



LECTURE # 5

In this lecture you will learn about:

Leveling

- Definition, Objective & Principle.
- Terms Used in Leveling.
- Types of Leveling.
- Methods of Reducing Levels.
- Errors in Leveling.

Course Name:
“Surveying I”

Course Code: CT-123

Credit Hours: 2

Semester: Summer 2020



LEVELING

DEFINITION

Leveling is a branch of surveying in civil engineering which deals with the relative heights of different points on, above or below the surface of earth . Thus in leveling ,the measurements are taken in vertical plane



LEVELING

PRINCIPLE

The principle of leveling is to obtain horizontal line of sight with respect to which vertical distances of the points above or below this line of sight are found



LEVELING

OBJECTIVE

To Find the elevation of given point with respect to some assumed reference line called datum.



LEVELING

- **LEVEL SURFACE:** It is a curved surface perpendicular to direction of gravity or parallel to surface of the earth
- **HORIZONTAL PLANE:** Horizontal plane through a point is a plane tangential to the level surface and perpendicular to the plum bob
- **VERTICAL PLANE:** It is a normal horizontal plane and shown by the plum bob.
- **LEVEL LINE:** Line lying on level surface
- **DATUM:** It is an arbitrary level surface from which elevation of points may be referred



TERMS

- **MEAN SEA LEVEL (MSL):** Average height of sea for all the stages of sides considered for 19years period.
- **BACK SIGHT:** The first reading from a new instrument stand point(i.e. take the height of instrument)
- **FORE SIGHT:** The last reading from the current instrument station (i.e. give the height to a benchmark)
- **BENCHMARK:** It is a fixed reference point of known elevation with respect to datum.
- **PERMANENT BENCH MARK:** These are established between the great trigonometric survey by the government agencies clearly defined and permanent points such as top of parapet wall of a bridge or kilometer stones or railways platforms etc.



BASIC RULES FOR LEVELING

- Always start and finish leveling run on a benchmark and close the loops
- Keep foresight and back sight distances as equal as possible
- Keep lines of sight short (normally)
- Never read below 0.5m on a staff
- Use stable , well defined change points
- Beware of shadowing effects and crossing waters



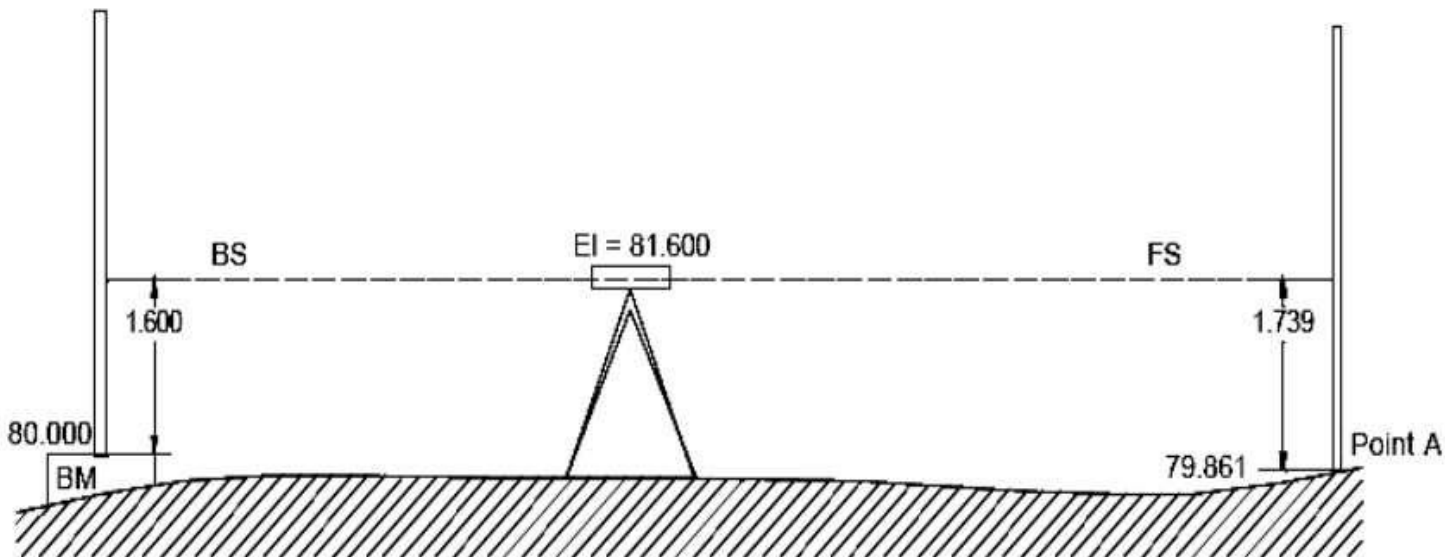
TYPES OF LEVELING

- Fly Leveling
- Differential Leveling
- Profile Leveling
- Precise Leveling
- Check Leveling
- Reciprocal Leveling
- Trigonometric Leveling
- Barometric Leveling
- Stadia Leveling



SIMPLE LEVELING

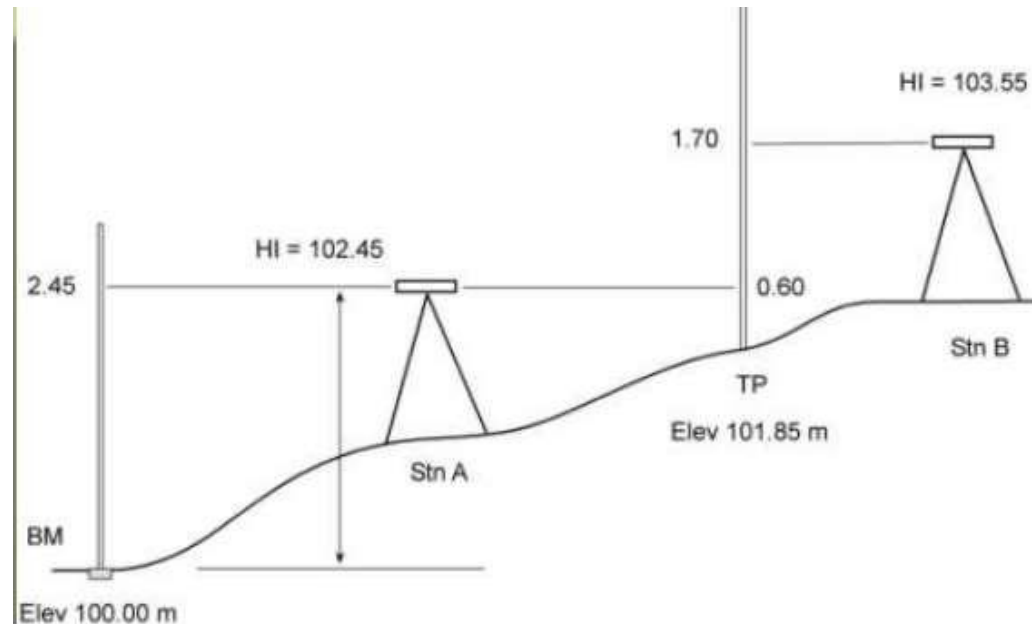
It is a simple and basic form of leveling in which the leveling instrument is placed between the points which elevation is to be found. Leveling rods are placed at those points and sighted through the leveling instrument. It is performed only when the points are nearer to each other without any obstacles.





DIFFERENTIAL LEVELING

Differential leveling is performed when the distance between two points is more. In this process, number of inter stations are located and instrument is shifted to each station and observed the elevation of inter station points. Finally difference between original two points is determined.

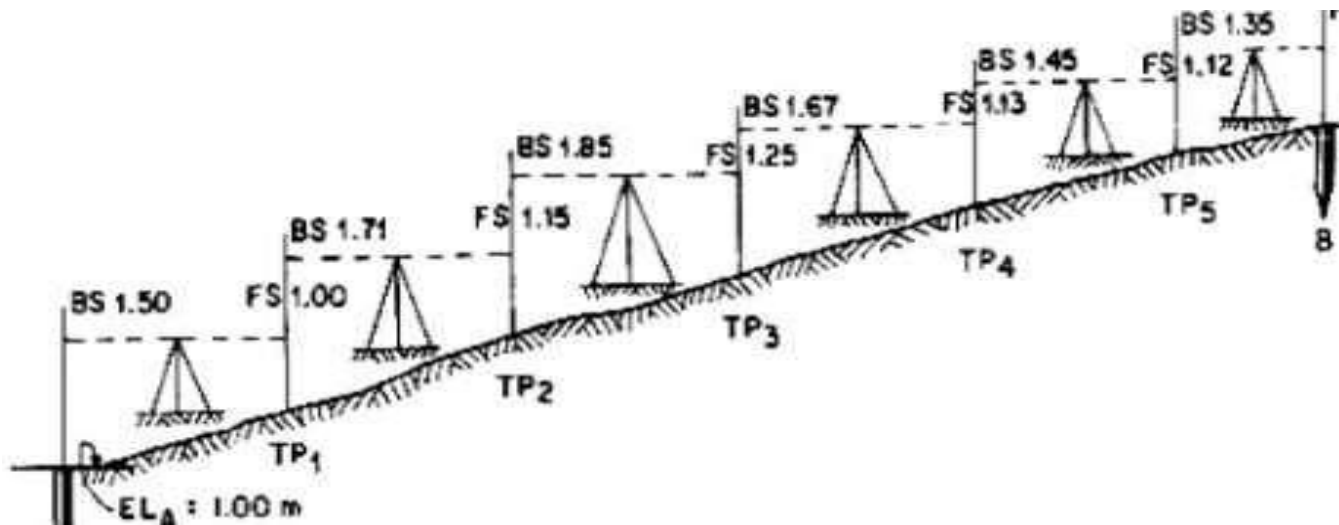


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FLY LEVELING

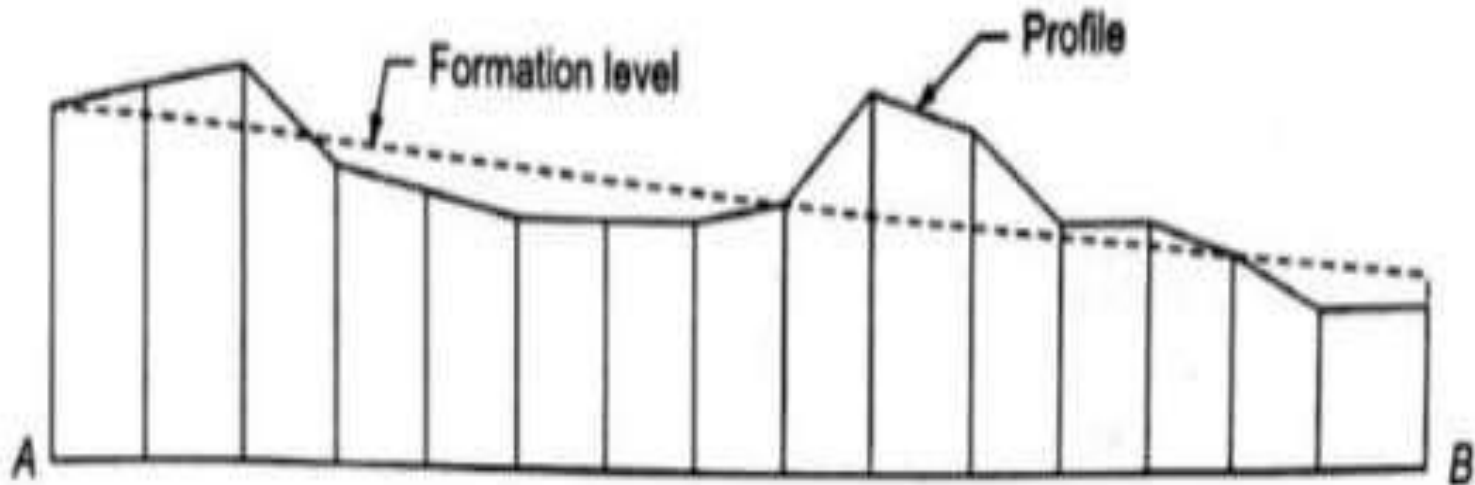
Fly leveling is conducted when the benchmark is very far from the work station. In such case, a temporary bench mark is located at the work station which is located based on the original benchmark. Fly leveling is just like differential leveling carried out to check the accuracy of leveling work. In fly leveling only B.S. and F.S. are taken.





PROFILE LEVELING

Profile leveling is generally adopted to find elevation of points along a line such as for road, rails or rivers etc. The object is to determine the undulations of the ground surface along the alignment.





PRECISE & CHECK LEVELING

Precise Leveling

It is used for establishing bench marks for future public use. It is carried out with high degree of accuracy using advanced instruments Trigonometric Leveling . The accuracy of 1 mm per 1 km is achieved.

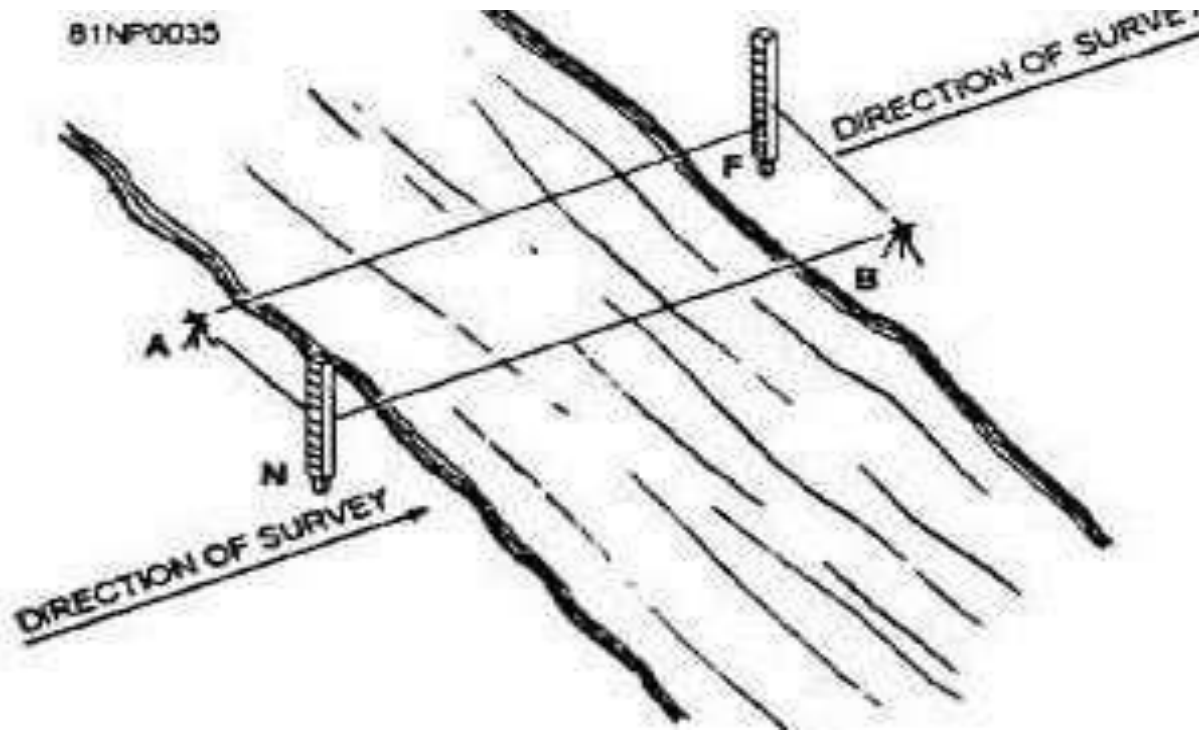
Check Leveling

This kind of leveling is carried out to check the accuracy of work. It is done at the end of the days work in the form of fly leveling to connect the finishing point and starting point



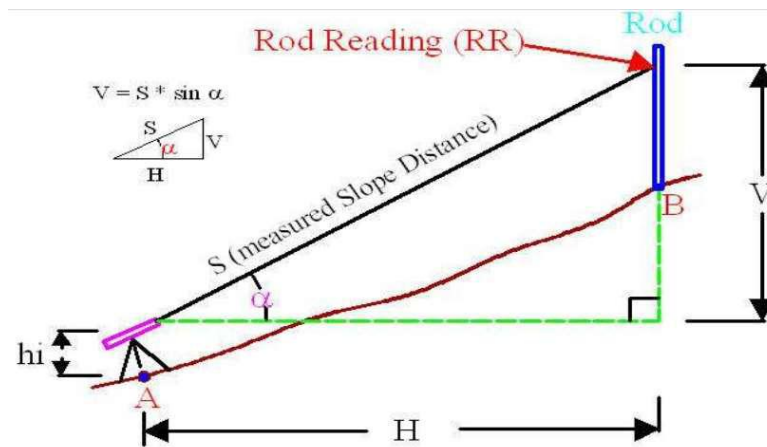
RECIPROCAL LEVELING

This method is adopted to accurately determine the difference of level between two points which are far apart. It is also used when it is not possible to setup level in midway between two points.



TRIGONOMETRIC LEVELING

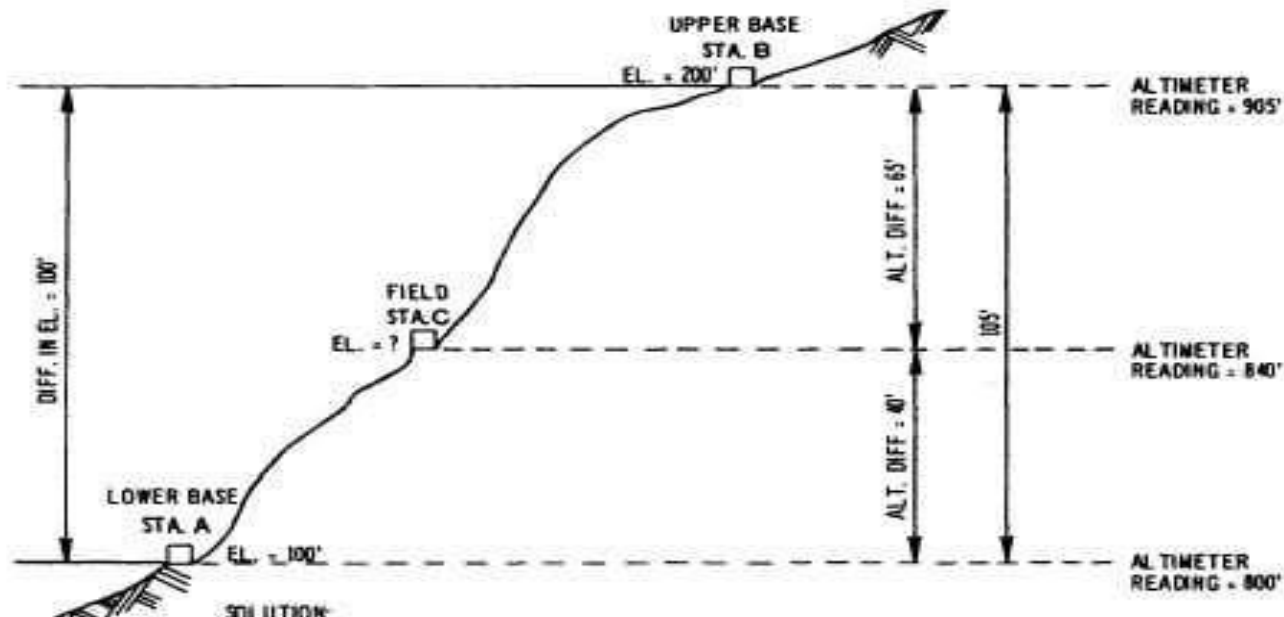
- The process of leveling in which the elevation of point or the difference between points is measured from the observed horizontal distances and vertical angles in the field is called trigonometric leveling.
- In this method, trigonometric relations are used to find the elevation of a point from angle and horizontal distance so, it is called as trigonometric leveling. It is also called as indirect leveling.





BAROMETRIC LEVELING

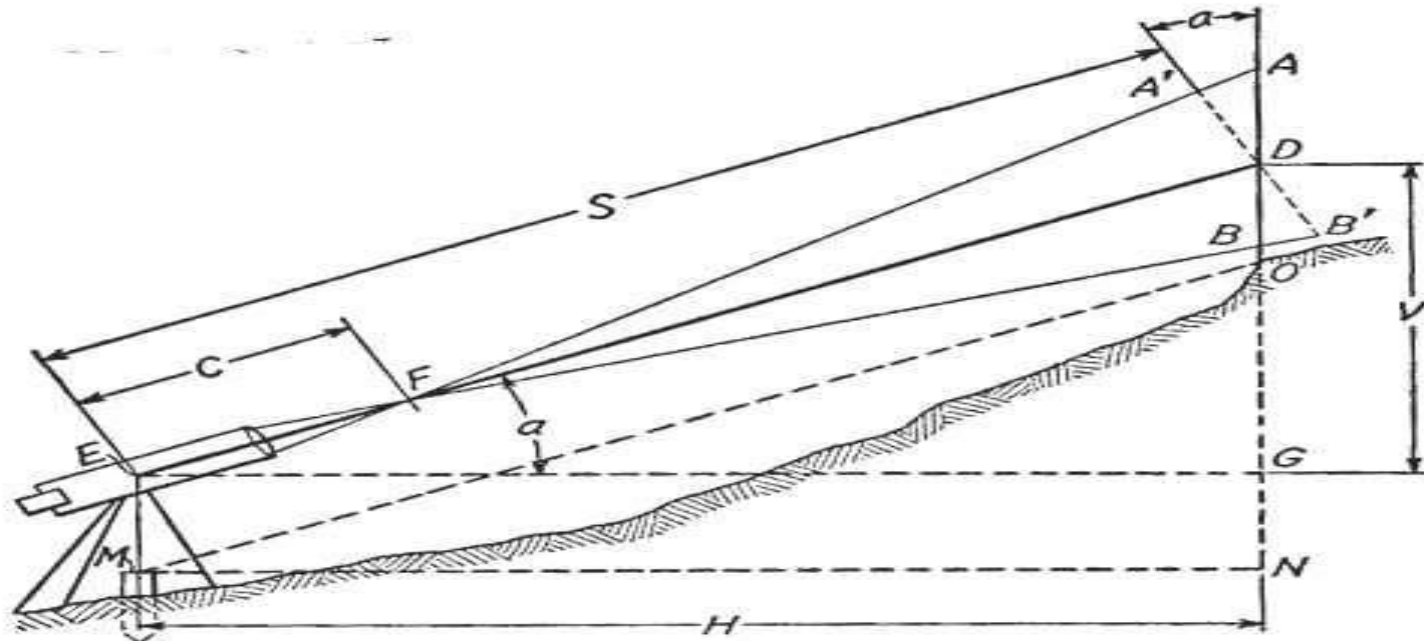
Barometer is an instrument used to measure atmosphere at any altitude. So, in this method of leveling, atmospheric pressure at two different points is observed, based on which the vertical difference between two points is determined. It is a rough estimation and used rarely.





STADIA LEVELING

It is a modified form of trigonometric leveling in which Tachometer principle is used to determine the elevation of point. In this case the line of sight is inclined from the horizontal. It is more accurate and suitable for surveying in hilly terrains.





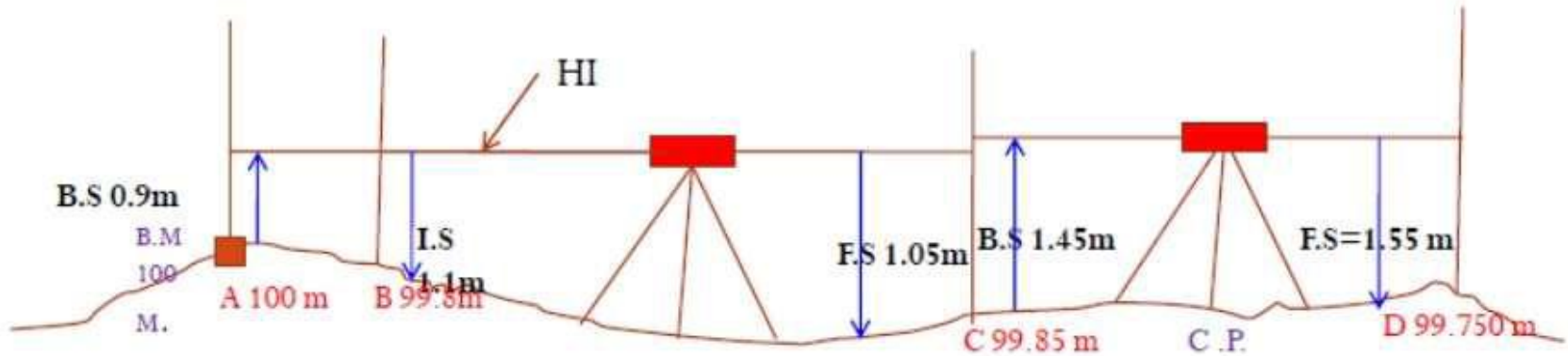
METHODS OF REDUCING LEVELS

HEIGHT OF INSTRUMENT METHOD

This method consist of finding H.I. for every setup of instrument, and then obtaining the R.L. of point of reference with respect to H.I.



METHODS OF REDUCING LEVELS



Station	B.S	I.S	F.S	H.I	R.L	Remark
A	0.9			100.9	100.00	B.M
B		1.1			99.800	
C	1.450		1.05	101.3	99.850	C.P.
D			1.550		99.750	



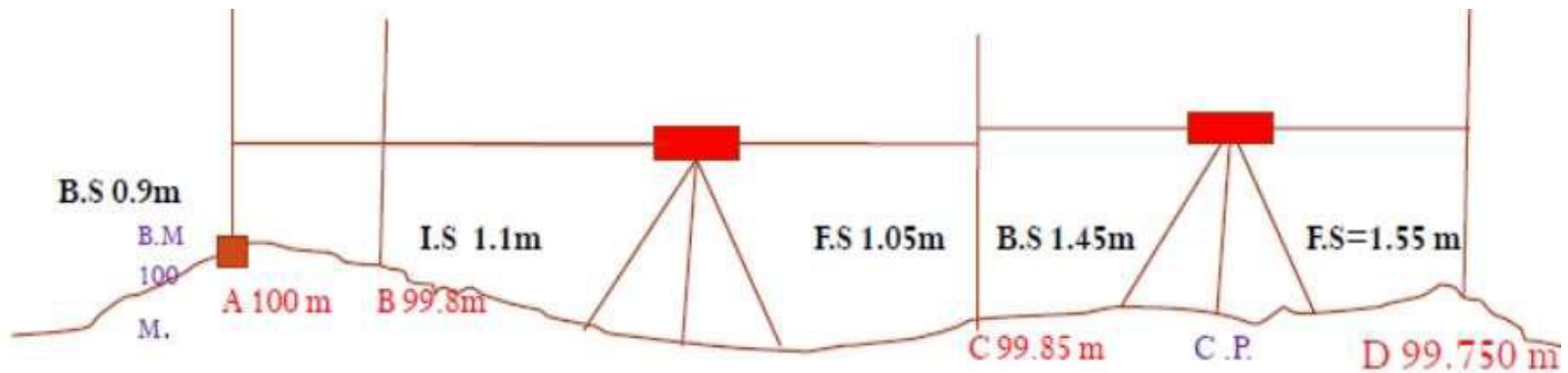
METHODS OF REDUCING LEVELS

RISE AND FALL METHOD

This method consist of determining the difference of level between consecutive points by comparing each point with immediate preceding point.



METHODS OF REDUCING LEVELS



Station	B.S	I.S	F.S	Rise	Fall	R.L	Remark
A	0.9					100.00	B.M
B		1.1			0.2	99.800	
C	1.450		1.05	0.05		99.850	C.P.
D			1.550		0.1	99.750	



ERRORS IN LEVELLING

PERSONAL ERROR

- The Instruments may not be leveled
- The focusing of eye piece and objective glass may not be perfect
- The position of staff may have changed
- Entry and recording in the field book may not be correct
- The staff may not be fully extended, may not be held vertical.



ERRORS IN LEVELLING

INSTRUMENTAL ERROR

- The Permanent adjustment of the instrument may not be perfect. That is the line of collimation may not be horizontal line.
- The internal arrangement of focusing tube may not be correct
- Defective bubble tube, if the bubble tube is sluggish, it may apparently be in the mid-position even though the bubble line is not horizontal.

