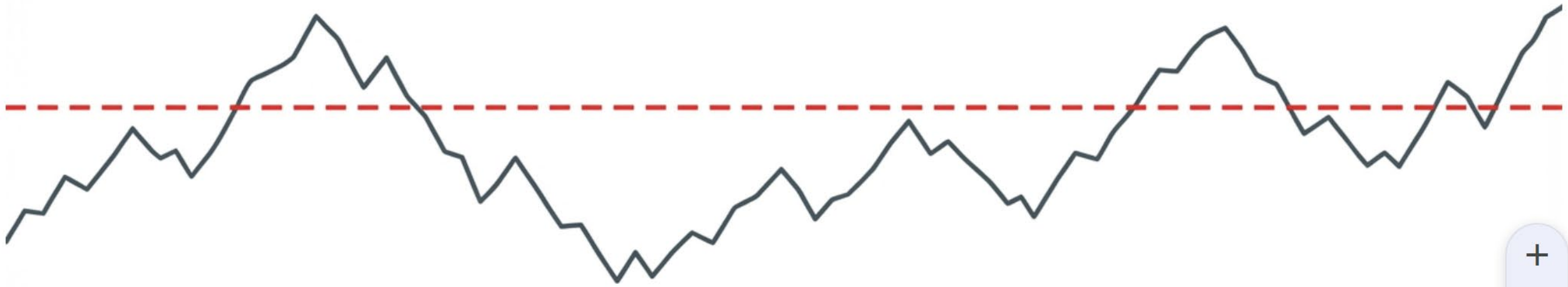
$$C = 60^{\circ} 00' 20'' - 6.7'' = 60^{\circ} 00' 13.3''$$

Levelling



Levelling

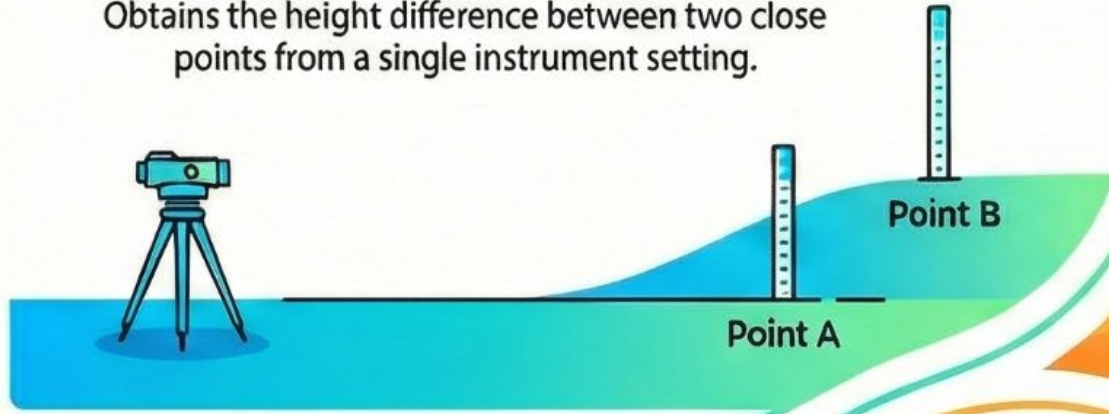
Levelling in surveying is the process of determining the height of one level relative to another.



DISTANCE-BASED LEVELING

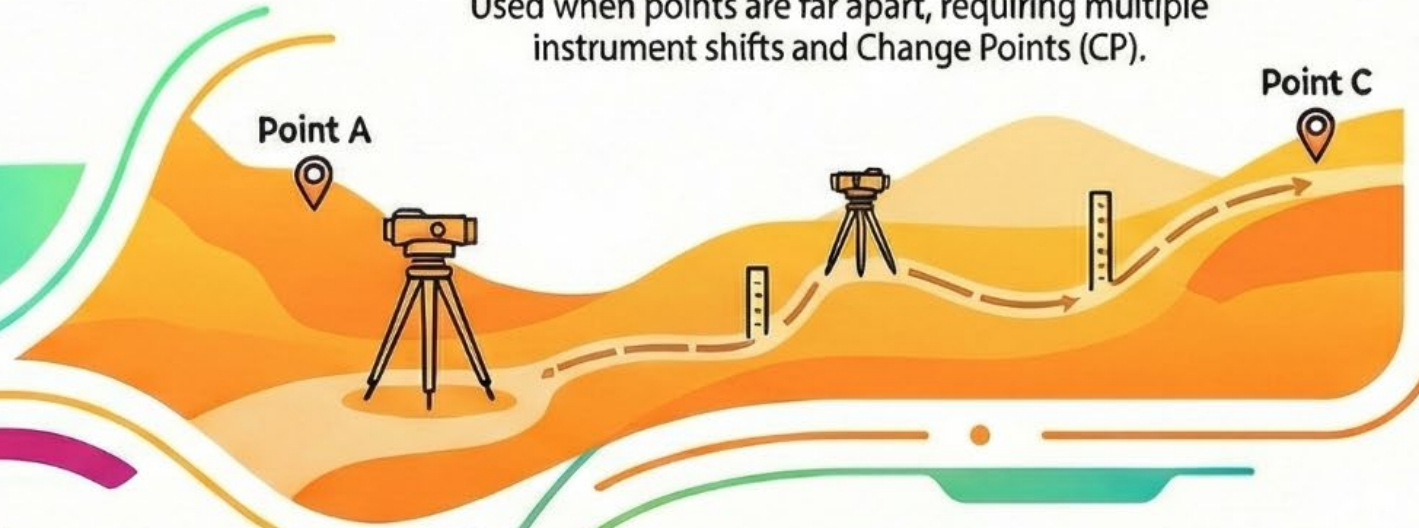
Simple Leveling for Nearby Points

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



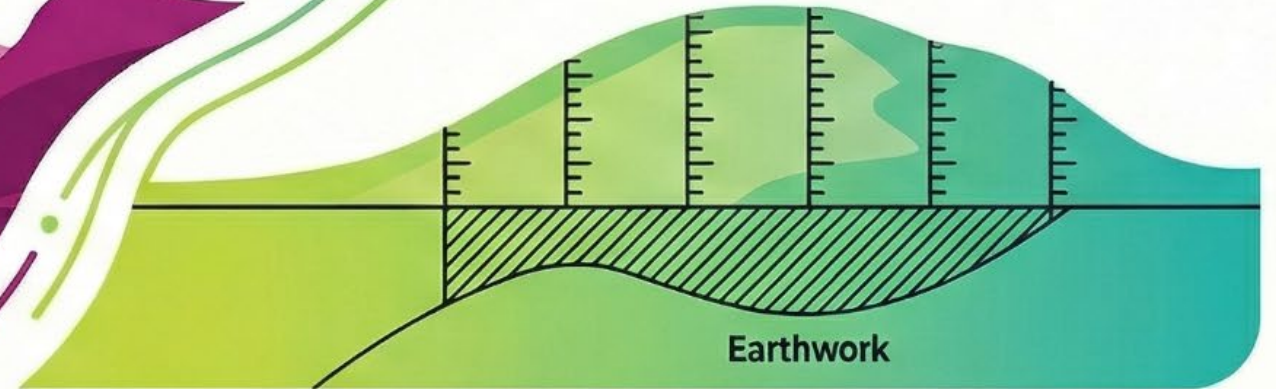
Differential Leveling for Large Distances

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.

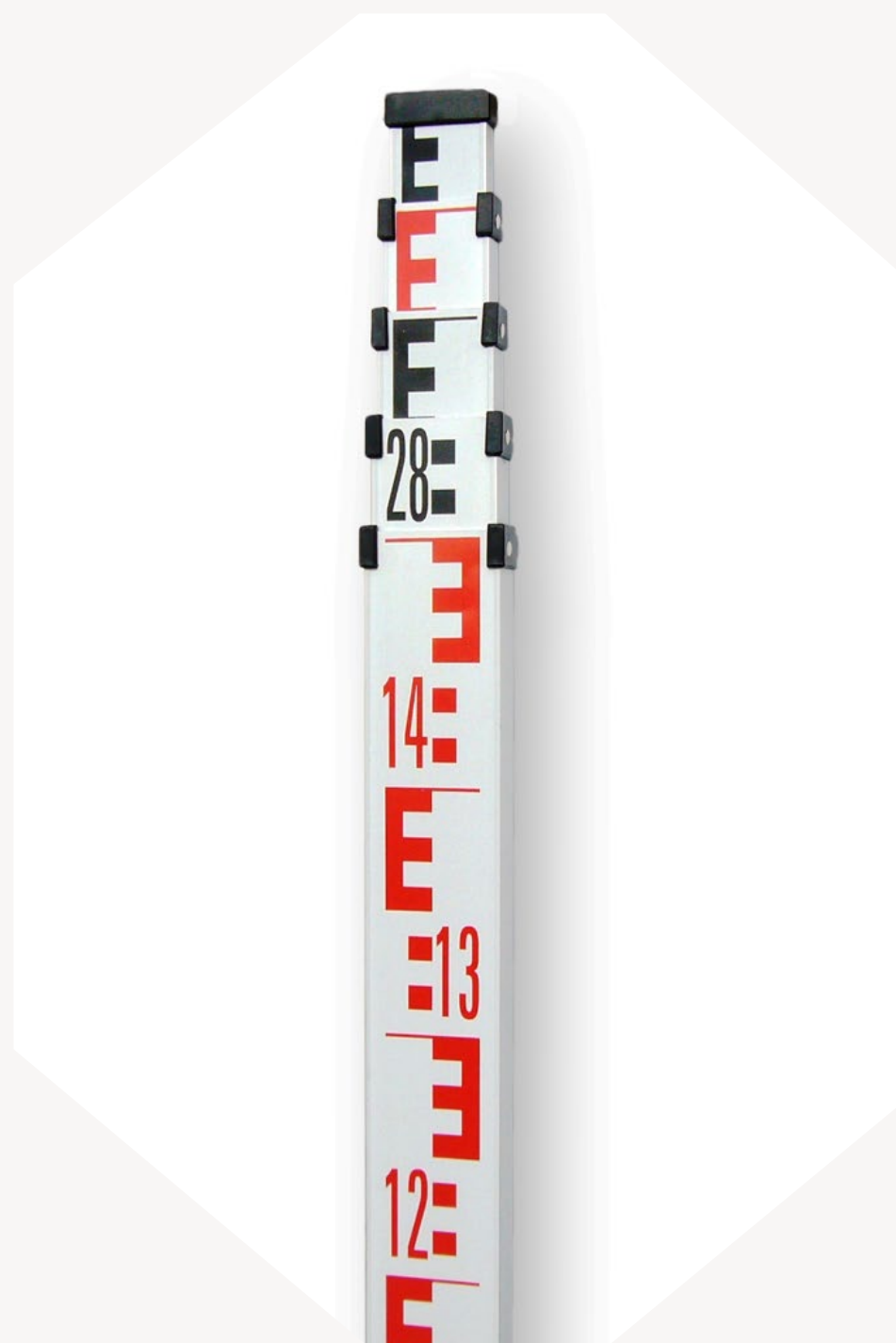


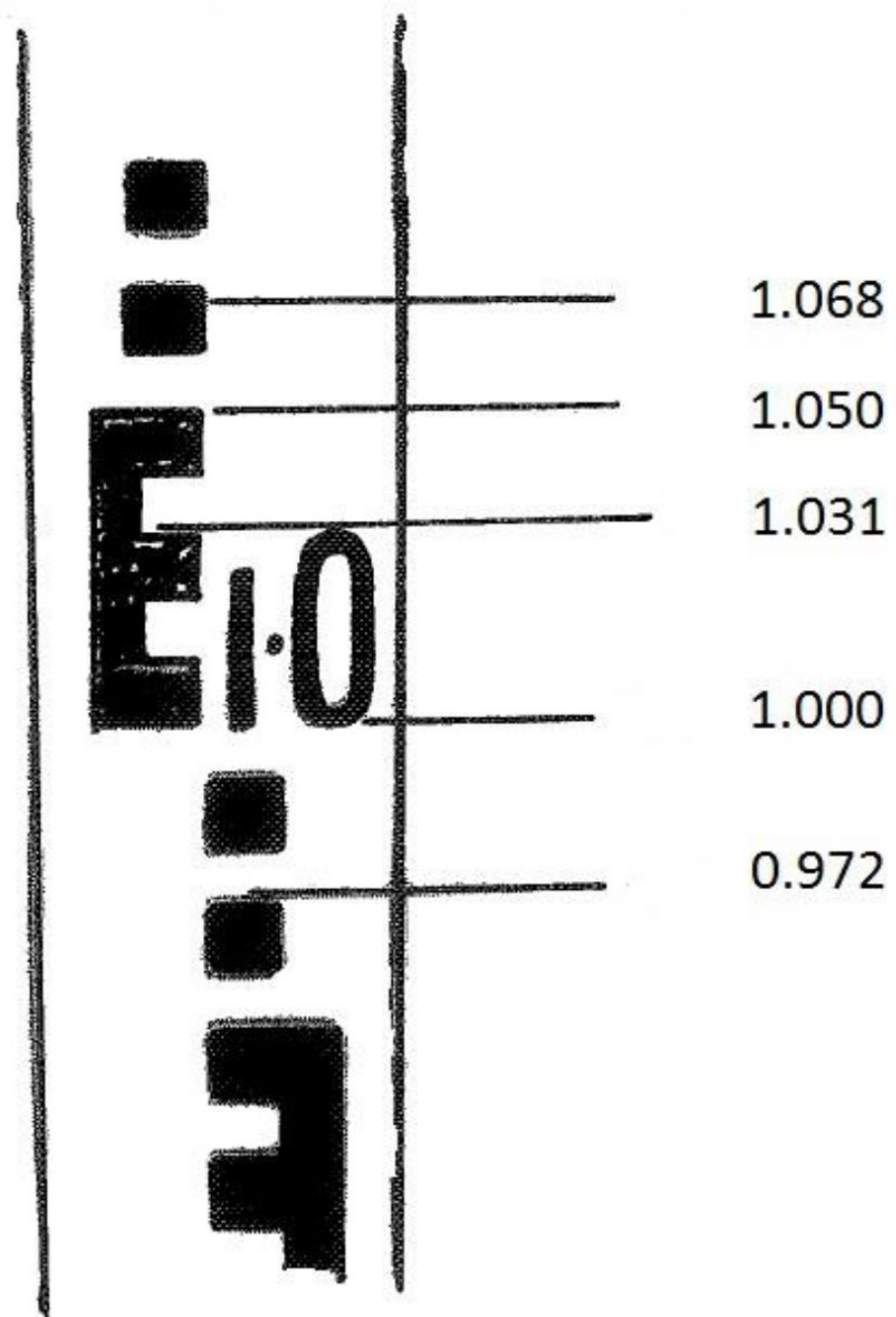
Cross-sectioning for Earthwork

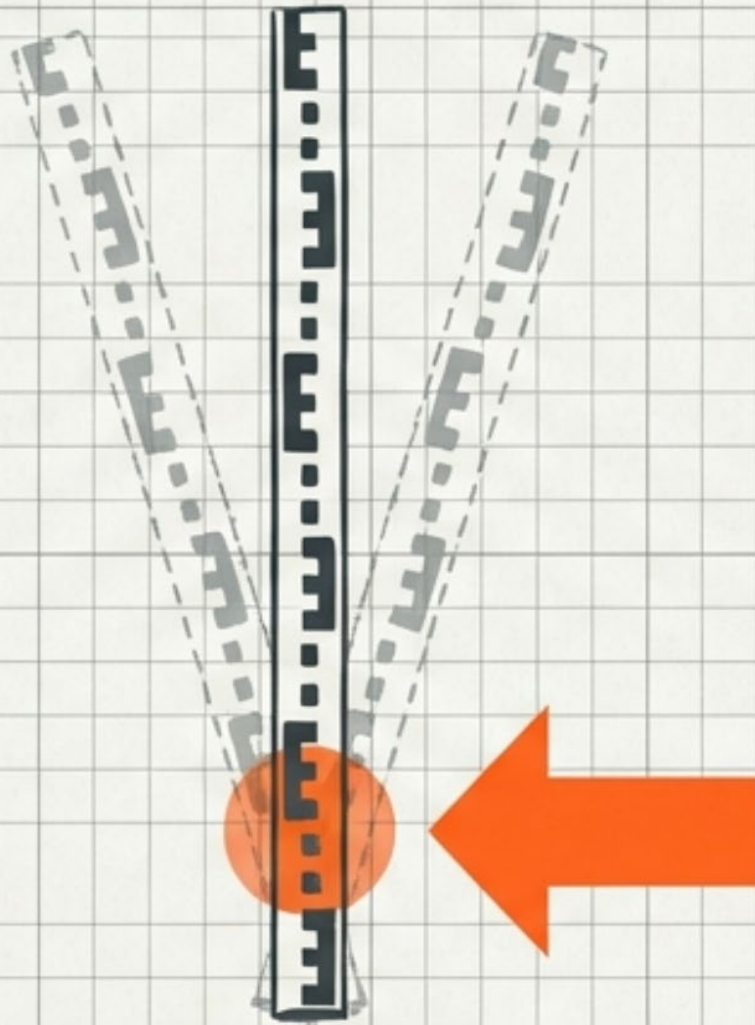
Measurements taken at regular intervals to calculate ground volume for engineering projects.

PROJECT-SPECIFIC LEVELING





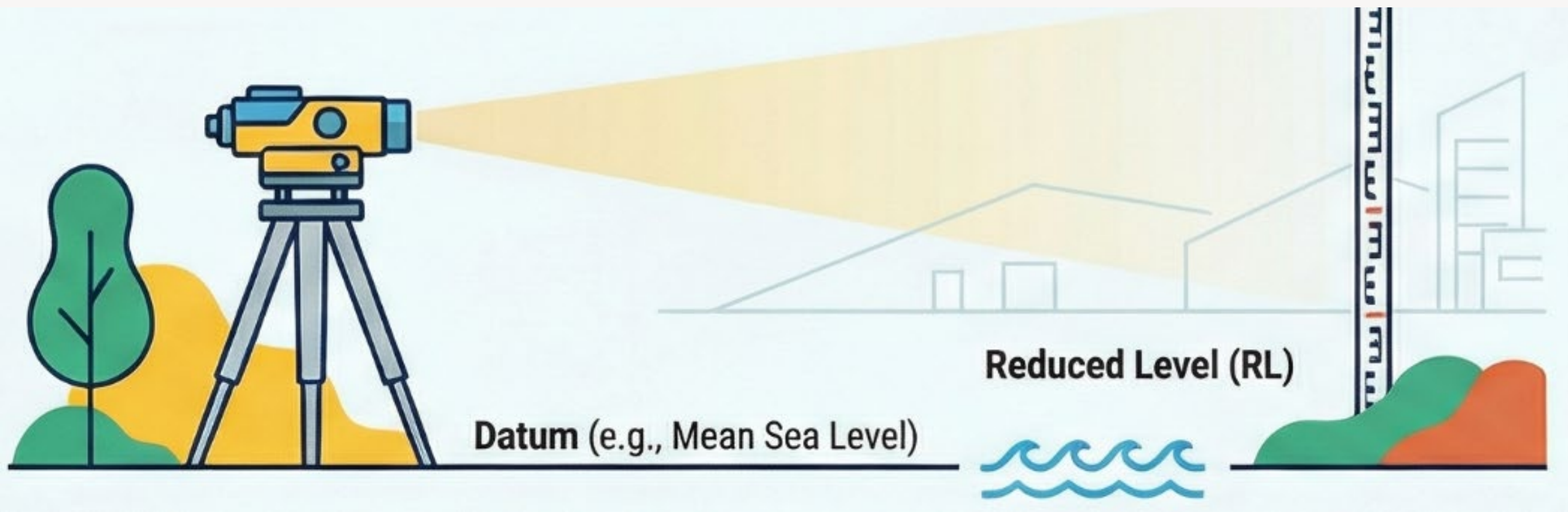


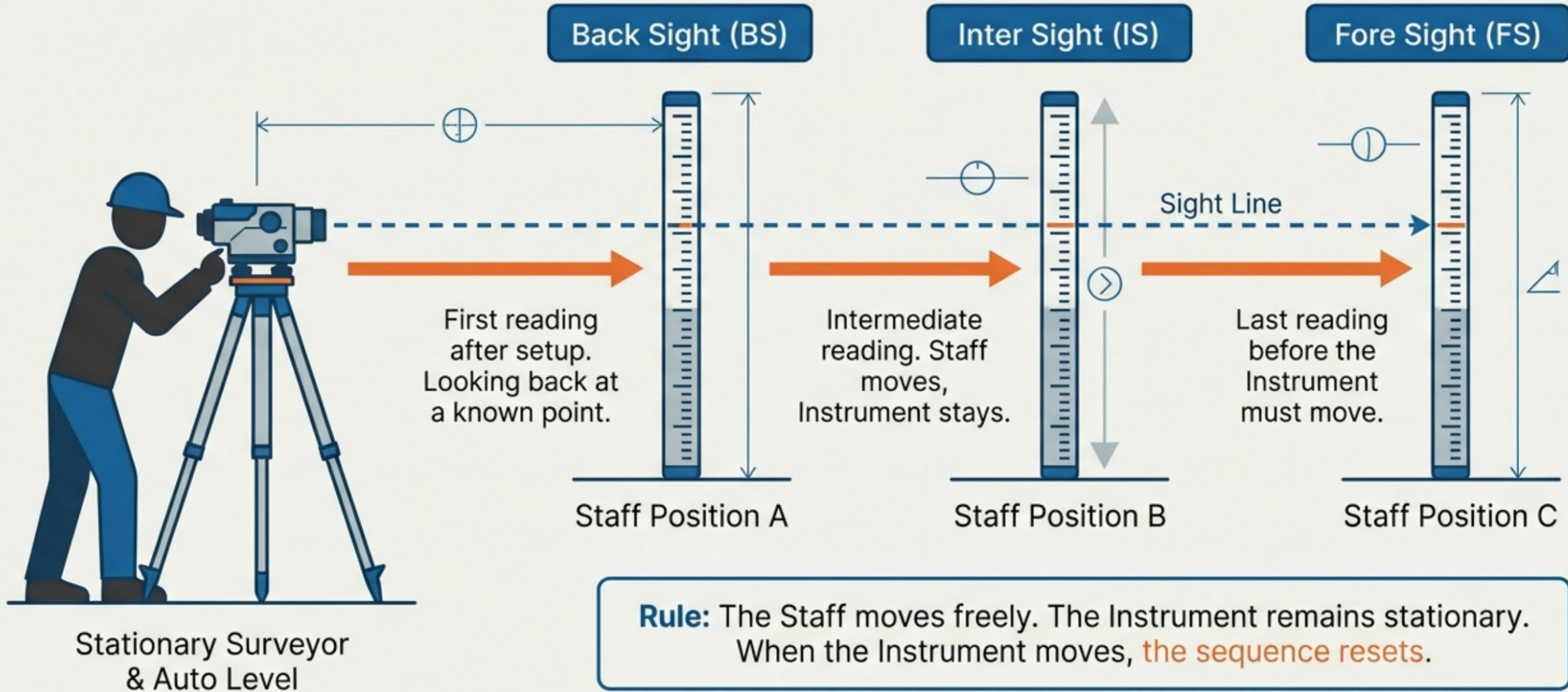


THE ROCKING RULE:

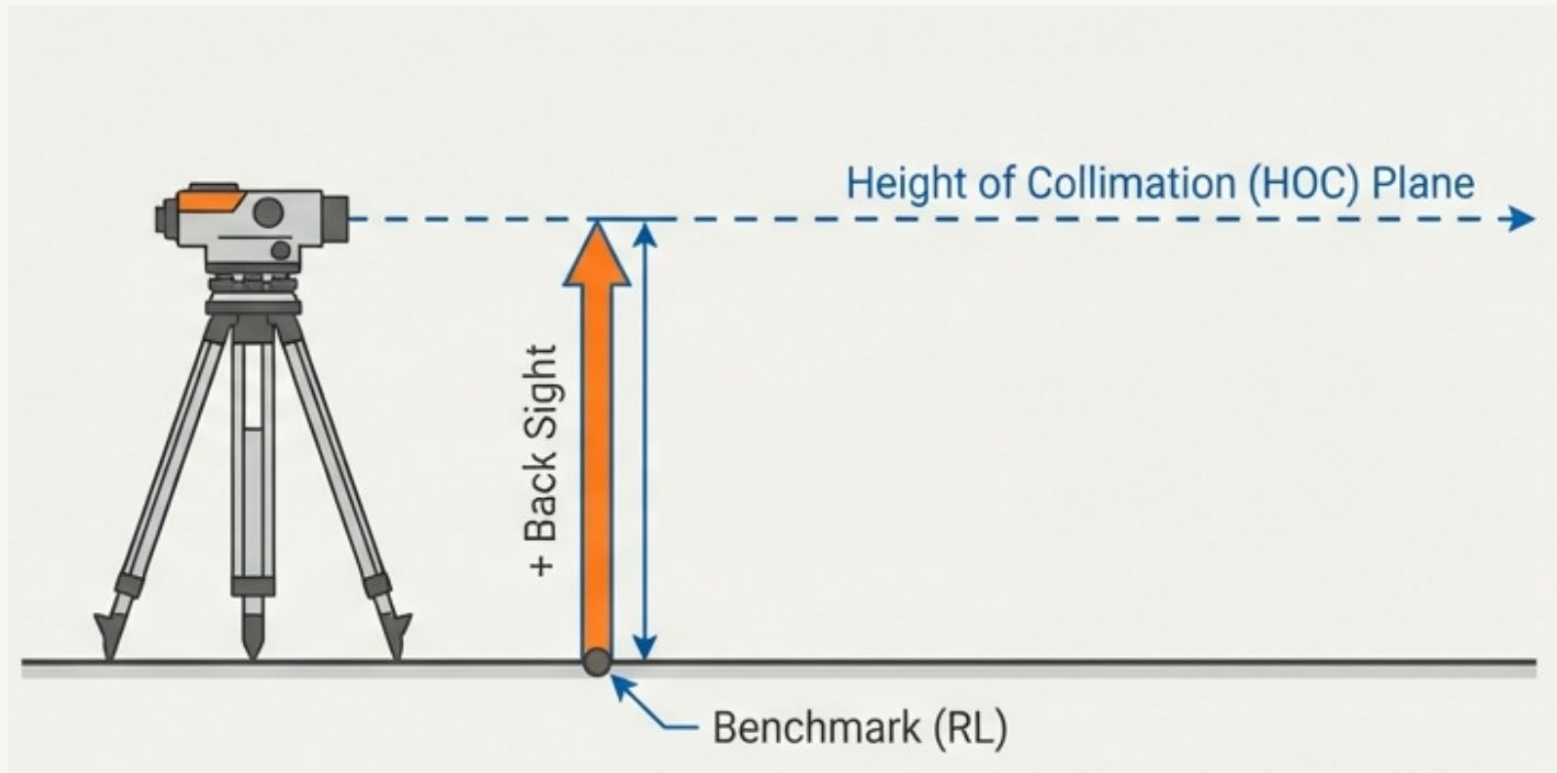
Record the LOWEST reading observed.

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





Height of Collimation



$$\text{Reduced Level (R.L)} + \text{Backsight (B.S)} \\ = \text{Height of Collimation (HoC)}$$

Establishing the First Plane of Sight



Station	Back Sight (BS)	Inter Sight (IS)	Fore Sight (FS)	Height of Collimation (HOC)	Reduced Level (RL)
1	1.034	1.961	...	[Blank → 87.486]	86.452
		1.961		-	
					85.525



Step 1: $86.452 + 1.034 = 87.486$ (New HOC)
Step 2: $87.486 - 1.961 = 85.525$ (New Point RL)

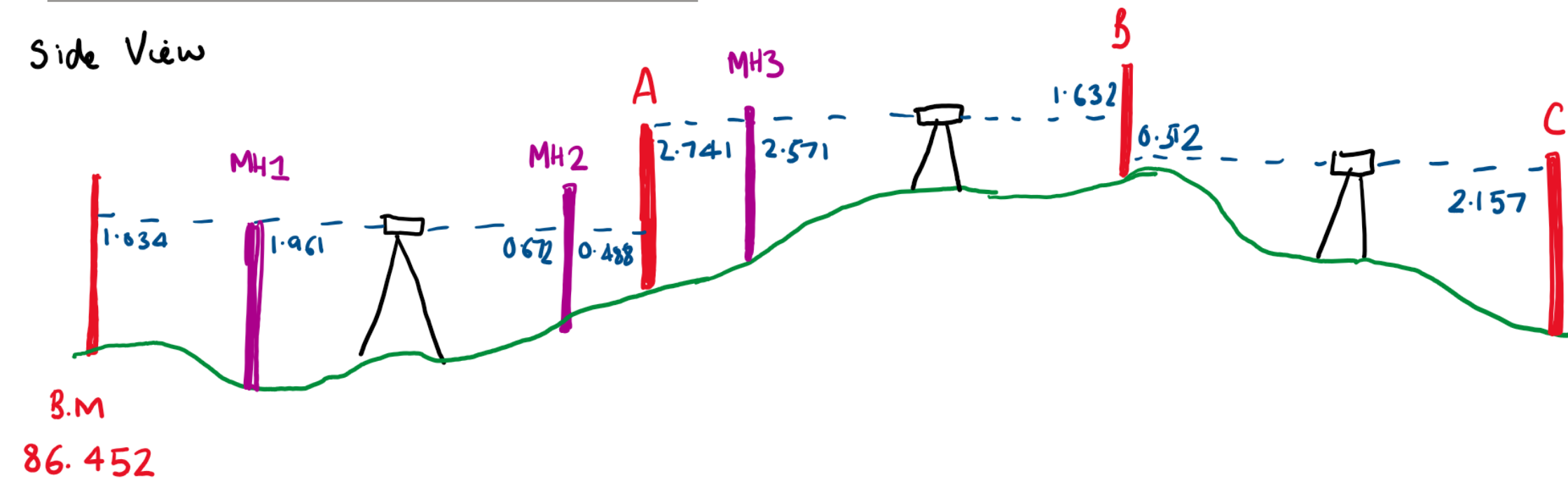
Arithmetic Check

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

Height of Collimation Method

Search Notebooks

Side View



Plan View



B.S	IS	F.S	HOC	RL	Remarks
1.034			$86.452 +$ $1.034 =$ 87.486	<u>86.452</u>	BM
	1.961			$87.486 -$ $1.961 =$ <u>85.525</u>	MH1
	0.672			$87.486 -$ $0.672 =$ <u>86.814</u>	MH2
2.741		0.488	$86.998 +$ $2.741 =$ 89.739	$86.452 -$ $0.488 =$ <u>86.998</u>	A (Change Point)
	2.571			$89.739 -$	

			$2.741 =$ 89.739	$0.488 =$ <u>86.998</u>	A (Change Point)
	2.571			$89.739 -$ $2.571 =$ <u>87.168</u>	MH3
0.512		1.632	$88.107 +$ $0.512 =$ 88.619	$89.739 -$ $1.632 =$ <u>88.107</u>	B (Change Point)
		2.157		$88.619 -$ $2.157 =$ <u>86.462</u>	C

Check

$$\sum BS - \sum FS = \text{Last R.L} - \text{First R.L}$$

$$(1.034 + 2.741 + 0.512) - (0.488 + 1.632 + 2.157) =$$

$$4.287 - 4.277 = 0.01$$

$$86.462 - 86.452 = 0.01$$

