

LEVELLING

What is levelling?

Levelling is the process by which elevations of points or differences in elevation are determined

Areas of Application

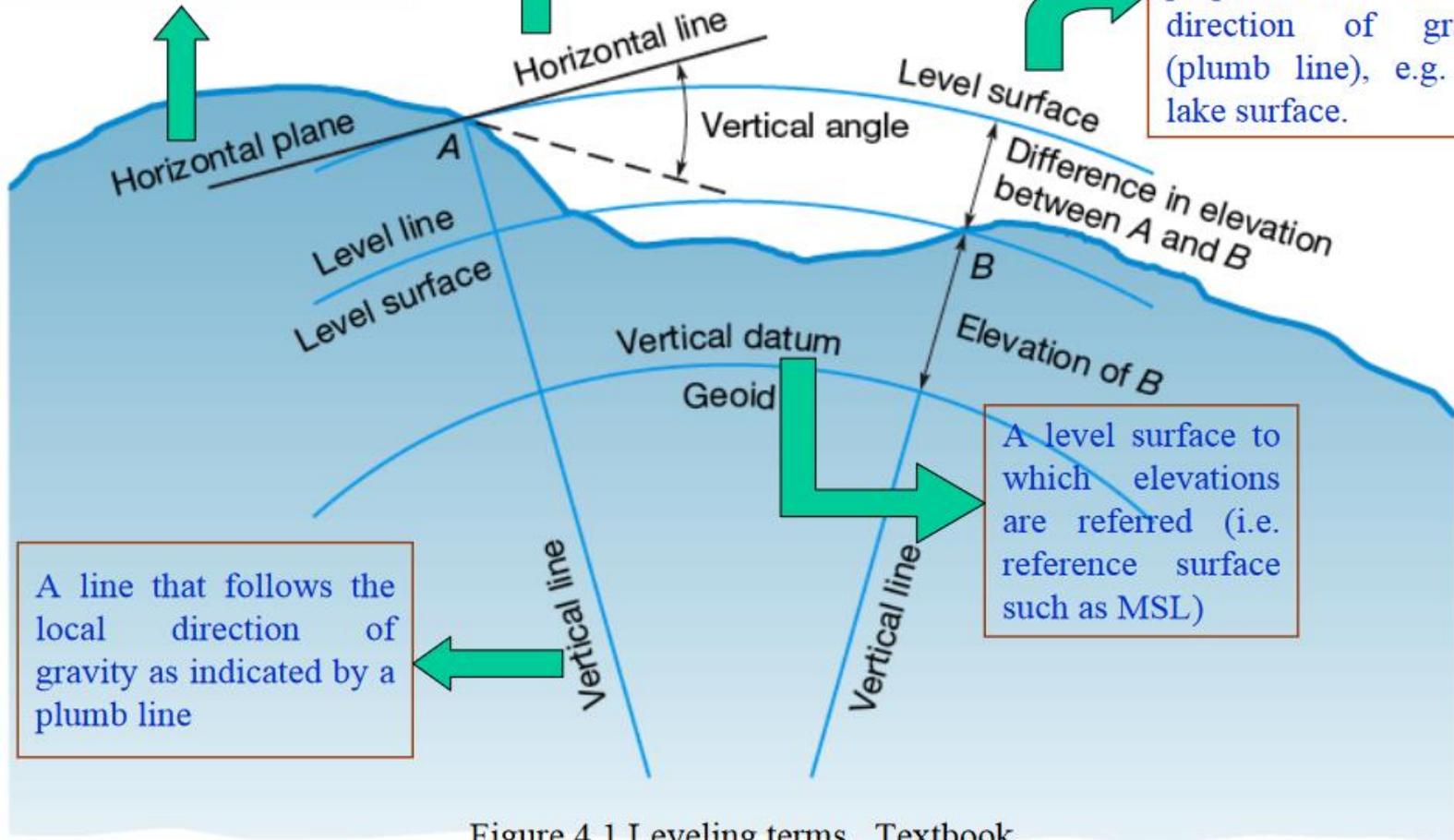
- ◆ Design of highways, railroads, canals, etc.
- ◆ Layout construction projects according to specific design
- ◆ Calculate earthwork volumes
- ◆ Investigate drainage characteristics
- ◆ Develop maps showing general ground configurations
- ◆ Monitor earth subsidence

Definitions

A plane perpendicular to the local direction of gravity or local vertical line (In plane surveying)

Line perpendicular to the vertical

curved surface that at every point is perpendicular to the direction of gravity (plumb line), e.g. still lake surface.



A line that follows the local direction of gravity as indicated by a plumb line

A level surface to which elevations are referred (i.e. reference surface such as MSL)

Figure 4.1 Leveling terms., Textbook

Definitions

Mean Sea Level (MSL):

Average elevation of the sea surface based on hourly tide gauge measurements over a period of 19 years

Bench Mark (BM):

A permanent reference point with a known elevation (relative to some datum, usually MSL)

Temporary Bench Mark (TBM):

A point of known height above a pre-defined level. This level is not absolute and is defined locally by the surveyor for the purpose of the survey. Based on the TBM the survey may then later be reduced to absolute levels if the level of TBM is known.

LEVEL

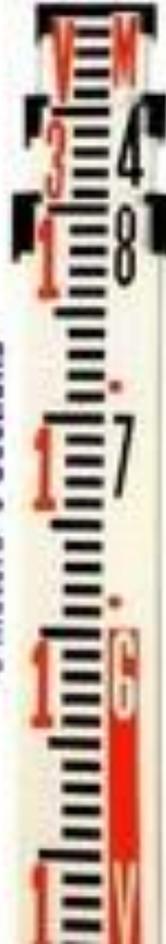
- For Vertical measurements



4 Meters 3 Sections

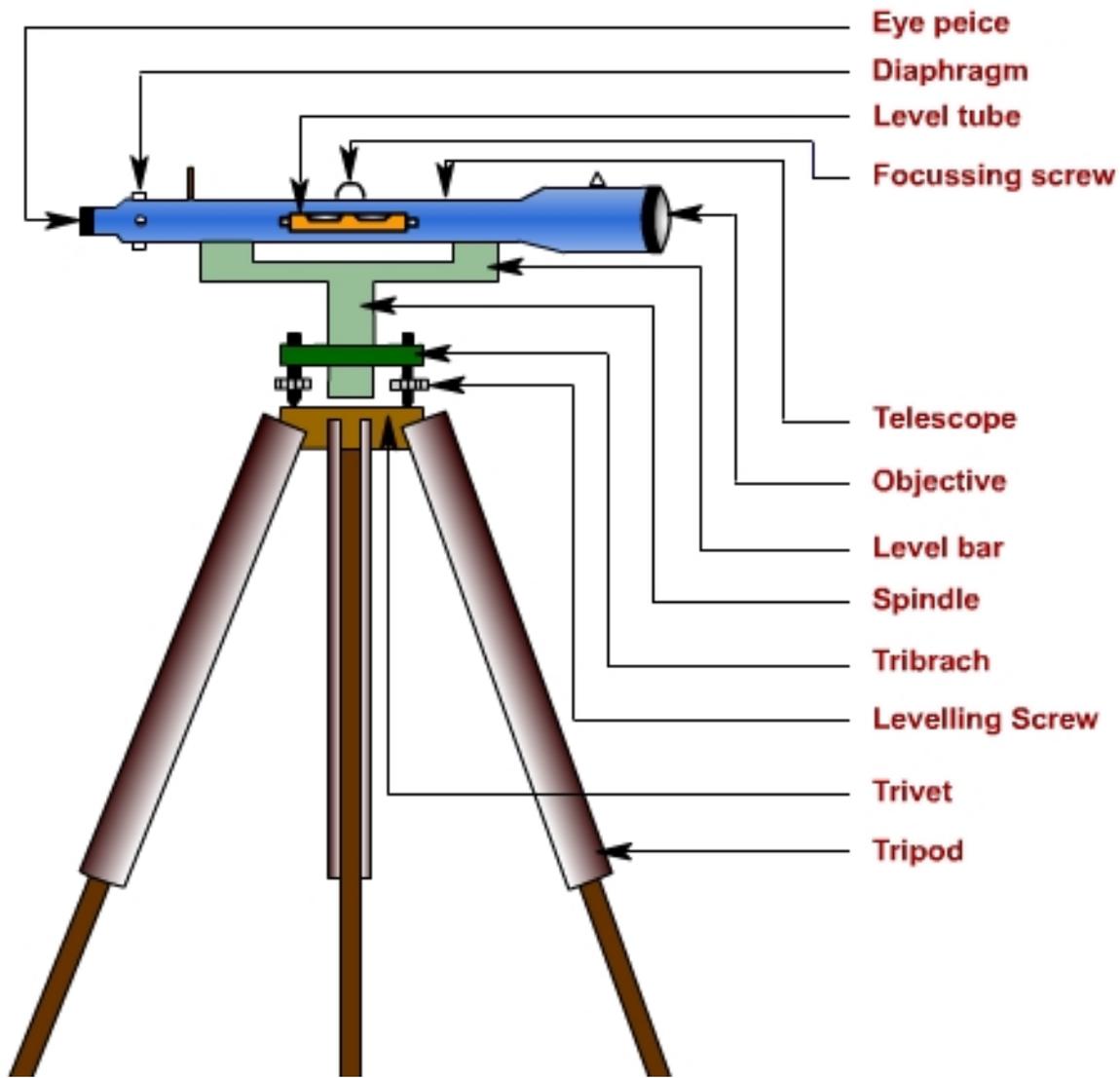


5 Meters 3 Sections



6 Meters 3 Sections

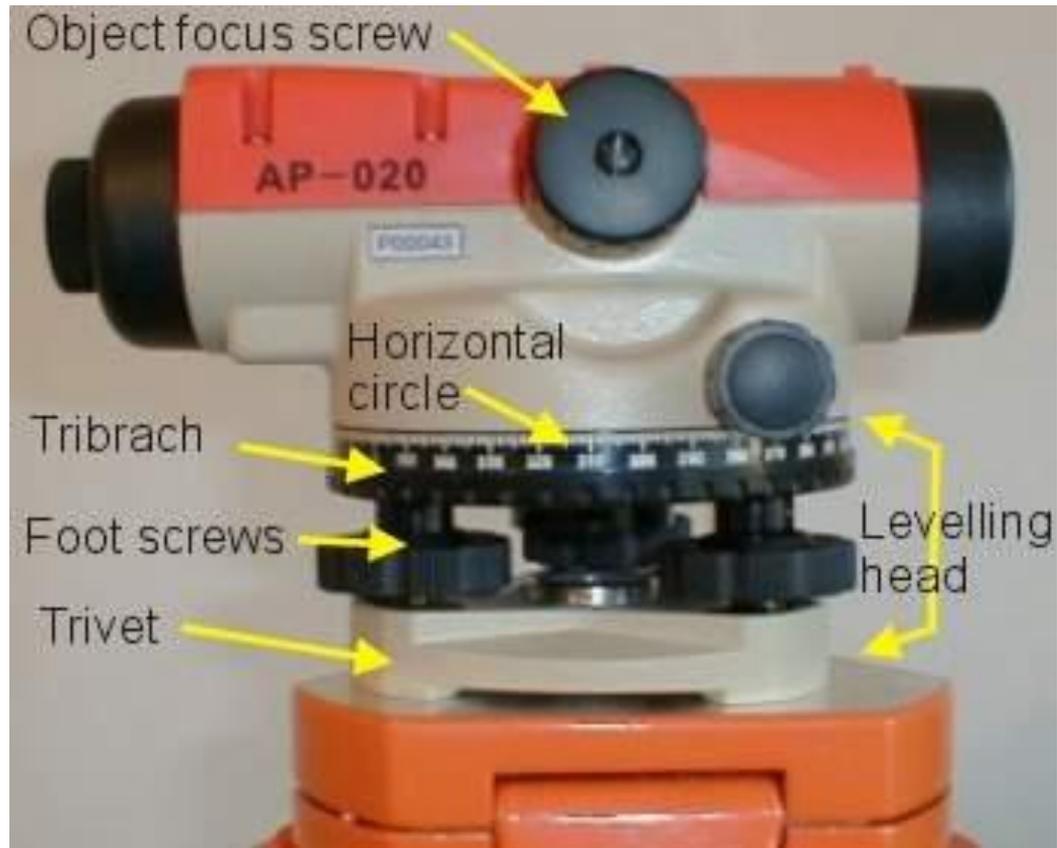




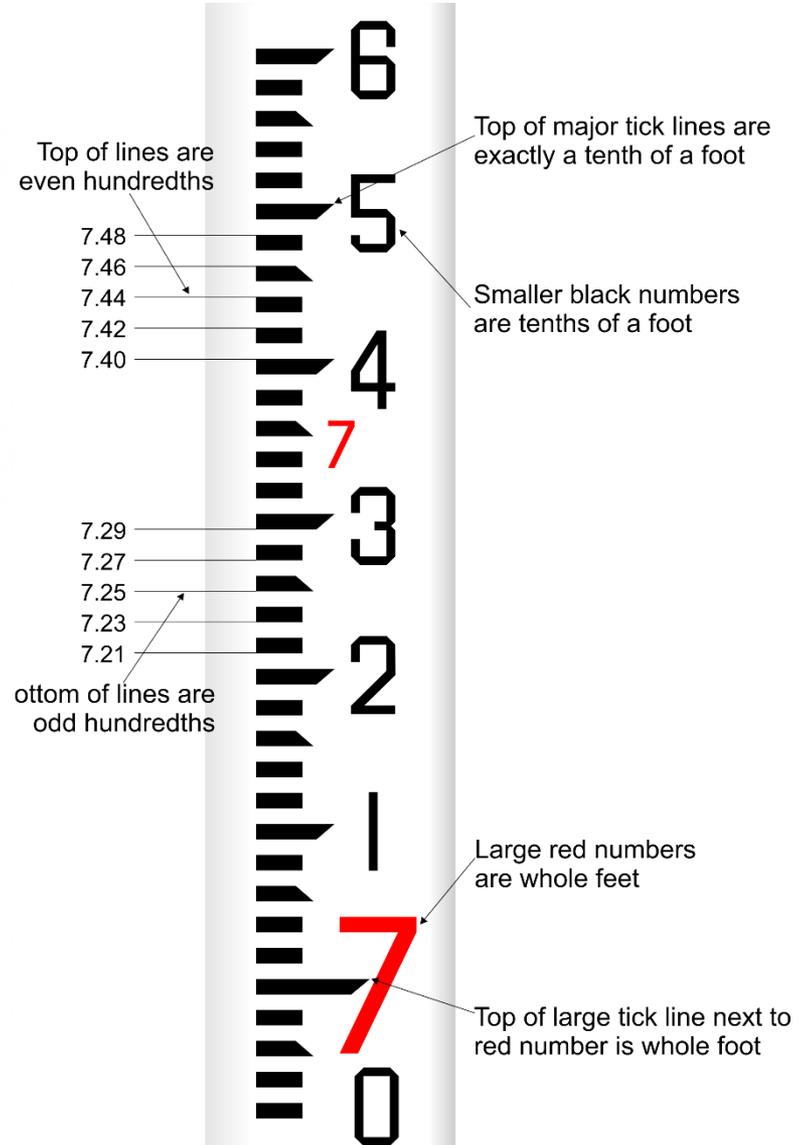
Parts

- **Telescope** : used to sight a staff placed at desired station and to read staff reading distinctly.
- **Diaphragm** : holds the cross hairs (fitted with it).
- **Eye piece** : magnifies the image formed in the plane of the diaphragm and thus to read staff during leveling.
- **Level Tube** : used to make the axis of the telescope horizontal and thus the line of sight.
- **Leveling screws** : to adjust instrument (level) so that the line of sight is horizontal for any orientation of the telescope.
- **Tripod stand** : to fix the instrument (level) at a convenient height of an observer

Parts of level



LEVELLING STAFF



Temporary adjustments

- Temporary adjustments are to be made at each setup of the instrument.
1. Setting up of the level
 2. Leveling up
 3. Elimination of parallax.

SETTING UP OF THE LEVEL

- i) Release the clamp screw of the instrument
- ii) Hold the instrument in the right hand and fix it on the tripod by turning round only the lower part with the left hand.
- iii) Screw the instrument firmly.
- iv) Bring all the foot screws to the center of its run.
- v) Spread the tripod legs well apart.
- vi) Fix any two legs firmly into the ground by pressing them with the hand.
- vii) Move the third leg to the right or left until the main bubble is approximately in the center.
- viii) Then move the third leg in or out until the bubbles of the cross-level is approximately in the center.
- ix) Fix the third leg firmly when the bubbles are approximately in the centers of their run.

LEVELLING UP

- i) Place the telescope parallel to a pair of foot screws.
- ii) Bring the bubble to the center of its run by turning the foot screws equally either both inwards and both outwards.
- iii) Turn the telescope through 90° so that it lies over the third foot screw.
- iv) Turn this third foot screw so that the bubble corners to the center of its run.
- v) Bring the telescope back to the original position without reversing the eye-piece and object glass.
- vi) Repeat the above operations until the bubble remains in the center of its run in both the positions.
- vii) Turn the telescope through 180° and check whether the bubble remains central

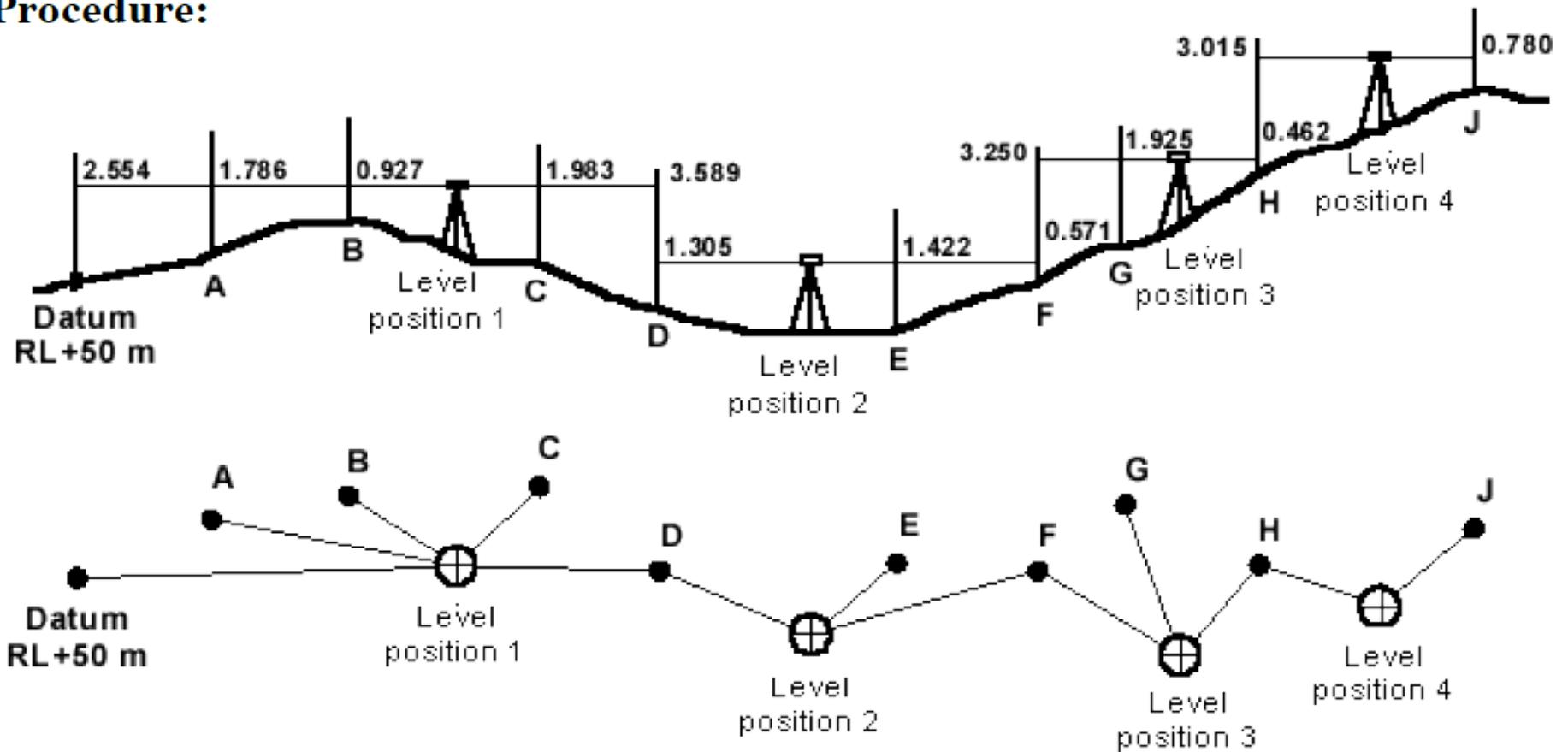
ELIMINATION OF PARALLAX

- i) Remove the lid from the object glass.
- ii) Hold a sheet of white paper in front of the object glass.
- iii) Move the eyepiece in or out until the cross hairs are distinctly visible.
- iv) Direct the telescope towards the staff.
- v) Turn the focusing screw until a clear and sharp image is formed in the plane of the cross hairs.

Taking the levels of various points with Single setup

1. Set the level at a convenient point.
2. Perform the temporary adjustments.
3. Hold the staff vertically over the Benchmark, Observe the staff reading and write in the B.S column of the field book.
4. Hold the staff at other points and note the staff reading in the I.S column of the field book.
5. Hold the staff on the last point and enter the staff reading in the F.S column of the field book.
6. Find R.L. of all the points by both the methods.
7. Apply arithmetical check.

Procedure:



TABULAR FORM FOR HEIGHT OF INSTRUMENT (H.I) METHOD

Station	Readings			Height of Instrument	Reduced Level	Remarks
	Back sight	Inter Sight	Fore Sight			

Points	Staff Reading (m)			Difference in elevation (m)		H.I (m)	R.L. (m)	Remarks
	B.S.	I.S.	F.S.	Rise	Fall			
A	2.365					102.365	100.000	B.M.
S ₁	0.685		1.235	1.130		101.815	101.130	T.P. ₁
S ₂	1.745		3.570		2.885	99.990	98.245	T.P. ₂
B			2.340		0.595	102.365	97.650	
S	4.795		7.145		3.480	101.815		

FLY LEVELLING

1. Let A and B be the two given points whose difference in elevation is to be found.
2. Set the level at a convenient point O1 carryout temporary adjustments and take B.S on A
3. Take FS on the Point C
4. Shift the instrument to point O2 and perform temporary adjustments.
5. Take B.S on C.
6. Take F.S. on D.
7. Shift the instrument to point O3 and perform temporary adjustments.
8. Take B.S on D
9. Take F.S on B.
10. Find the difference in elevation between A and B by both the methods