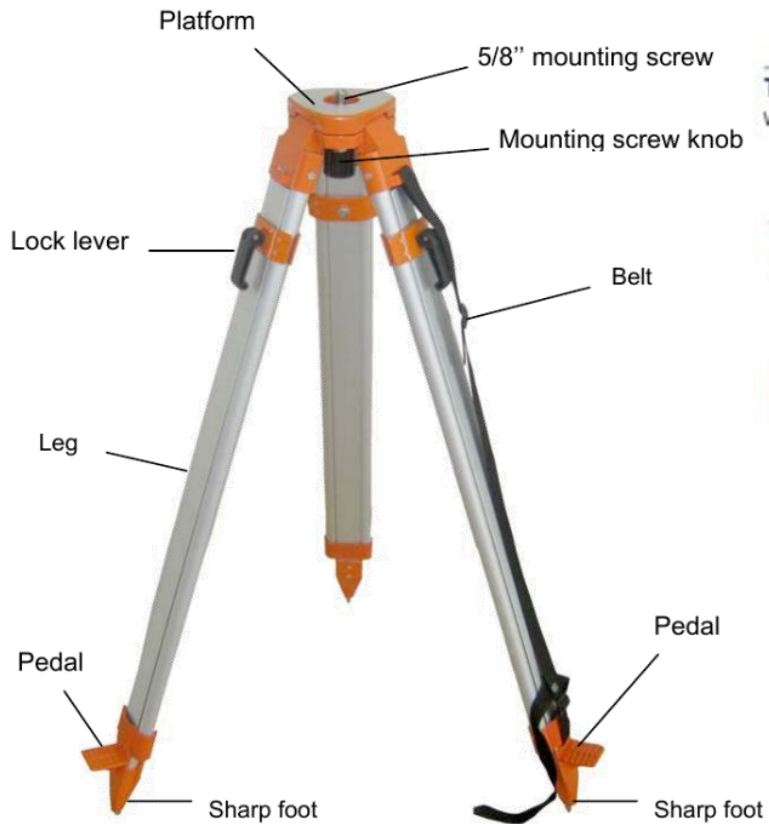# *Introduction to Levelling Survey*
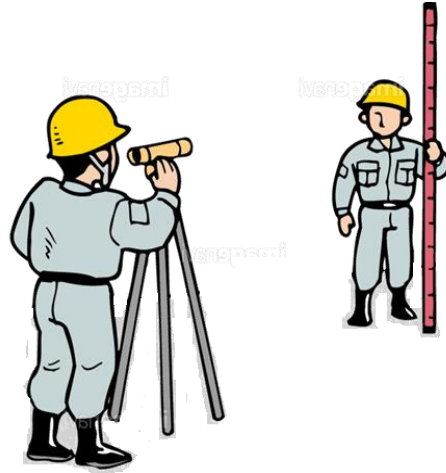
February 2022

Project for Increasing Farmers Households' Income through Strengthening Domestic Rice Production in Timor-Leste
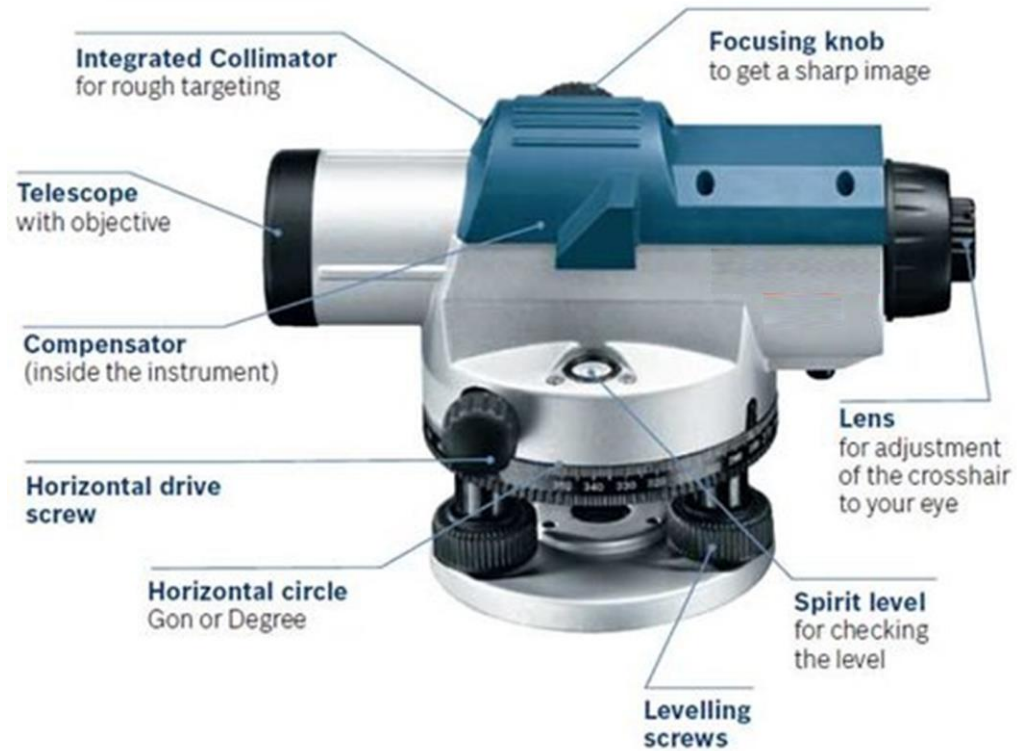
Levelling Survey Instrument

Level Staff

Tripod

Auto Level

Platform

5/8" mounting screw

Mounting screw knob

Lock lever

Belt

Leg

Pedal

Pedal

Sharp foot

Sharp foot

Integrated Collimator for rough targeting

Focusing knob to get a sharp image

Telescope with objective

Compensator (inside the instrument)

Lens for adjustment of the crosshair to your eye

Horizontal drive screw

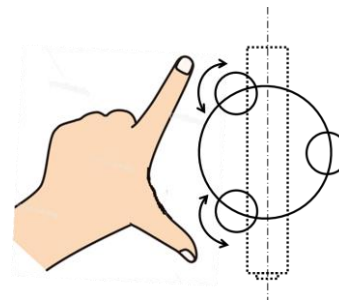**Horizontal circle** Gon or Degree

Spirit level for checking the level

Levelling screws

1

Install the Instrument

Auto Level

Spirit level
(Bulls Eye Bubble)

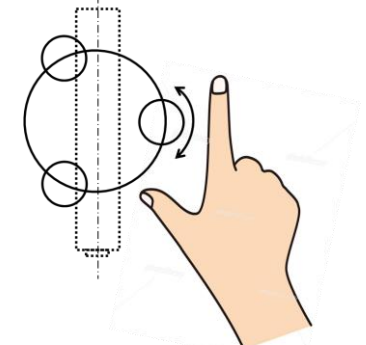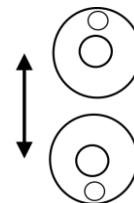Levelling screws

Adjust the levelling screws to level,
looking at the spirit level (Bulls Eye Bubble))
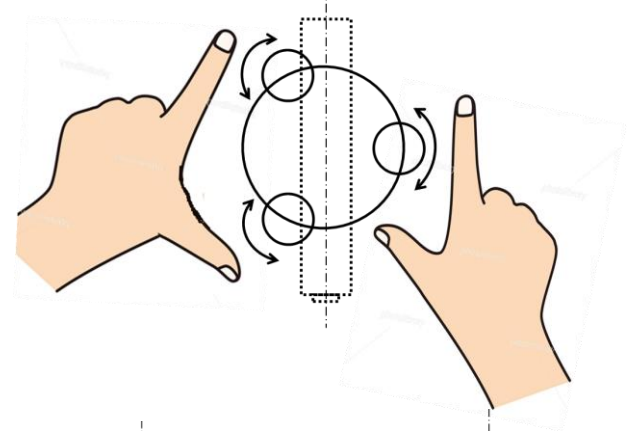
Adjust back and forth
with your left thumb and
index finger

Adjust left and right
with your right index
finger
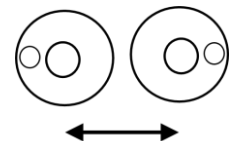
How to Read the Staff

There are various types of staff scales.

Your view of the levelling staff with the crosshair.

Crosshair

This indicates a reading of 0.267 m, interpolated between the 0.260 m and 0.270 m marks.

This indicates a reading of 1.422 m, interpolated between the 1.420 m and 1.430 m marks.

Take minimum reading!

OK **No**
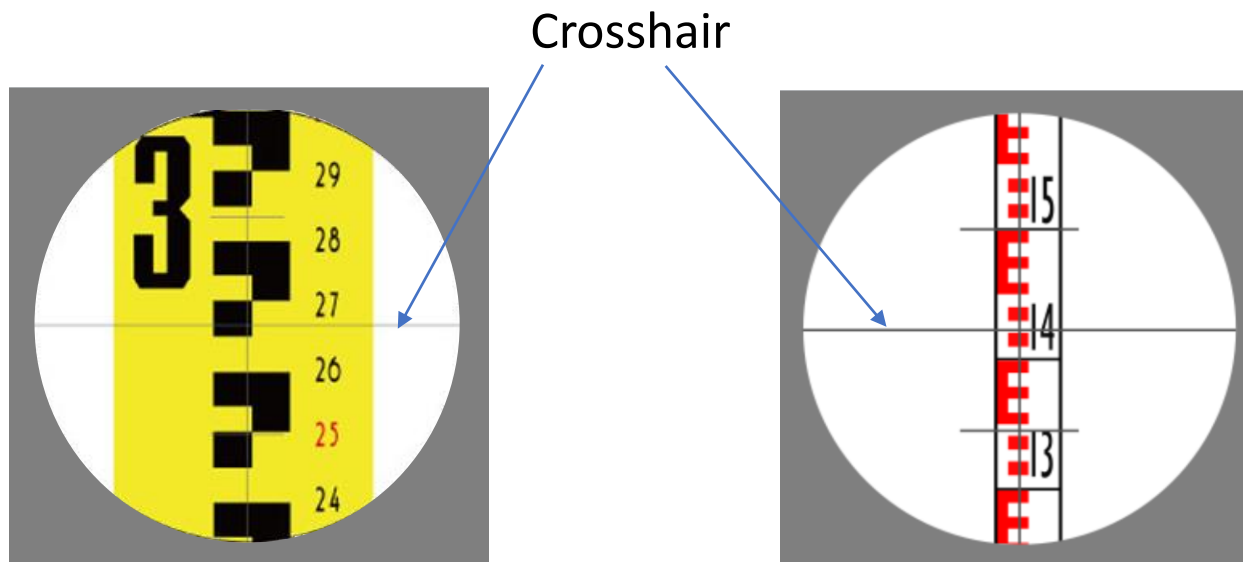
B A & C

A B C

A B C
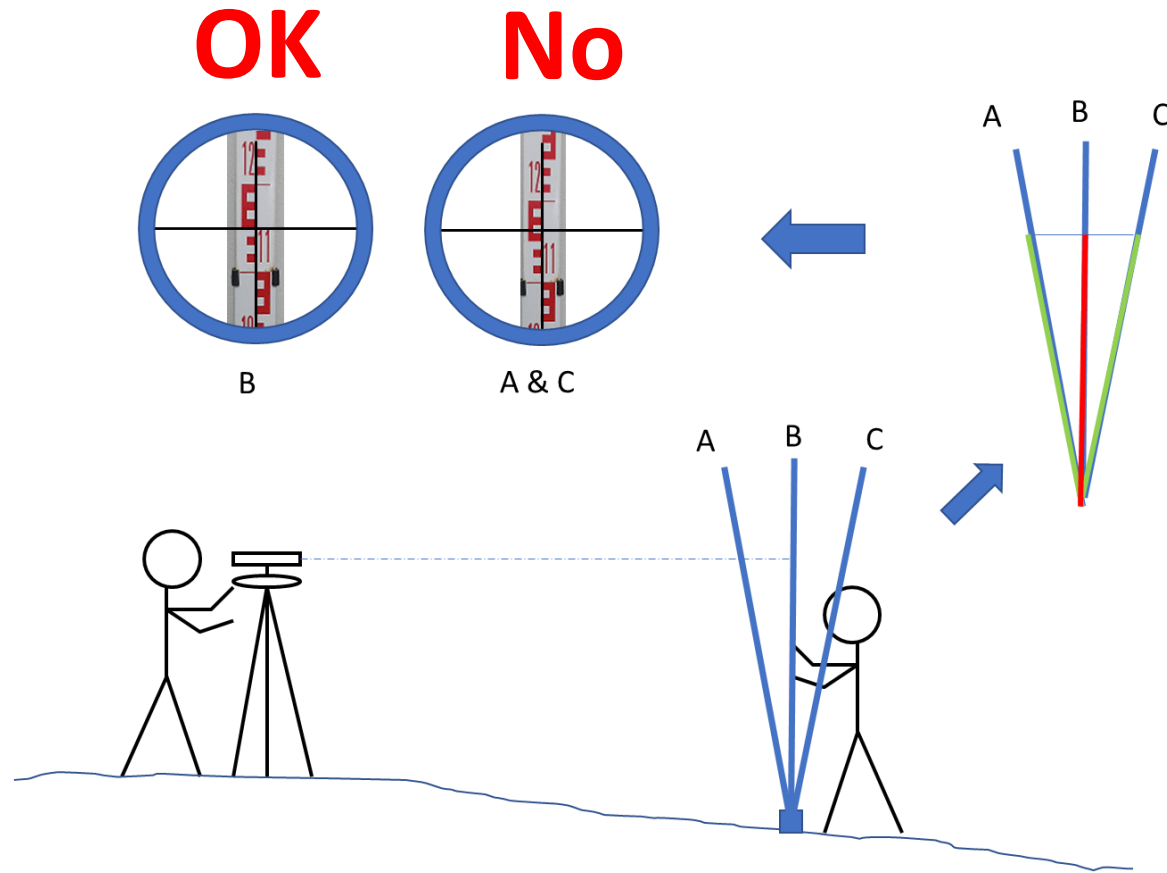
Basic Levelling Survey

- The reading at the known point is called the backsight (BS)
- The reading taken after turning the instrument and moving the staff is the foresight (FS) at the unknown points

BS
Reading: 0.267 (m)

FS
Reading: 0.502 (m)

BS

Line of sight

FS

0.267 m

0.502 m

Known point
(EL. 100.000 m)

$h = 0.502 - 0.267 = 0.235$ (m)

Unknown point
$100.000 - 0.235 = 99.765$ (m)
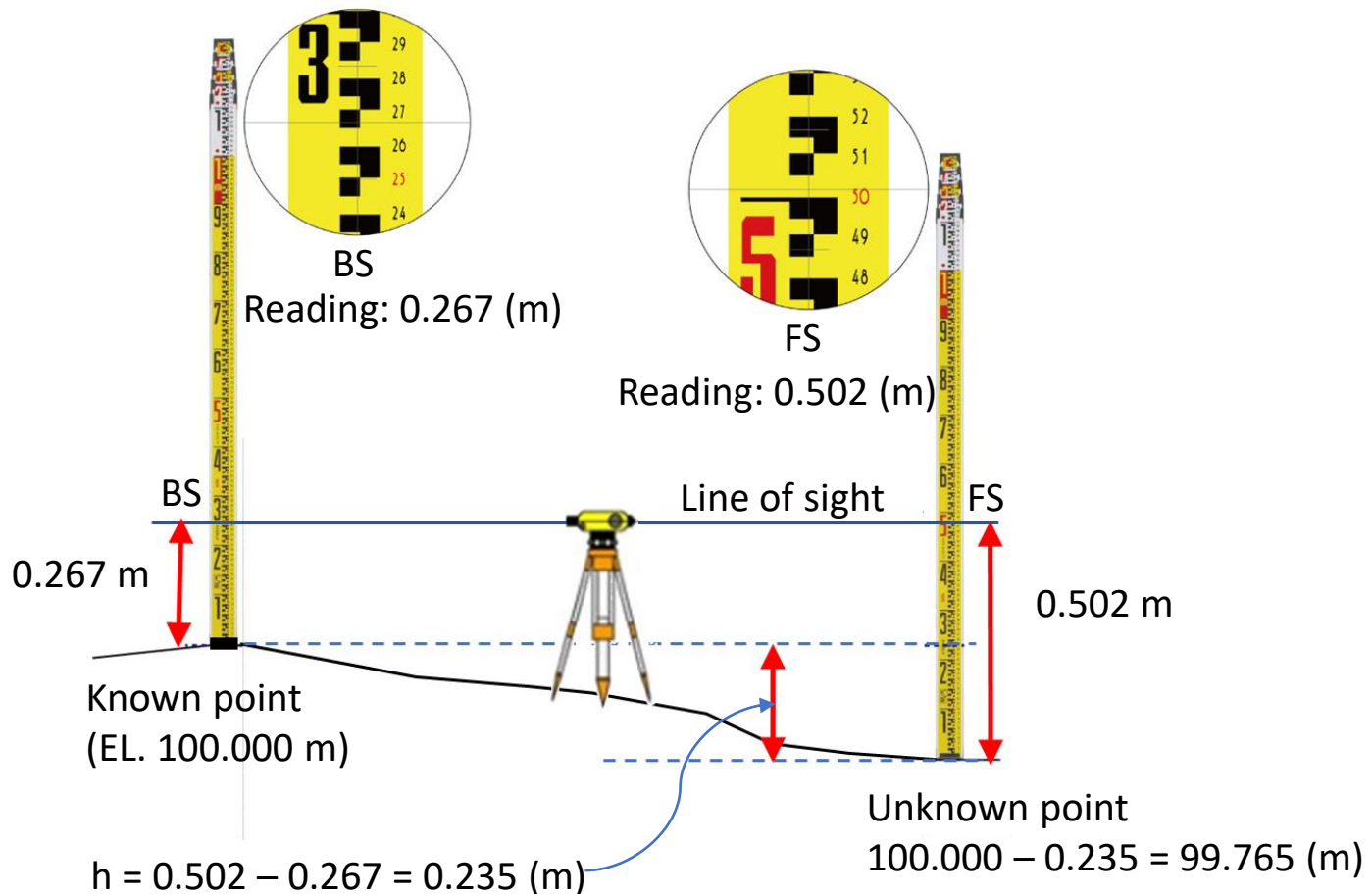
Basic Levelling Survey

- To continue levelling, the staff is kept on the point at A and the instrument moved to the midpoint between A and the next point, B.
- A is called the change point (CP) or turning point (TP).
- The staff at A is carefully turned toward the instrument and a BS reading taken.
- Then the staff is moved to B and a FS reading is made.
- The procedure is repeated as many times as needed.

B

A

BM
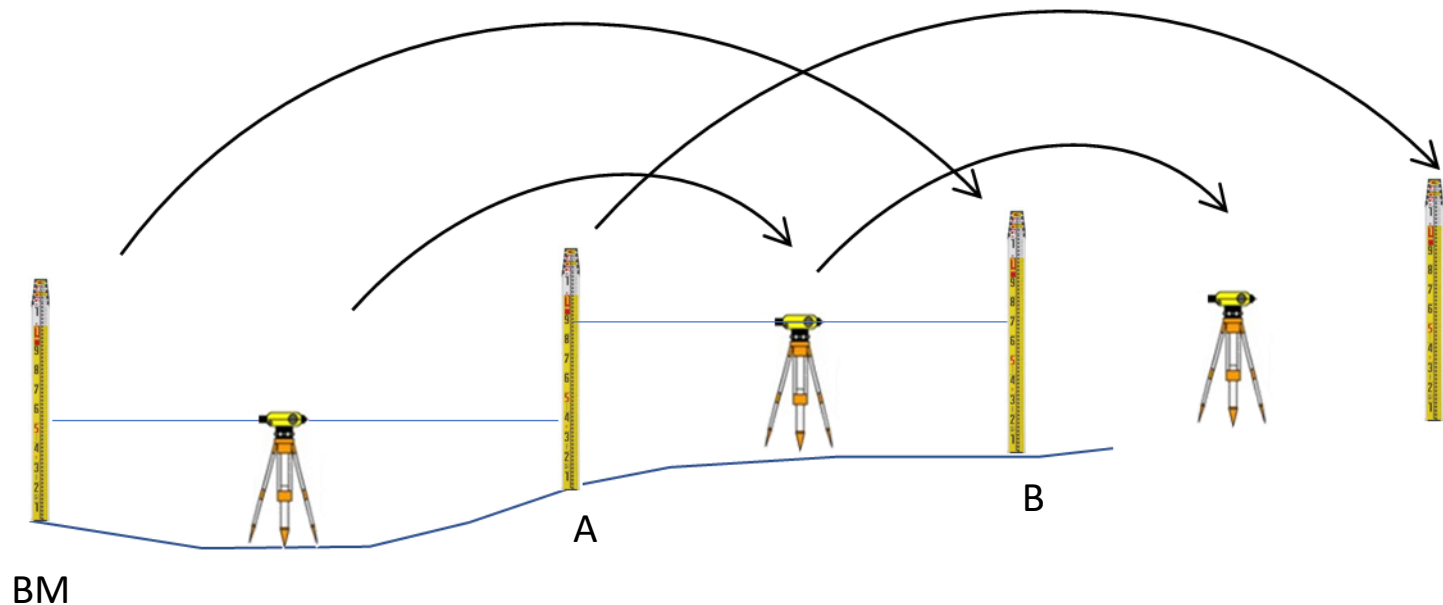
Recording Sheet (Sample)
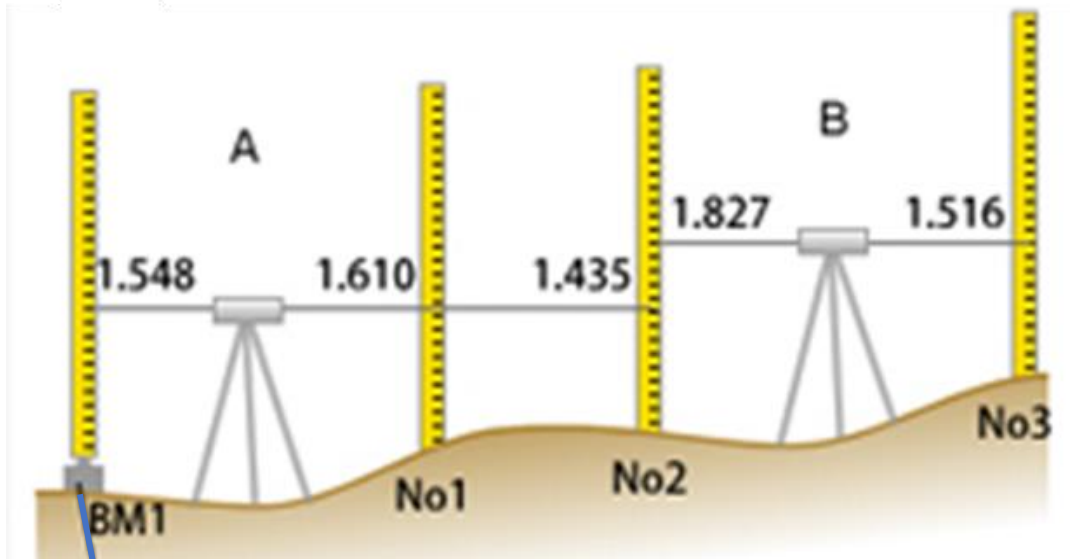
Benchmark (Known ground height)
=25.000, as a sample

Point	BS	FS	GH
BM1	1.548		25.000
No.1		1.610	24.938
No.2	1.827	1.435	25.133
No.3		1.516	25.424

Distance Measurement with Measuring Tape

Measuring tape

Auto Level

No. 0

OK

OK

No

OK

No
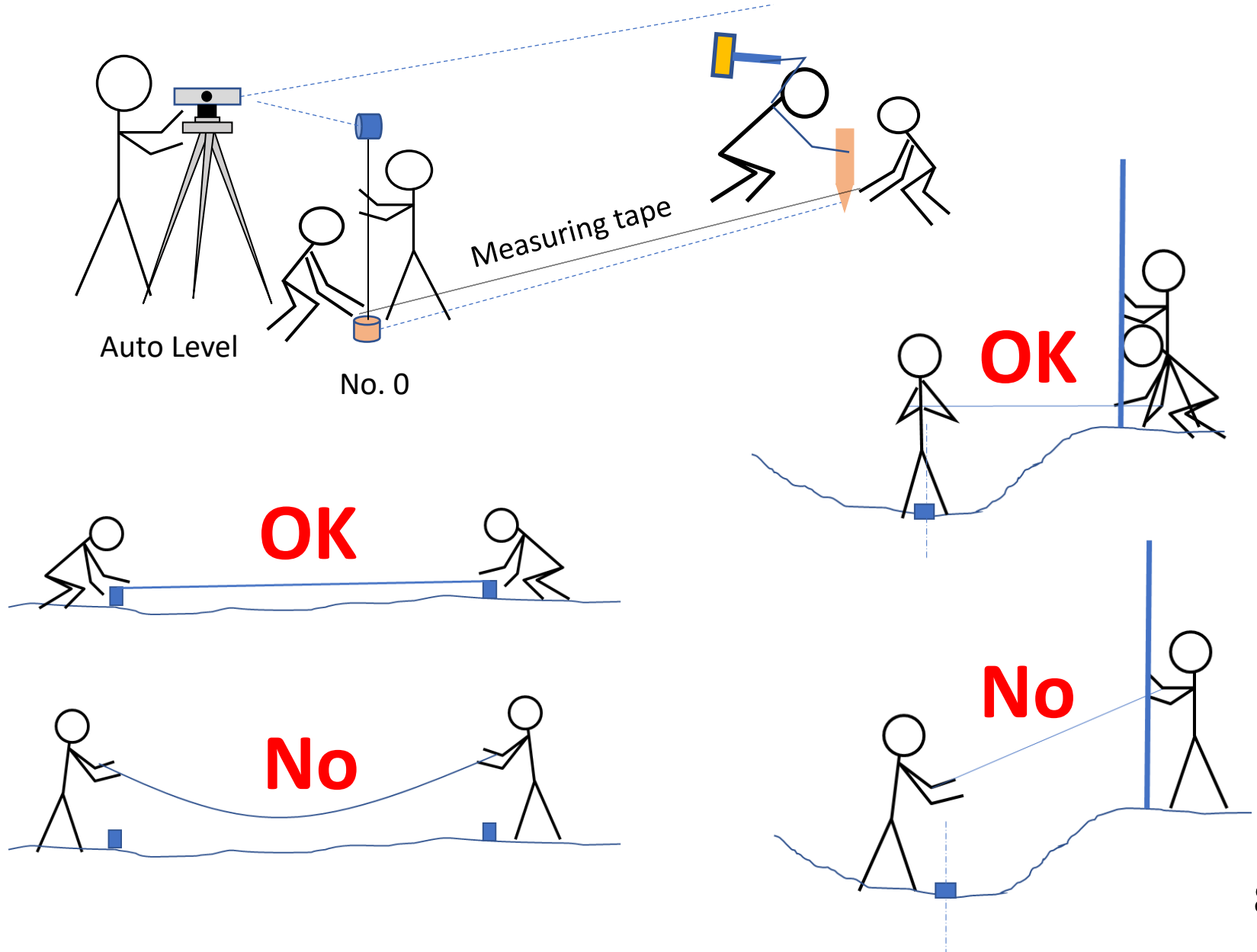
Measurement of Elevation (Sample)

Case 1:
Elevations of "T1" and "T4" are known

Sta.	BS	FS	EL
T 1	1.145	+	100.000
No.0	-	1.724	99.421
No.1	0.542	2.265 +	98.880
No.2	-	1.520	97.902
No.3		1.862	97.560
No.4	1.255	1.982	97.440
No.5		1.386	97.309
T 4		1.445	97.250

(97.238)

101.145
1.145
1.724
2.265
99.421
99.422
0.542
1.520
98.880
97.902
97.238

T 1
No.0
No.1
No.2
No.3
No.-
T 4
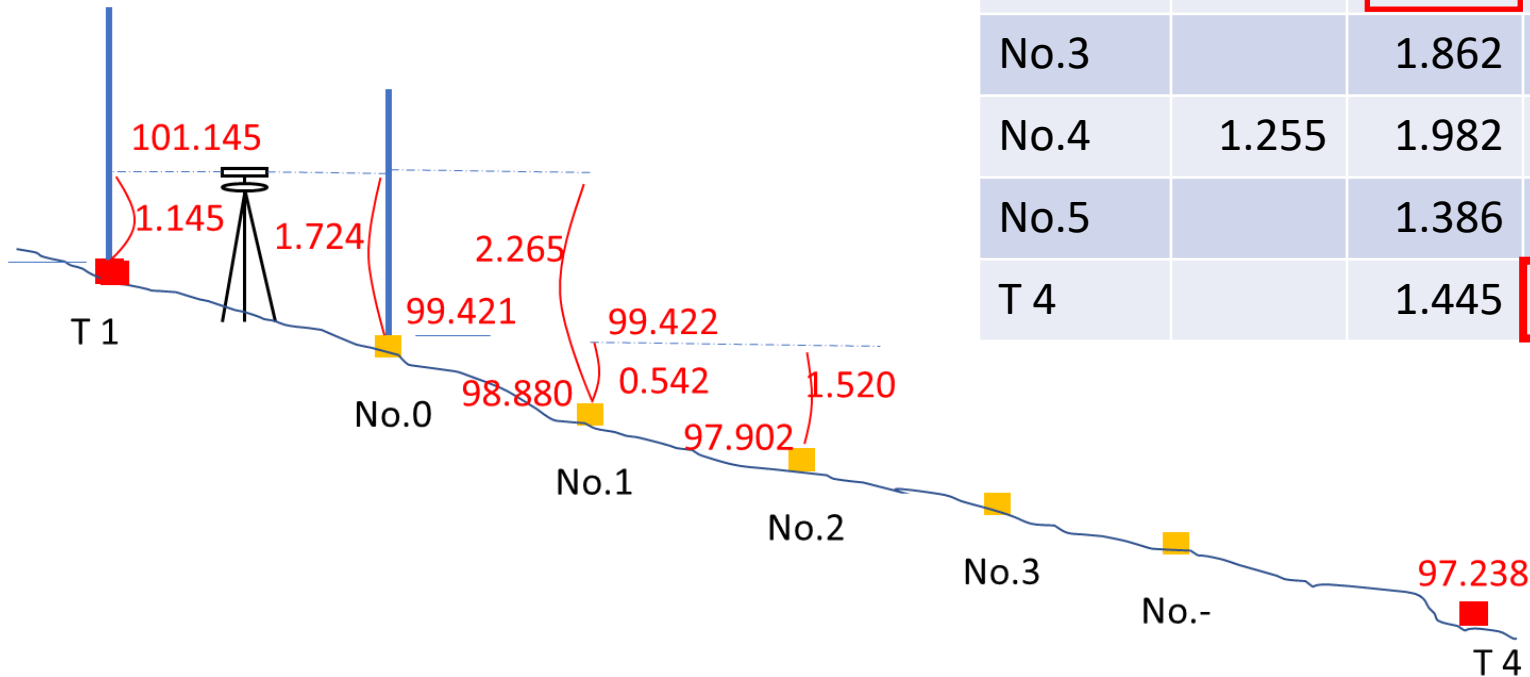
Measurement of Elevation (Sample)

Adjustment of Elevation

Sta.	BS	FS	EL	Adjustment	Accum. Adjustment	Adjusted EL
T 1	1.145		100.000			100.000
No.0		1.724	99.421	-0.002	-0.002	99.419
No.1	0.542	2.265	98.880	-0.002	-0.004	98.876
No.2		1.520	97.902	-0.002	-0.006	97.896
No.3		1.862	97.560	-0.001	-0.007	97.553
No.4	1.255	1.982	97.440	-0.002	-0.009	97.431
No.5		1.386	97.309	-0.001	-0.010	97.299
T 4		1.445	97.250	-0.002	-0.012	99.238

(97.238)   -0.012

-0.012

Measurement of Elevation (Sample)

Case 2:
Comparison of "Go" and "Return"

"Go": TBM 1 – TBM 2

Sta.	BS	FS	EL	Diffe.
TBM 1	1.145		100.000	
No.0	1.426	1.724	99.421	0.579
No.1	0.542	2.265	98.582	0.839
No.2	0.762	1.520	97.604	0.978
No.3	0.955	1.862	96.504	1.100
No.4	1.255	1.982	95.477	1.027
No.5	1.484	1.386	95.346	0.131
TBM 2		1.445	95.385	-0.039

"Return": TBM 2 – TBM 1

Sta.	BS	FS	EL	Diffe.
TBM 2	1.498		95.385	
No.5	1.489	1.539	95.344	0.041
No.4	1.591	1.360	95.473	-0.129
No.3	1.830	0.568	96.496	-1.023
No.2	1.846	0.727	97.599	-1.103
No.1	1.905	0.873	98.572	-0.973
No.0	1.843	1.066	99.411	-0.839
TBM 1		1.262	99.992	-0.581

$100.000 – 99.992 = 0.008 \rightarrow 8mm$ (error)

# Measurement of Elevation (Sample)

Adjustment of "TP" Elevations

	Go	Return	Go	Return		
Sta.	EL	EL	Diffe.	Deffe.	Mean	Adjusted EL
TBM 1	100.000	99.992			-	100.000
No.0	99.421	99.411	0.579	0.581	0.580	99.420
No.1	98.582	98.572	0.839	0.839	0.839	98.581
No.2	97.604	97.599	0.978	0.973	0.976	97.605
No.3	96.504	96.496	1.100	1.103	1.102	96.503
No.4	95.477	95.473	1.027	1.023	1.025	95.478
No.5	95.346	95.344	0.131	0.129	0.130	95.348
TBM 2	95.385	95.385	-0.039	-0.041	-0.040	95.388

Corrected elevation

Longitudinal Profile (Sample)

Sta.	Dist.	GEL
No.0	0	99.19
No.1	20	98.71
No.2	40	97.71
No.3	60	97.33
No.4	80	97.29
No.5	100	97.10
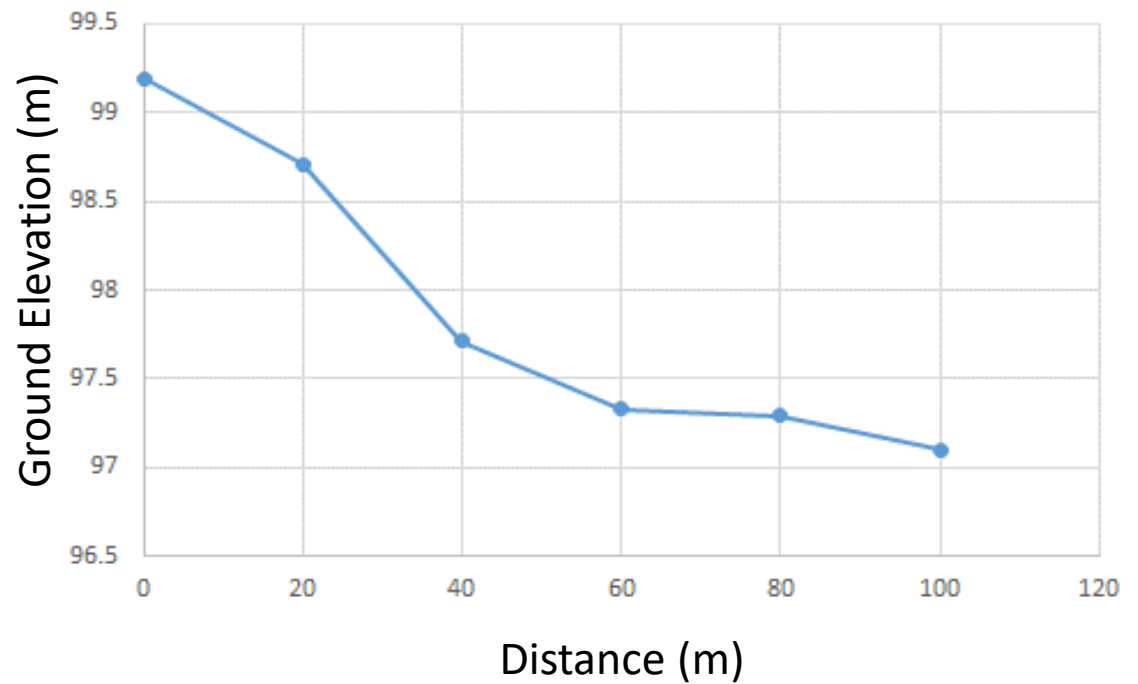
Cross-section Profile (Sample)

Sta.	Dist.	BS	FS	EL
No. 0	0	R0		99.419
	d1		R1	(99.419 + R0 − R1)
	d2		R2	(99.419 + R0 − R2)
	d3		R3	(99.419 + R0 − R3)