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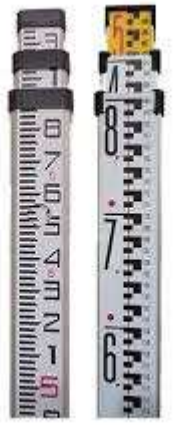
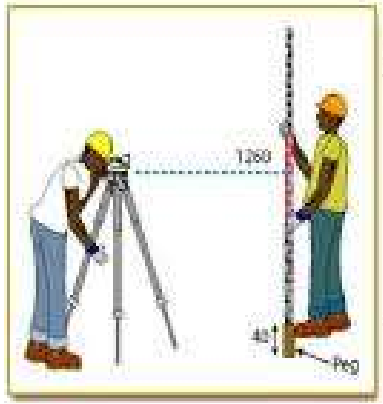
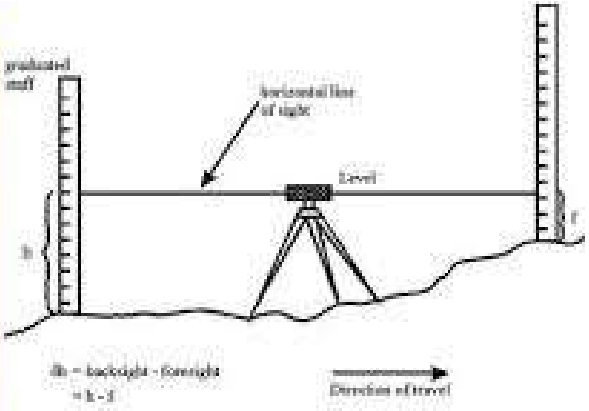
Module - 4
Leveling







Subject:- BCE Code:-3110004	Prepared by: Asst.Prof. Nutan C. Patel (Civil Department,ACET)	AMIRAJ COLLEGE OF ENGINEERING & TECHNOLOGY

Definition

❑ Leveling :-

❑ The art of determining the relative heights of different points on or bellow the surface of the earth is known as leveling.

❑ Aim / Object of Surveying:-

❑ The main aim of leveling is to determine the relative heights of different points on or bellow the surface of the earth..

Use of Leveling

- To prepare Contour map to know the topography of the area.
- To determine the different height of the different important points
- To prepare Cross section which Shows the quantity of the filling or cutting of the earth work.
- To prepare a layout map for water supply, Sewerage treatment plant or drainage scheme.

Terms used in leveling

- Level Surface :- A surface parallel to the mean spherical surface of the earth is called level surface. Such a surface obviously curved surface.

- Level line :- it is the line laying on the level surface is called a level line.

- Horizontal Plane :- it is a plane tangential to the level surface at any point is known as horizontal Plane

- Horizontal line :- A Line laying on the horizontal plane is called level line.

- Vertical line :- A line Perpendicular to the level surface is called Vertical line.

- Vertical Plane :- A line passing through the vertical line is known as a vertical plane.

- Datum Surface or Line :- Datum surface is a level surface whose elevation is known or assumed. The vertical distance of different points are measured from above or bellow the datum surface.

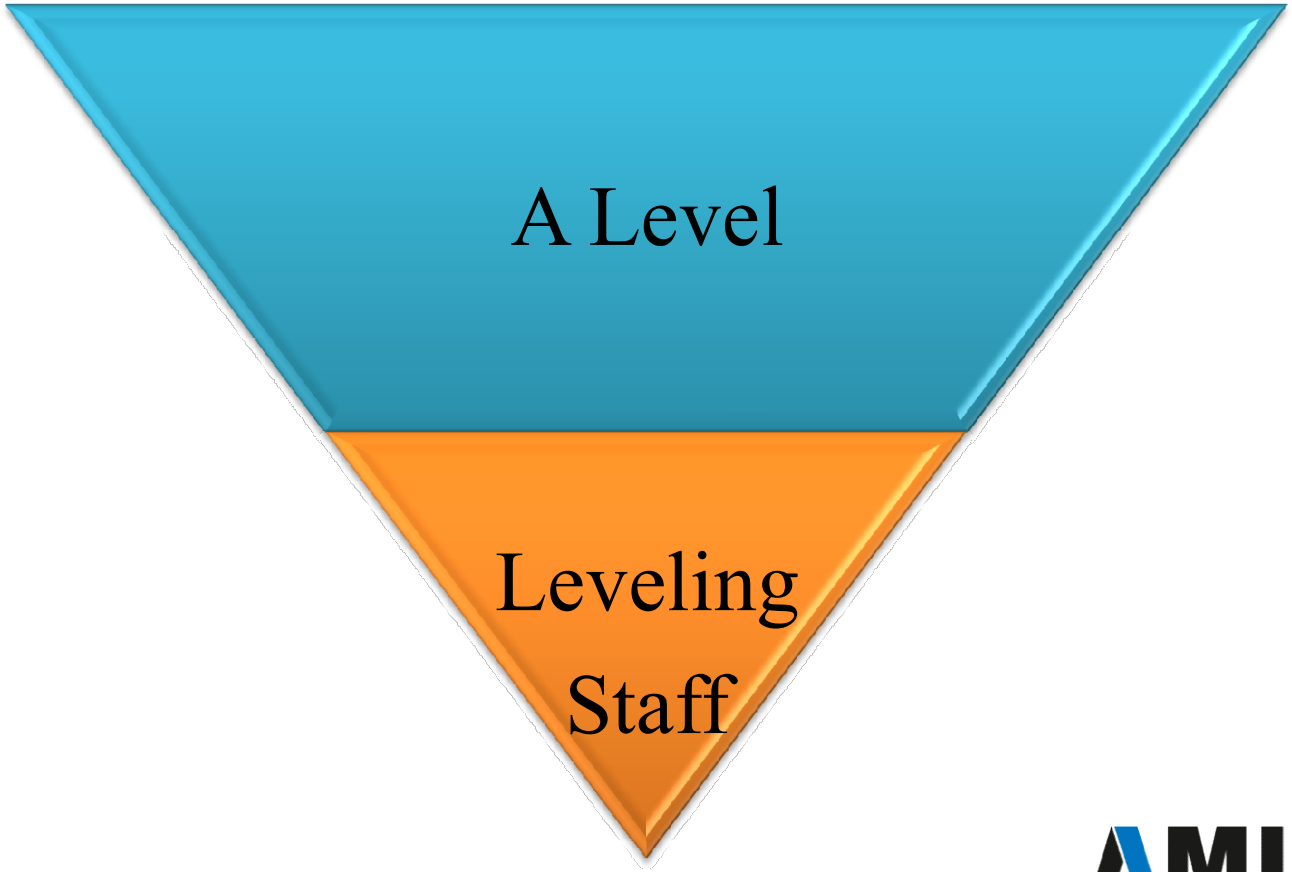
- Reduced Level (RL):- The vertical distance of a point above or bellow the datum surface is known as a Reduced Level of that point. It is also called elevation.

- Bench Mark (BM) :- The bench mark is a fixed point of the known RL above the datum. A Point whose RL is known can be used as a Bench Mark.

- Mean Sea Level :- Mean Sea level is the average height of the sea for all the point.

Leveling Instrument

- The instrument commonly used are



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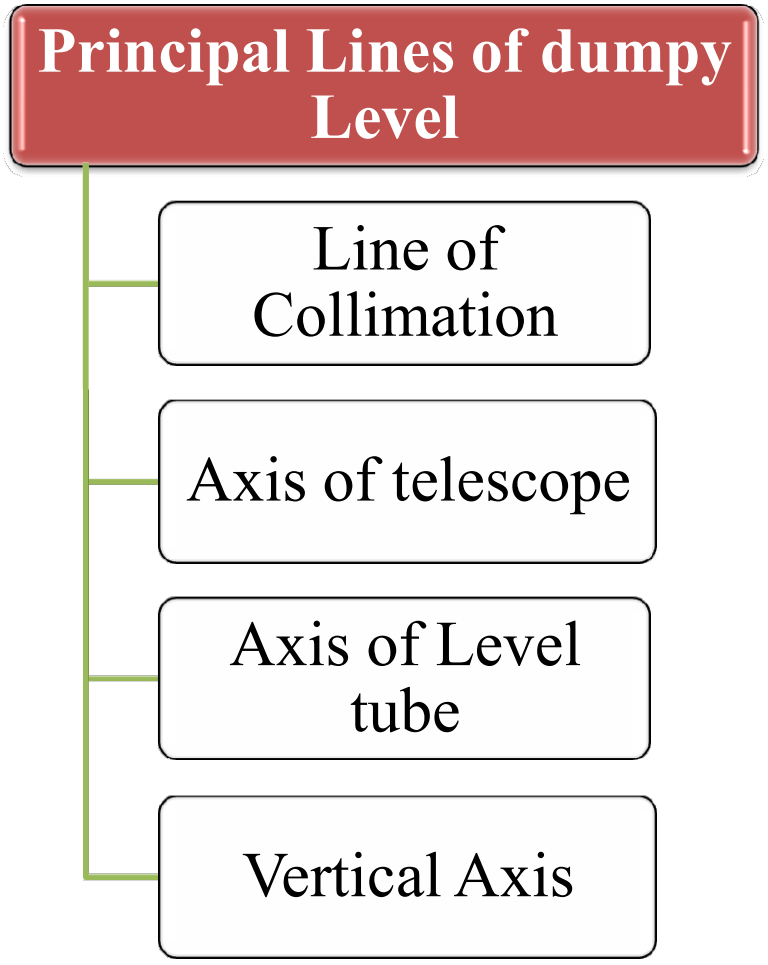
Dumpy Level

- Tripod Stand :- The tripod stand consist of three legs which may be solid. The legs are made of wood or aluminum.
- Leveling Head :- The leveling head consist of the two parallel plate having three groves to support the foot screw.
- Foot Screw :- Three foot screw are provided between the two plate. And with the help of the foot screw level the instrument.

- Telescope :- Telescope consist of the two metal tubes. One moving within inside of other. It also consist of object glass and eye piece on opposite end.
- Bubble Tube :- The bubble tube are fixed on top of the telescope. There are main two bubble tube and both bubble tube are right angle to each other.
- Compass :- in some instrument compass is provide just bellow the telescope for measuring magnetic bearing.

Axis of dumpy Level



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Line of Collimation

- It is the line joining of the intersection of the cross hair of a diaphragm to the optical centre of the object glass is called line of collimation
- It is also called line of sight.

Axis of Telescope

- It is the line joining the optical centre of eyepiece and object glass is called axis of telescope

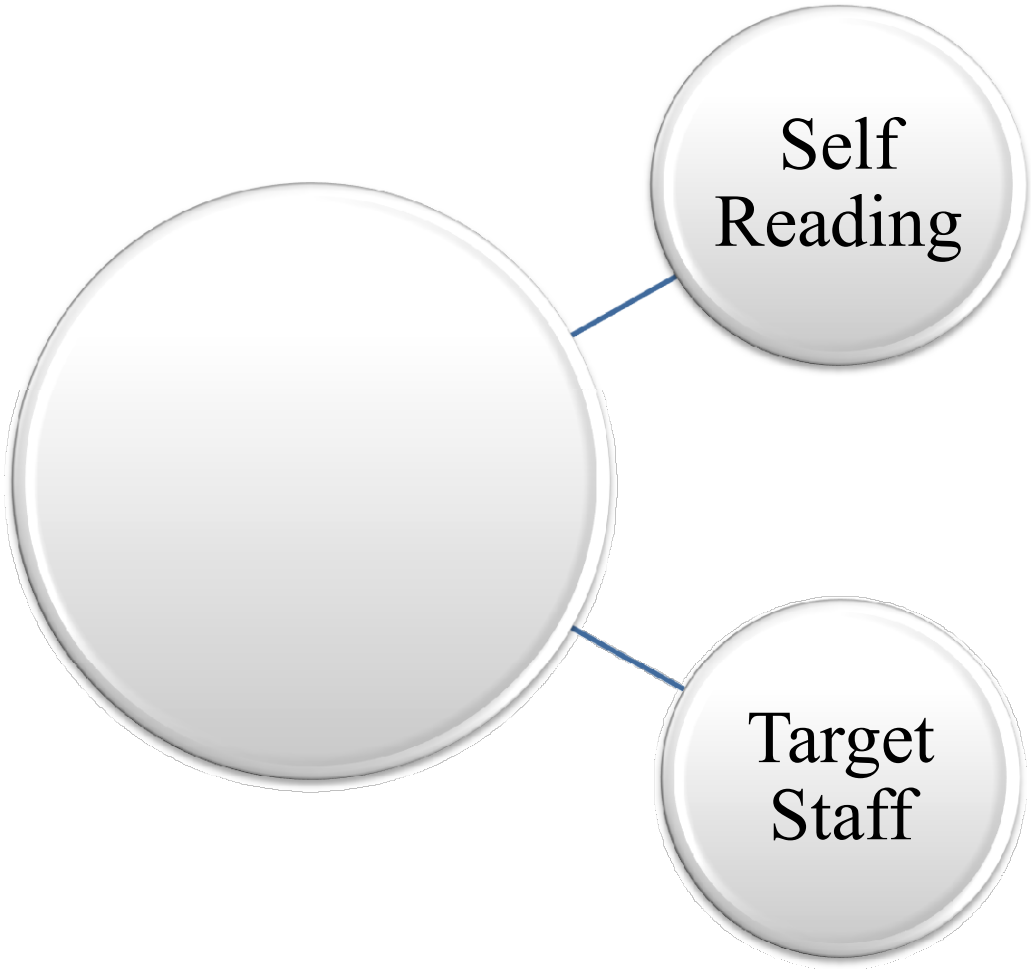
Axis of Level tube

- It is an imaginary line which is tangential to the longitudinal curvature of bubble tube is called axis of level tube

Vertical Axis

- It is an axis about which the telescope can be rotate in a horizontal plane.

Leveling Staff



- Solid Staff
- Telescopic Staff
- Folding Staff

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- Solid Staff :- The metric solid staff is generally 3m long, 75mm wide and 25mm thick with a metal shoe at the bottom and graduated on one face. The smallest division is of 5mm in metric system.
- Telescopic staff :- A telescopic staff consist of two hollow piece and one solid piece, each telescoping into bottom one.
- Folding Staff :- A folding staff is generally 4m long is divided into two equal part 2m each.

How to work with staff

- Holding the staff
  - The person hold the staff stands behind the staff and hold it in between the palms of his hand.
  - It is notified that hands of the staff man should not obstruct any of the staff reading
- Reading the staff
  - The central hair of the diaphragm is noted as the reading of the point on which staff held.

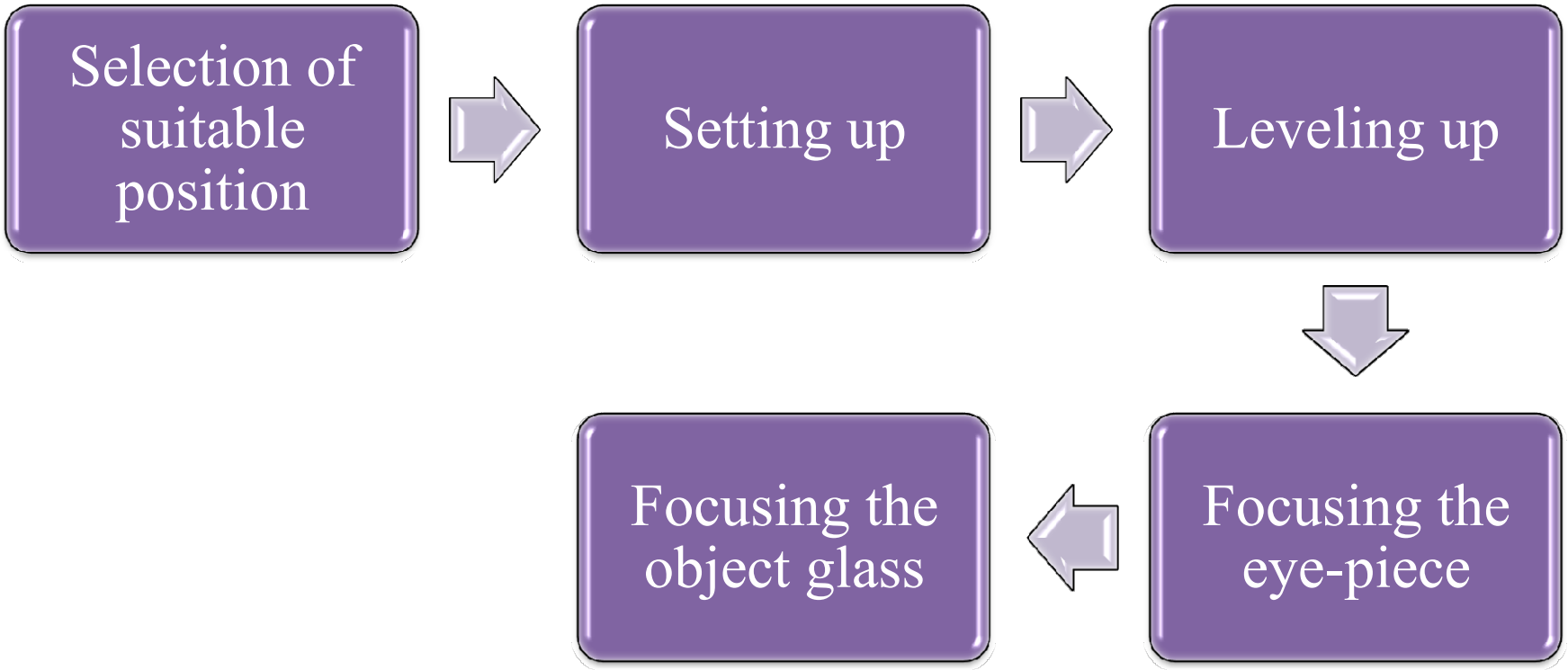
Special terms use in leveling

- Station :- in the leveling a station point is that point is where the leveling staff is held.

- Back Sight (BS):- This is the first staff reading taken after setting up the instrument .
- The B.S is used to determine the height of the instrument.
- Height of the instrument = Known elevation + B.S

- Foresight Reading (FS) :- It is the last staff reading in any setup of the instrument and it indicate the shifting the set up.
- Change Point (CP) :- This point indicate the shifting the instrument. At this point before shifting the instrument FS is taken and then after BS is taken from the next set up.

Temporary adjustment of level



Selection of suitable position

- Select a position in such a way that maximum number of reading can be taken perfectly without any type of the difficulties.

Setting up

- First the tripod is setup so that its legs are well apart, and pressed firmly into the ground.

Leveling up

- The purpose of leveling is to make the instrument vertical.
- The following procedure is used for the leveling :-

1. App. Leveling by tripod legs.
2. Perfect leveling by foot screws.

Focusing the eye-piece

- A piece of white paper is held in front of the object glass and eye piece is moved in or out by turning it clockwise or anti-clockwise until the cross-hair can be seen sharp.

Focusing the object glass

- Focusing of the object is done to bring the image of the object in the plane of the cross hair.
- Looking through the eye piece, the focusing screw is turned clockwise or anti-clockwise until the image of the object appears clear and sharp.

Methods of Levelling

Height of Instrument Method (H.I. Method)

Rise and Fall Method

Difference between

H.I. Method

- Less tedious, more rapid and simple method.
- Less number of Calculation are required.
- Less accurate.
- There is no check on each R.L of intermediate point

Rise & Fall Method

- This method is more tedious.
- More calculation are required.
- More accurate.
- Cross check on each R.L of intermediate point.

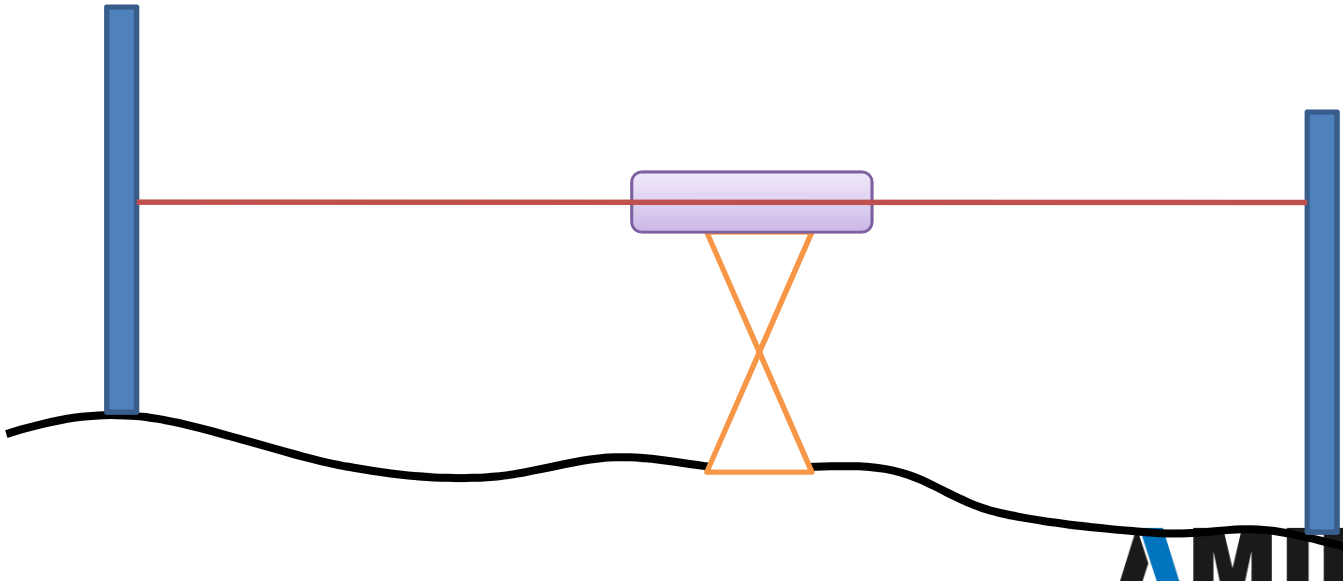
Methods of Levelling

Simple Levelling

Direct Leveling

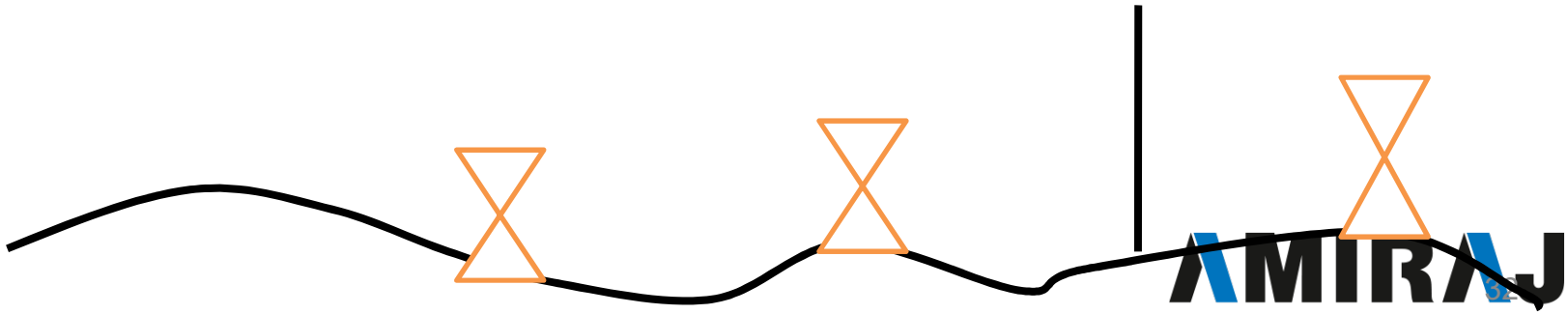
Simple Leveling

- The method is used to determine the different elevation of the two points which are visible from a single position of the instrument.

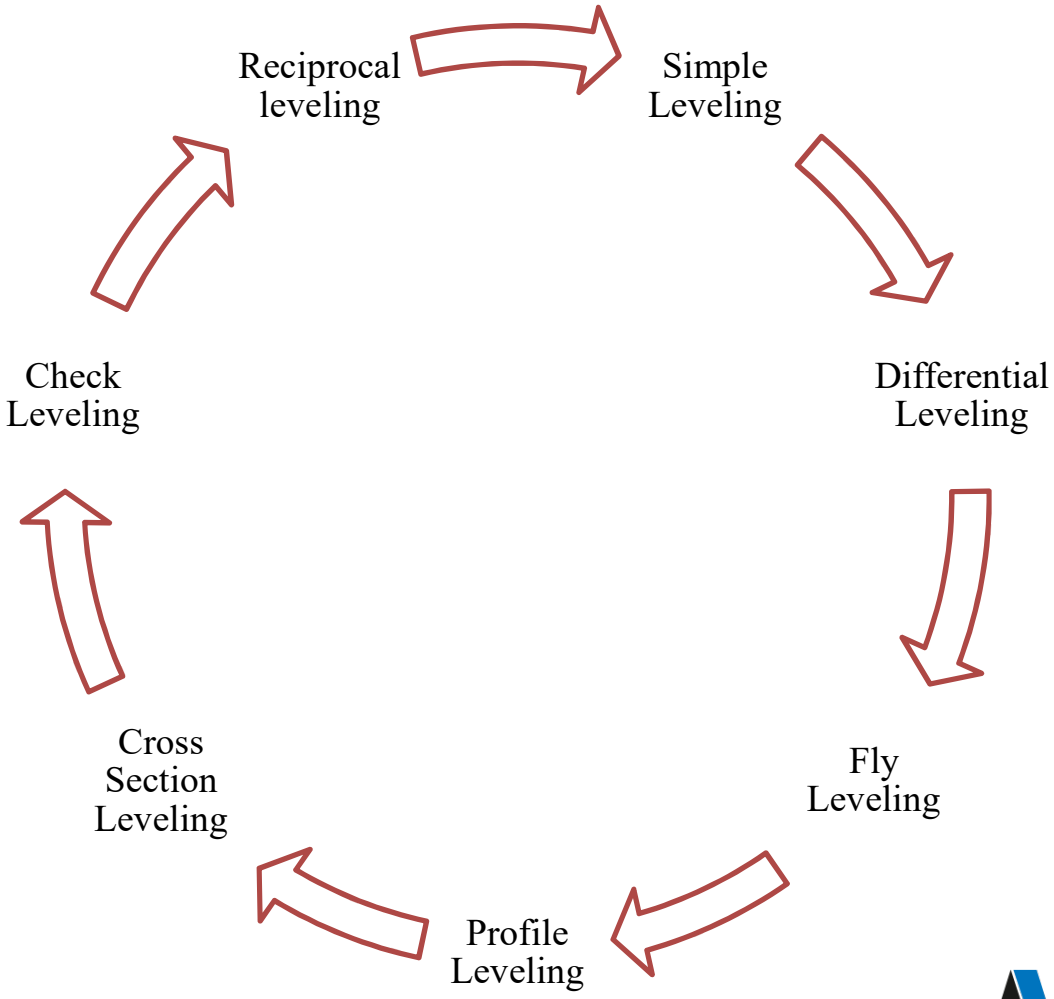


Differential leveling

- The method is used when the two points whose difference of elevation is large.
- This method is also known as compound leveling or continuous leveling.
- In this method the level is setup at several suitable position and staff reading is taken until the last point can be sight.



Direct Leveling



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Fly Leveling

- When differential leveling is done in order to connect a bench mark to the starting point of the alignment of any project (ie. Road, railway, canal) it is called fly leveling.

Profile Leveling

- This type of differential leveling done for the purpose of determining the elevation of the ground surface along an alignment of a road, canal, railway.
- Profile leveling is used to determine the filling and cutting of the earth work.

Cross section Leveling

- This type of differential leveling is done to determine the different elevation of the ground surface along the line.

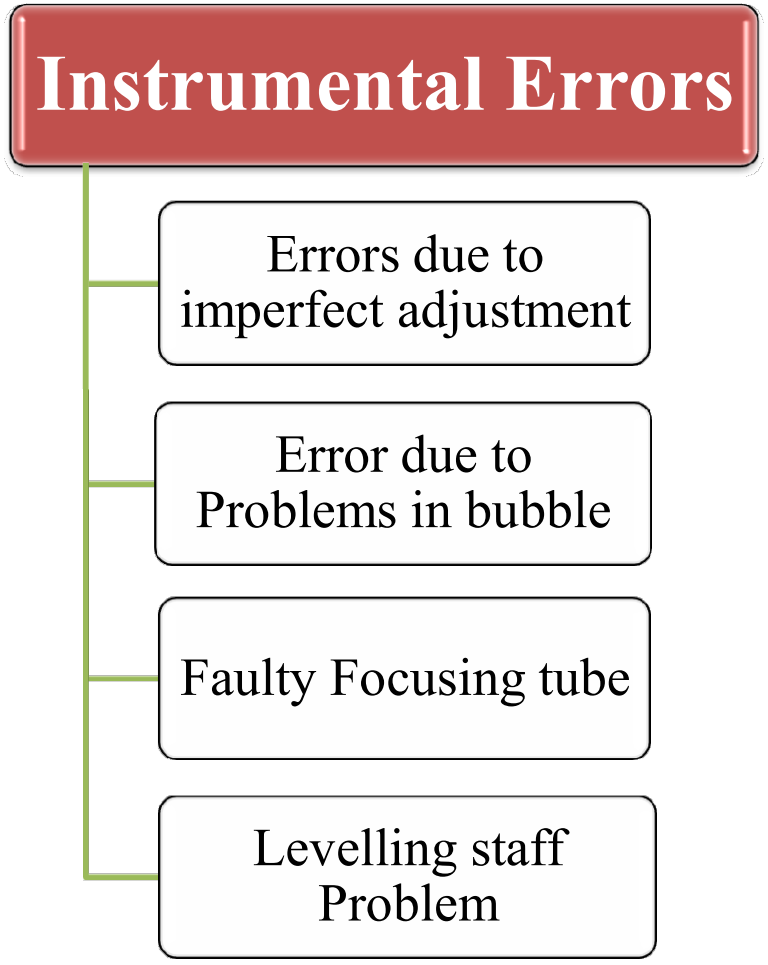
Check Leveling

- This leveling is done for the purpose of checking the different elevation which have already done.
- Check leveling is done at the end of the day to check the different level.

Reciprocal Leveling

- It is the method of leveling used to determine the different point of elevation of the two point which are situated opposite the river bank.
- It is not possible to set the instrument above the river water so the reading is taken on the both side of the river bank and take average of the reading.

Errors in Levelling



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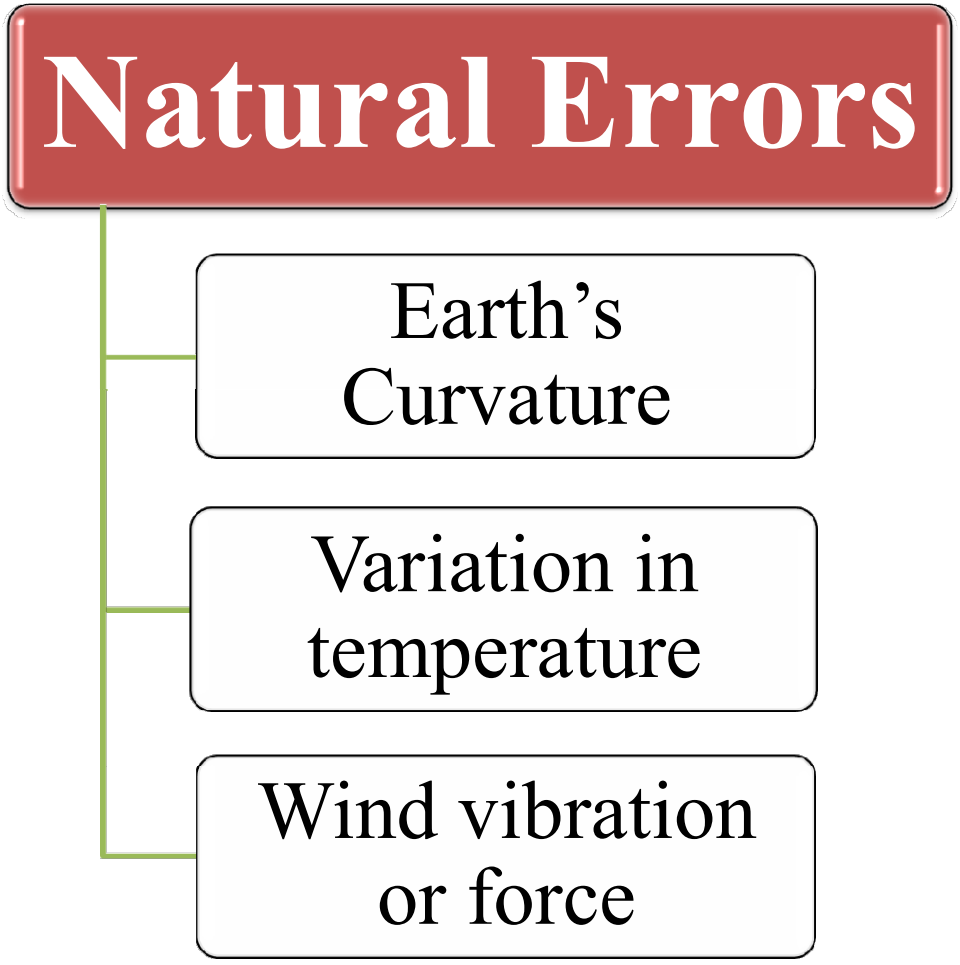

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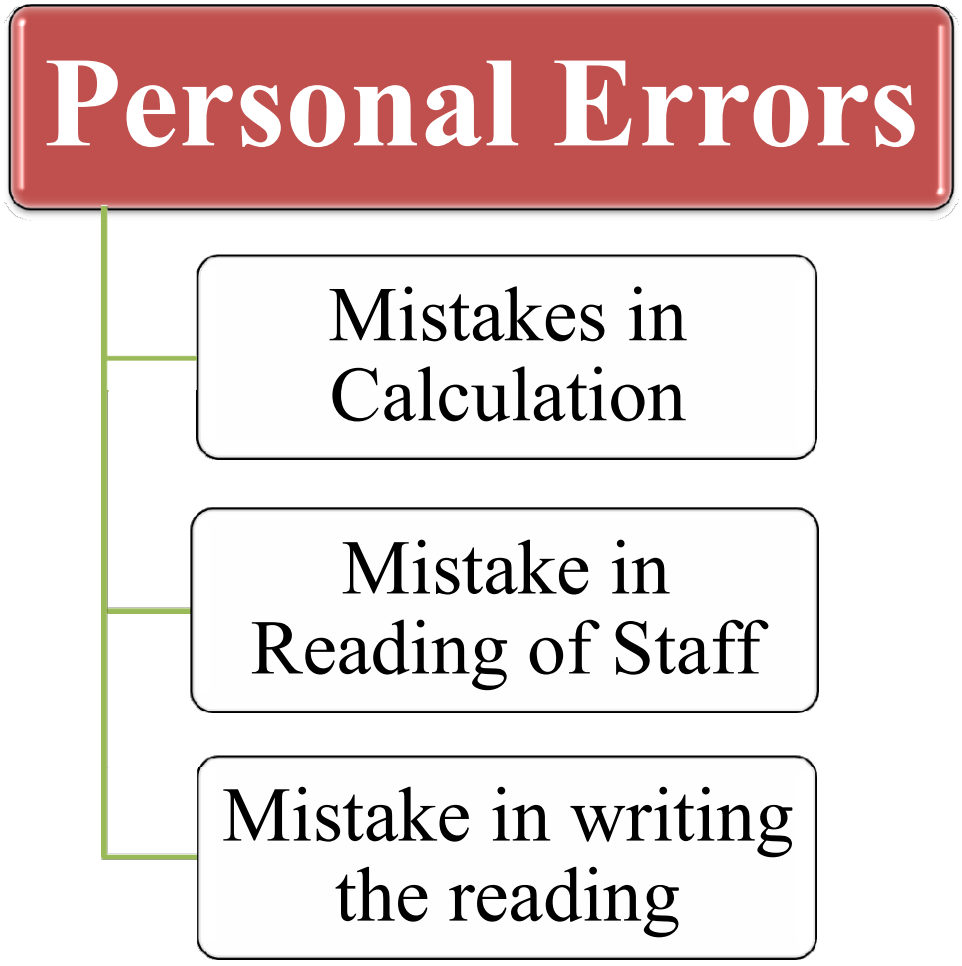
Errors in Levelling



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CONTOURING

Contouring

- Contour Line :- A contour line may be define as an imaginary line passing through points of equal level.
- Contour line on a plan illustrate the topography of the area.
- Contour line is used to know area (hill, depression, undulation)
- A map showing only the contour line of an area is called a contour map.

- Contour Interval :- The vertical Distance between two contour line is known as contour interval.
- Interval Depend upon the following factors

i. The nature of the ground

ii. The scale of the map

iii. The purpose of survey

- Horizontal Equivalent :-The horizontal distance between any two contour is known as horizontal equivalent.

Use of the contour map

- To select a site for engineering project like road, railway, canal.
- To find the possible route of communication between the two different place.
- To calculate the capacity of the reservoir.
- To know the ground surface along any direction.
- To estimate the cutting and filling of the earth.
- To know the drainage characteristic.

Characteristic of contour

- All the point on a single contour line has the same elevation.
- Two contour line do not intersect with each other.
- Contour line always closed circuit.
- Contour do not have sharp turning.
- The contour line are closer near the top of hill and wide apart near the foot.
- The contour line are closer near the bank of pond or depression and wide at the centre.

- Uniformly contour line indicate the uniform slope.
- Contour deflect uphill at valley lines and down hill at ridge line.
- Contour lines meet at a point indicate a vertical cliff.
- Contour line can not cross one another, except in the case of overhanging Cliff.

Methods of Contour

- There are main two method of contouring.

Direct method

Indirect method

Direct method

- In direct method RL of the different points are to be located.
- Contour are drawn by joining the different points.
- It is very accurate method.
- The method of locating contour directly consist of horizontal and vertical control.
- Horizontal control done by the chain or tap. And vertical control done by either level & staff or a hand level may be used.

Indirect method

- Indirect method are less expansive, less time consuming, less tedious.
- This method are used for large area.
- There are three different way to make the contour line.

I. Grid method

II. Cross section method

III. Radial line method

Grid method

- If the area is not large so it is divided into grid.
- The grid size vary from 5m x 5m to 25m x 25m depend upon the nature of the ground, contour interval, and scale of the map.

Cross section Method

- In this method, suitable spaced cross section are projected on either side of the center line of the area.
- Points are chosen at reasonable distance on either sides.

Radial Method

- In this method a number of radial lines are set out at 15^0 or 30^0 angular interval.
- The points are selected on a ground at regular interval.
- The observation are taken on the staff station and elevation and distance are then calculated.