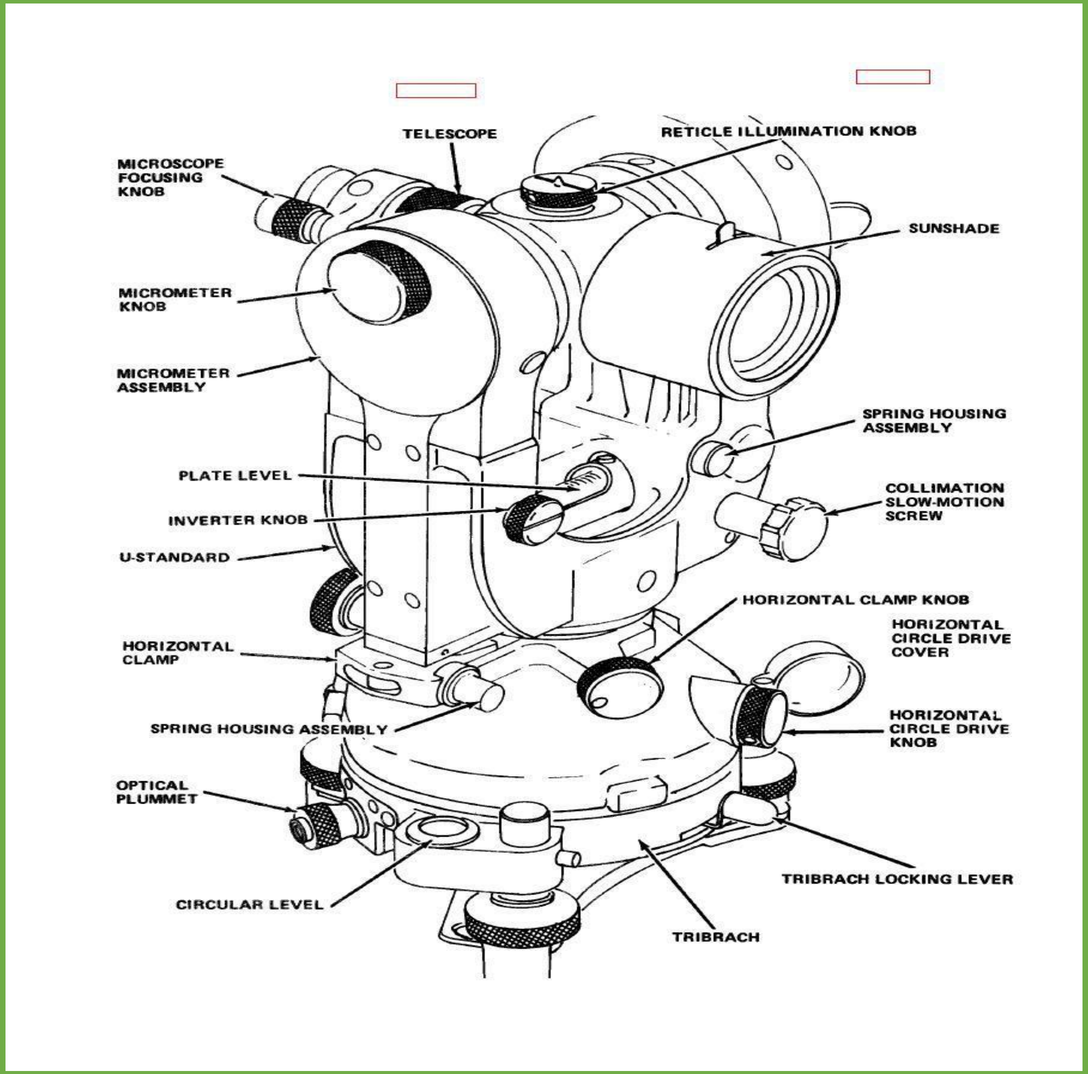
GOVT. POLYTECHNIC
MANESAR
GURGOAN

PRESENTATION ON CONTOUR

1. contouring

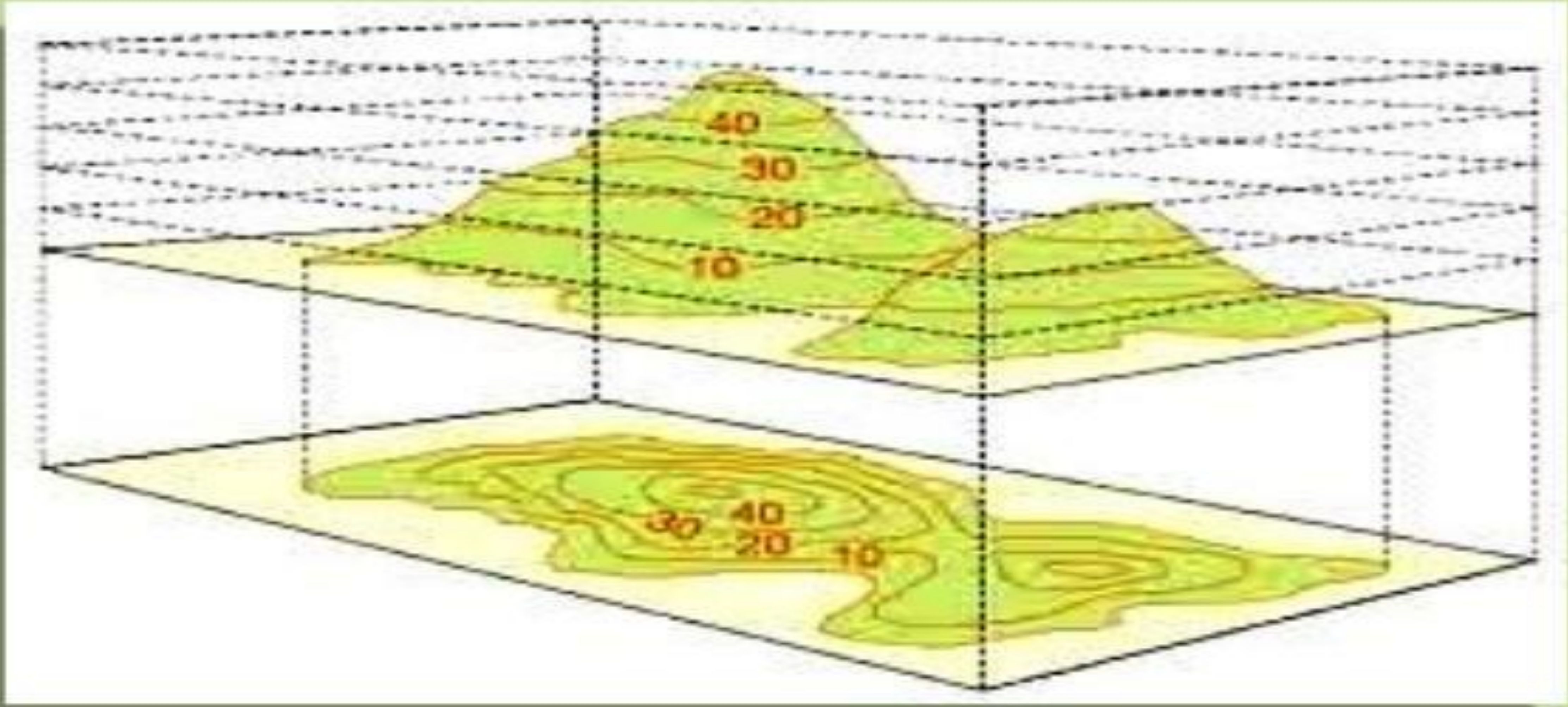


Contouring

Contouring

- Contour – définitions, objectives, contour interval, horizontal equivalent, uses and characteristics of contour lines, methods of plotting contours, direct and indirect methods of contouring, Contour gradient.

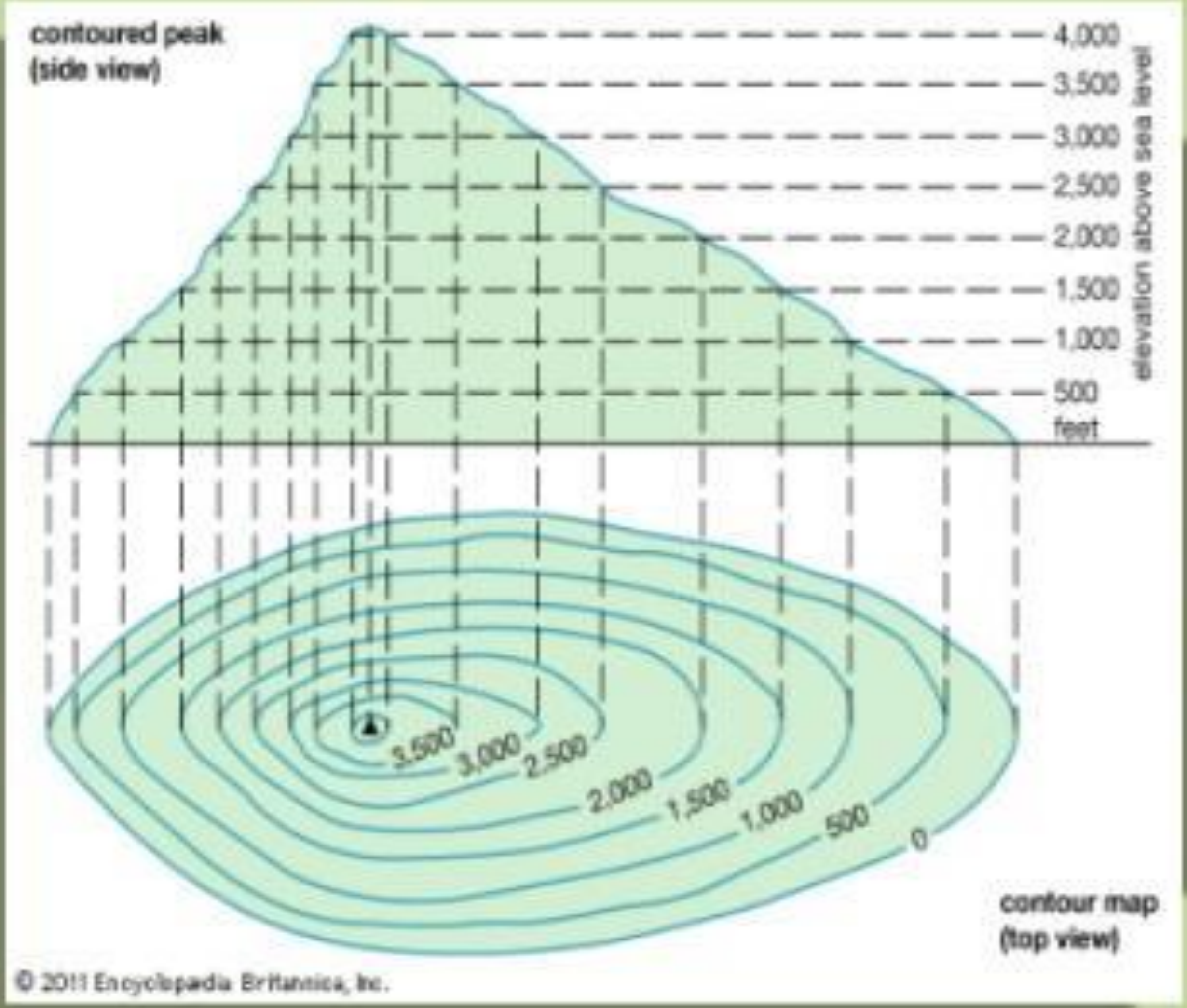
Levelling and Contouring

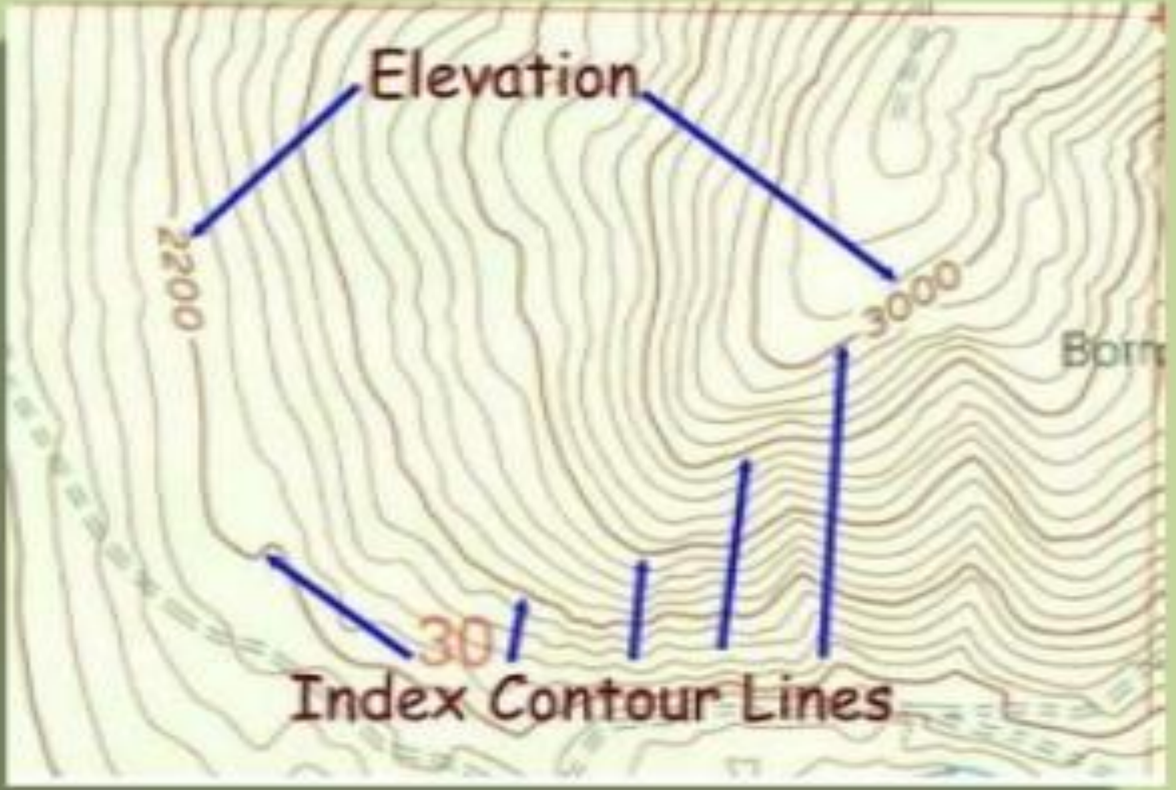


Contour Line

- A contour line may be defined as "***An imaginary line passing through points of equal reduced levels***". A contour line may also be defined "***as the intersection of a level surface with the surface of the earth"***. Thus, contour lines on a plan illustrates the topography of the area.
- For ex a contour of 90 m indicates that all the points on this line have RL of 90 m. Similarly, in a contour of 89 m all the points have RL of 89 m and so on.

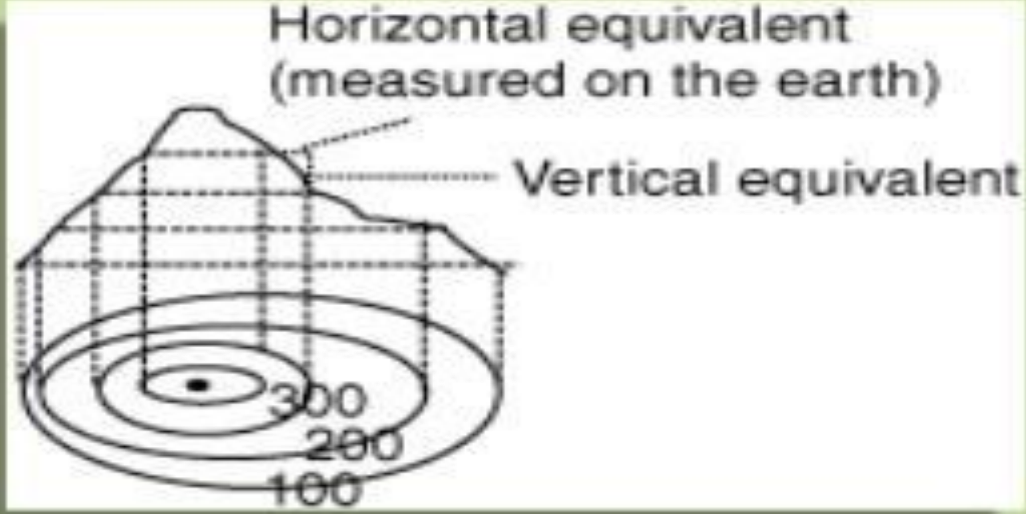
Contour Line





Horizontal Equivalent

- The horizontal distance between any two consecutive contours is known as **horizontal equivalent**. It is not constant. It varies from point to point depending upon the steepness of the ground. Steeper the ground, lesser is the horizontal equivalent.



Use of Contour Map

- Contour maps provide valuable information about the topography of the area, whether it is flat, undulating or mountainoueous. The nature of the ground surface of an area can be understood by studying a contour map.

The following are the specific uses of the contour map.

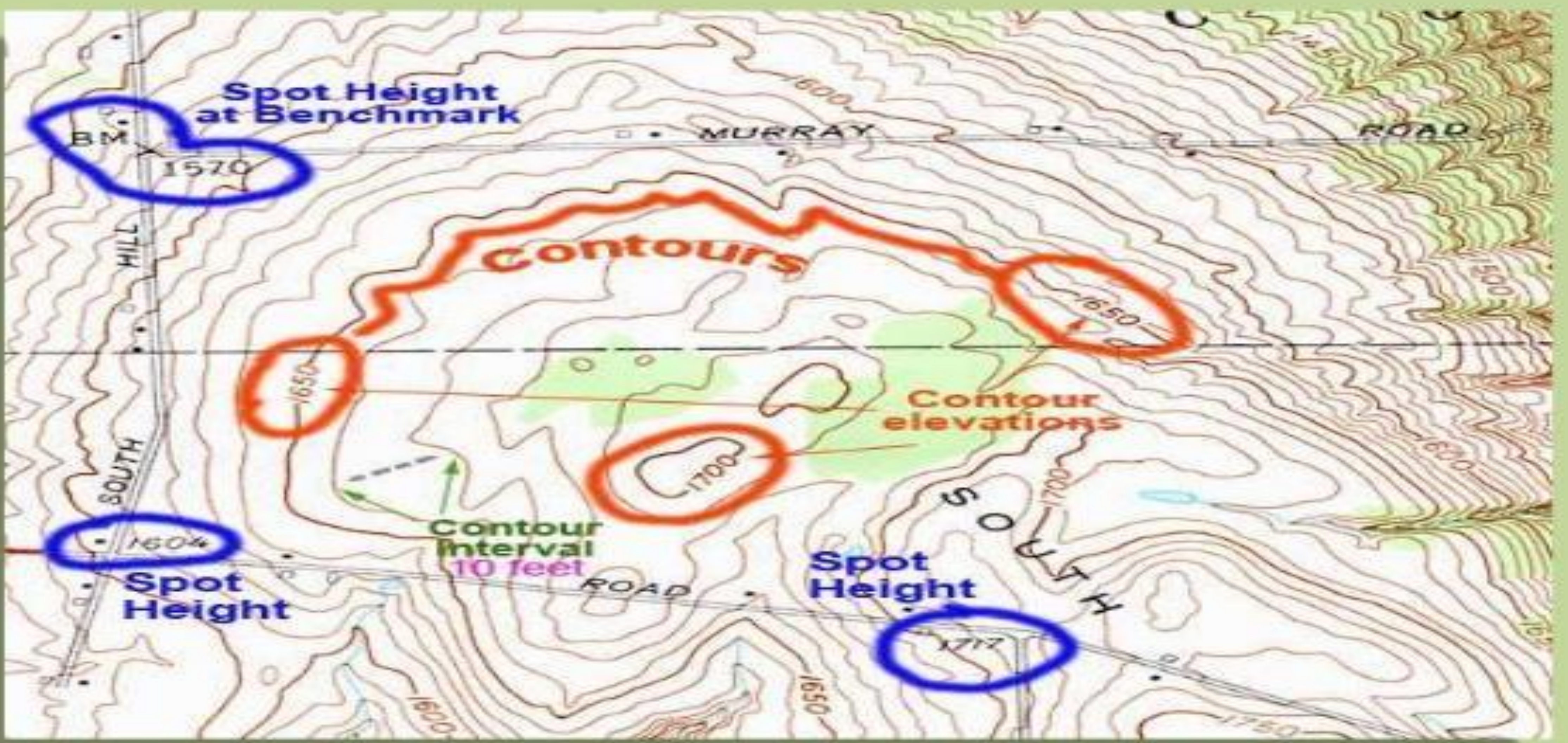
- To select sites for engineering projects such **as roads, canals, railways.**
- To find the **possible route of communication between different places.**
- The **capacity of a reservoir** and the **area of submergence** can be computed
- To ascertain the **indivisibility of stations**.
- To ascertain the profile of the ground surface along any direction.
- A suitable route for given gradient can be marked on the map.

Use of Contour Map

Characteristics of Contours

- Since every point on **a contour line has the same elevation**, a contour map with a constant interval portrays the conformation of the ground in a **characteristics manner**. The knowledge of **contour characteristics** helps in identifying the **natural features of the area** from the given map and in avoiding mistakes in plotting the contours correctly.

Characteristics of Contours



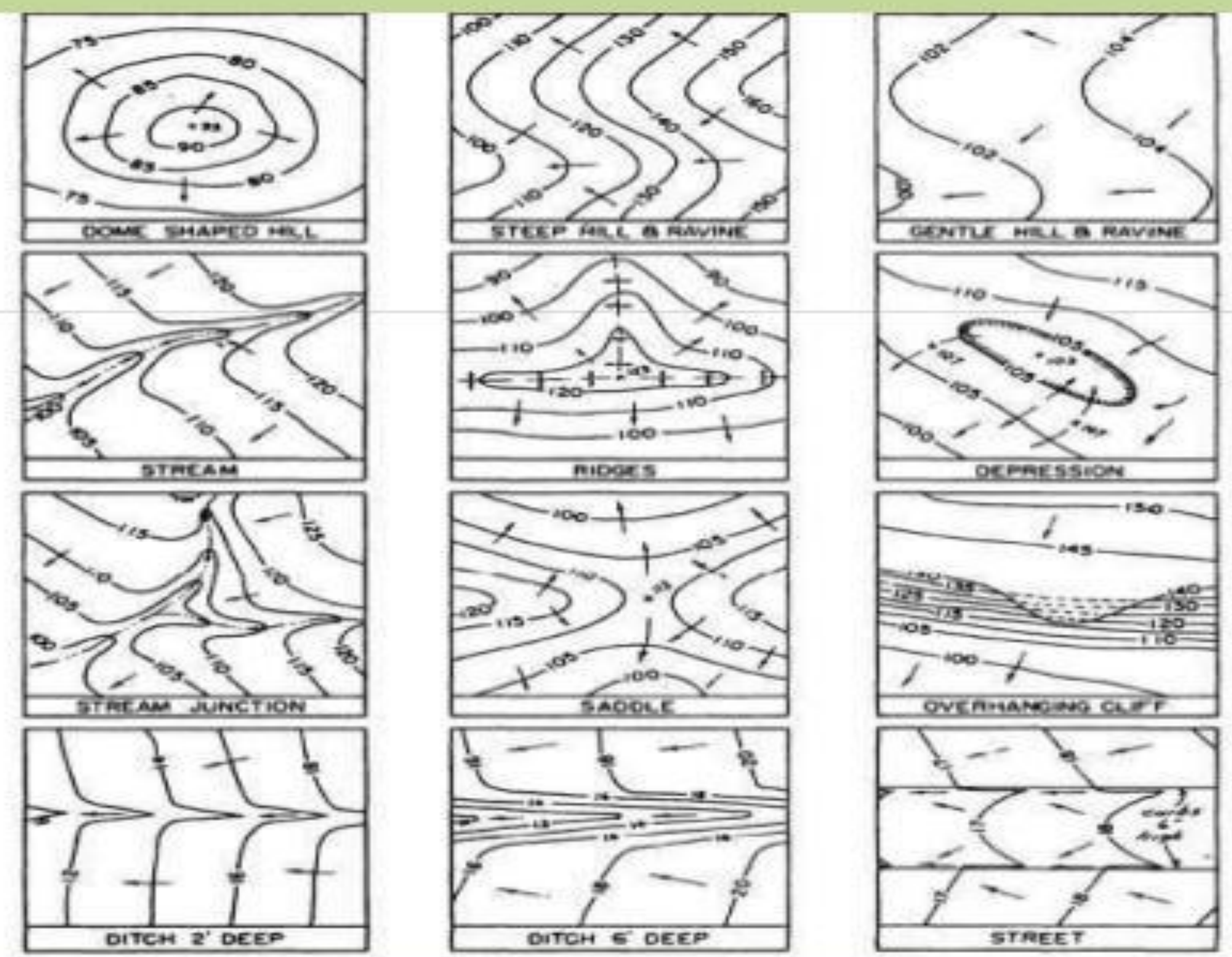
Characteristics of Contours

- ***The following characteristics help in plotting or reading a constant map.***
- All the **points on a contour line have the same elevation**. The elevations of the contour are indicated either by inserting the figure in a break in respective contour or printed close to the contour.
- **Two contour lines do not intersect** with each other.
- **Contour lines always from a closed circuit**. But these lines may be within or outside the limit of the map.
- **Contour do not have sharp turning.**

Characteristics of Contours

- The **contour lines are closer near the top of a hill** or high ground and wide apart near the foot. This **indicates a very steep slope towards** the peak and a flatter slope towards the foot.
- The **contour lines are closer near the bank** of a **pond or depression and wide towards the centre**. This indicates a **steep slope near the bank and a flatter slope at the centre**.
- **Uniformly spaced contour** lines indicate a **uniform slope.**

Characteristics of Contours



Characteristics of Contours

RULES FOR CONTOUR LINES

1. Every point on a contour line is of the exact same elevation; that is, contour lines connect points of equal elevation.

2. Contour lines always separate points of higher elevation (uphill) from points of lower elevation (downhill). You must determine which direction on the map is higher and which is lower, relative to the contour line in question, by checking adjacent elevations.

3. Contour lines always close to form an irregular circle. But sometimes part of a contour line extends beyond the mapped area so that you cannot see the entire circle formed.

4. The elevation between any two adjacent contour lines of different elevation on a topographic map is the *contour interval*. Often every fifth contour line is heavier so that you can count by five times the contour interval. These heavier contour lines are known as *index contours*, because they generally have elevations printed on them.

5. Contour lines never cross one another except for one rare case: where an overhanging cliff is present. In such a case, the hidden contours are dashed.

6. Contour lines can merge to form a single contour line only where there is a vertical cliff.

7. Evenly spaced contour lines of different elevation represent a uniform slope.

8. The closer the contour lines are to one another the steeper the slope. In other words, the steeper the slope the closer the contour lines.

9. A concentric series of closed contours represents a hill:

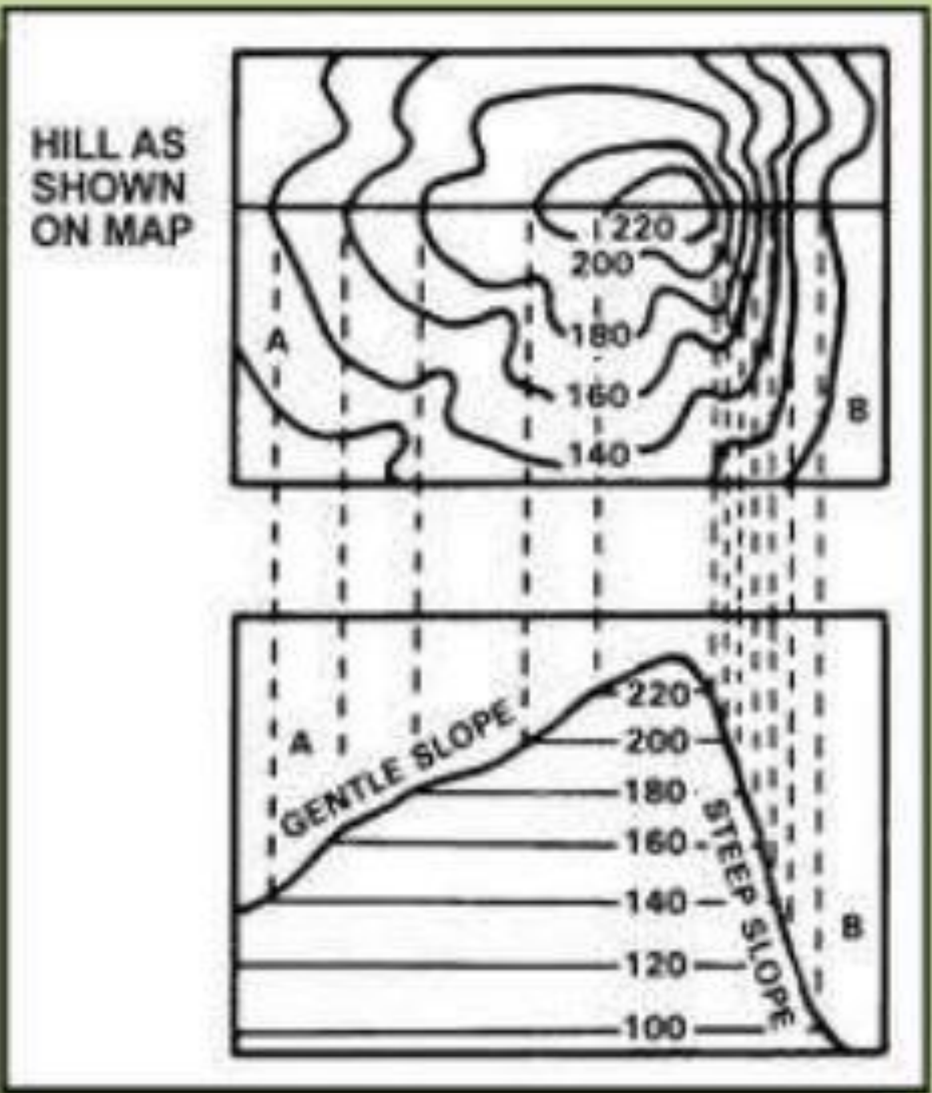
10. *Depression contours* have hachure marks on the downhill side and represent a closed depression:

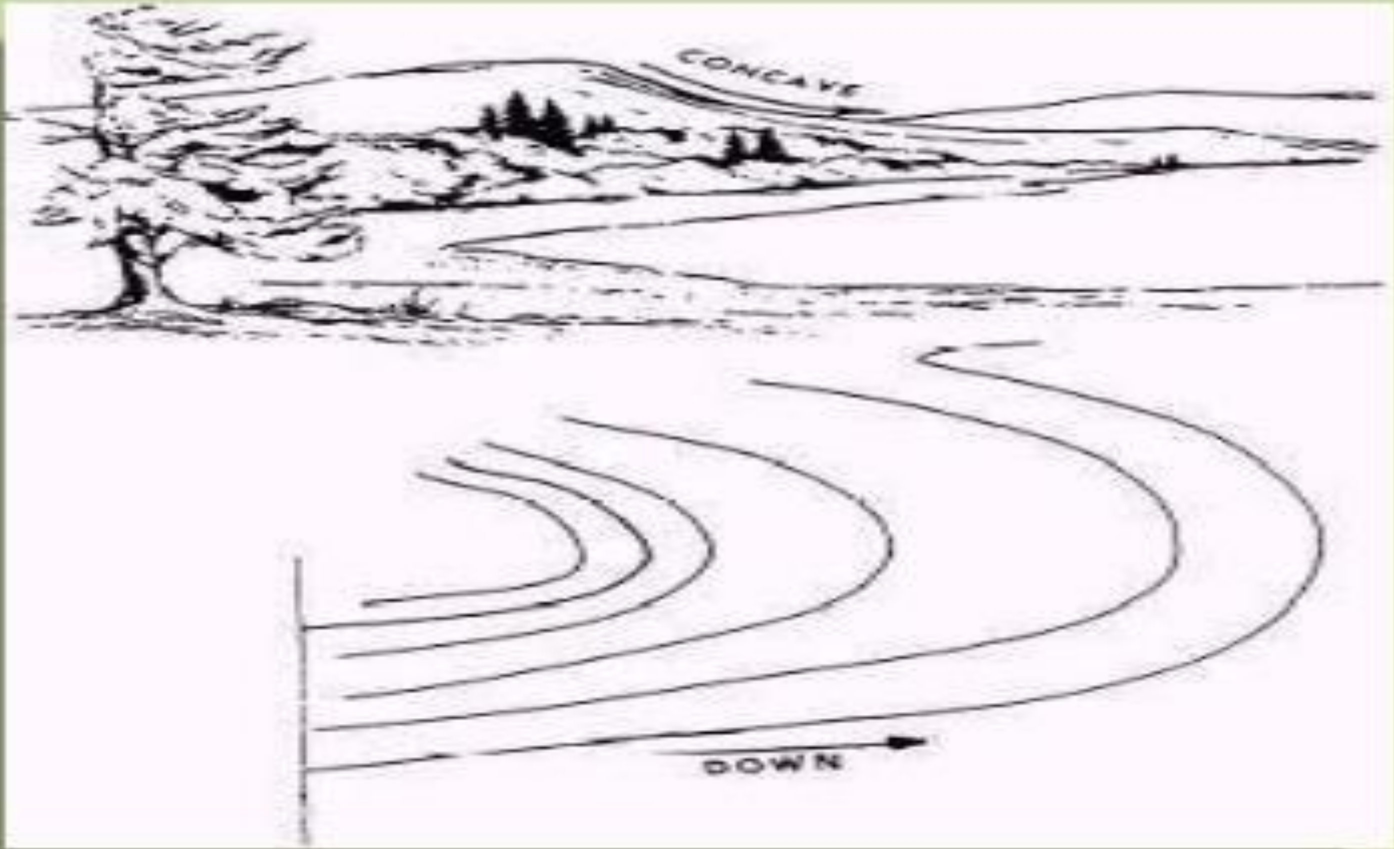
11. Contour lines form a V pattern when crossing streams. The apex of the V always points upstream (uphill):

12. Contour lines that occur on opposite sides of a valley always occur in pairs.

13. Topographic maps published by the U.S. Geological Survey are contoured in feet or meters referenced to sea level.

Characteristics of Contours





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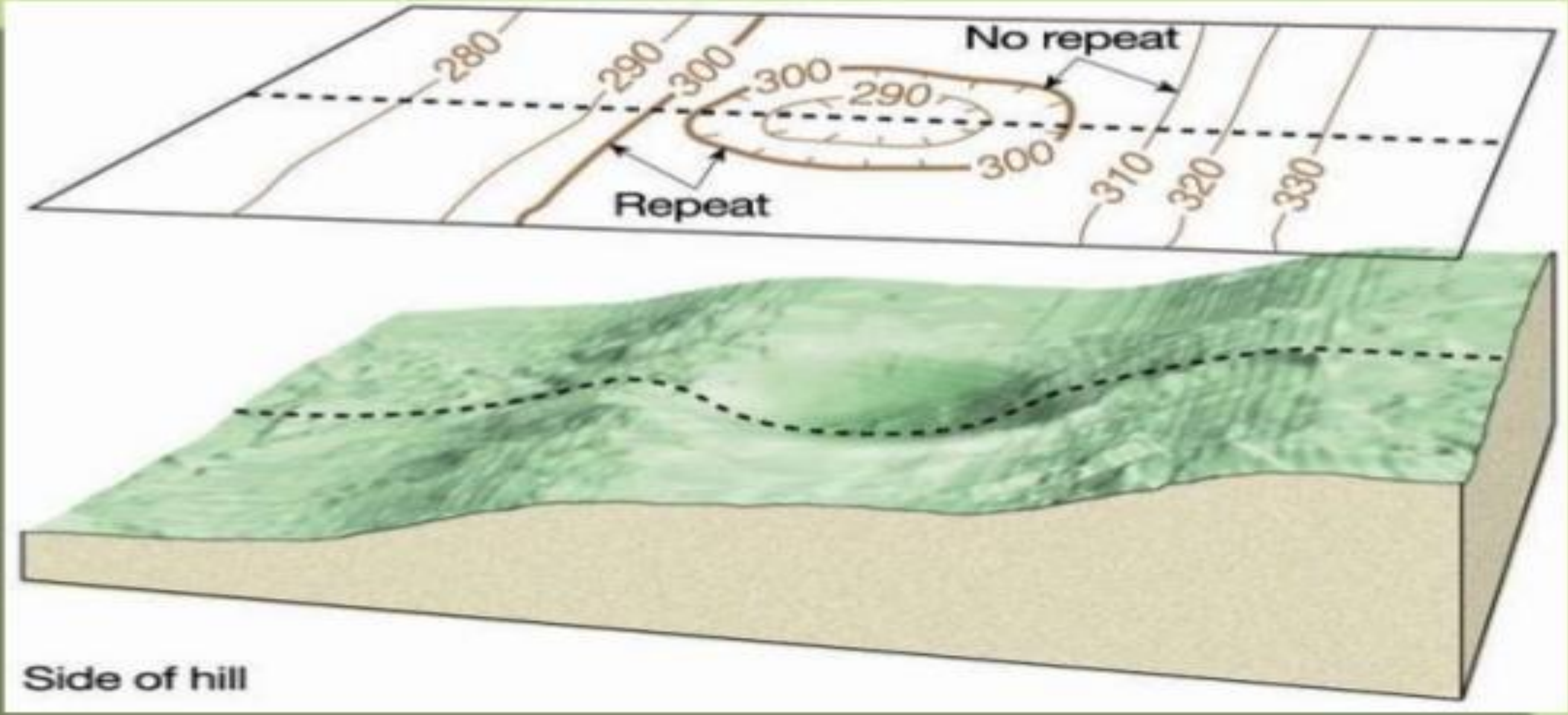
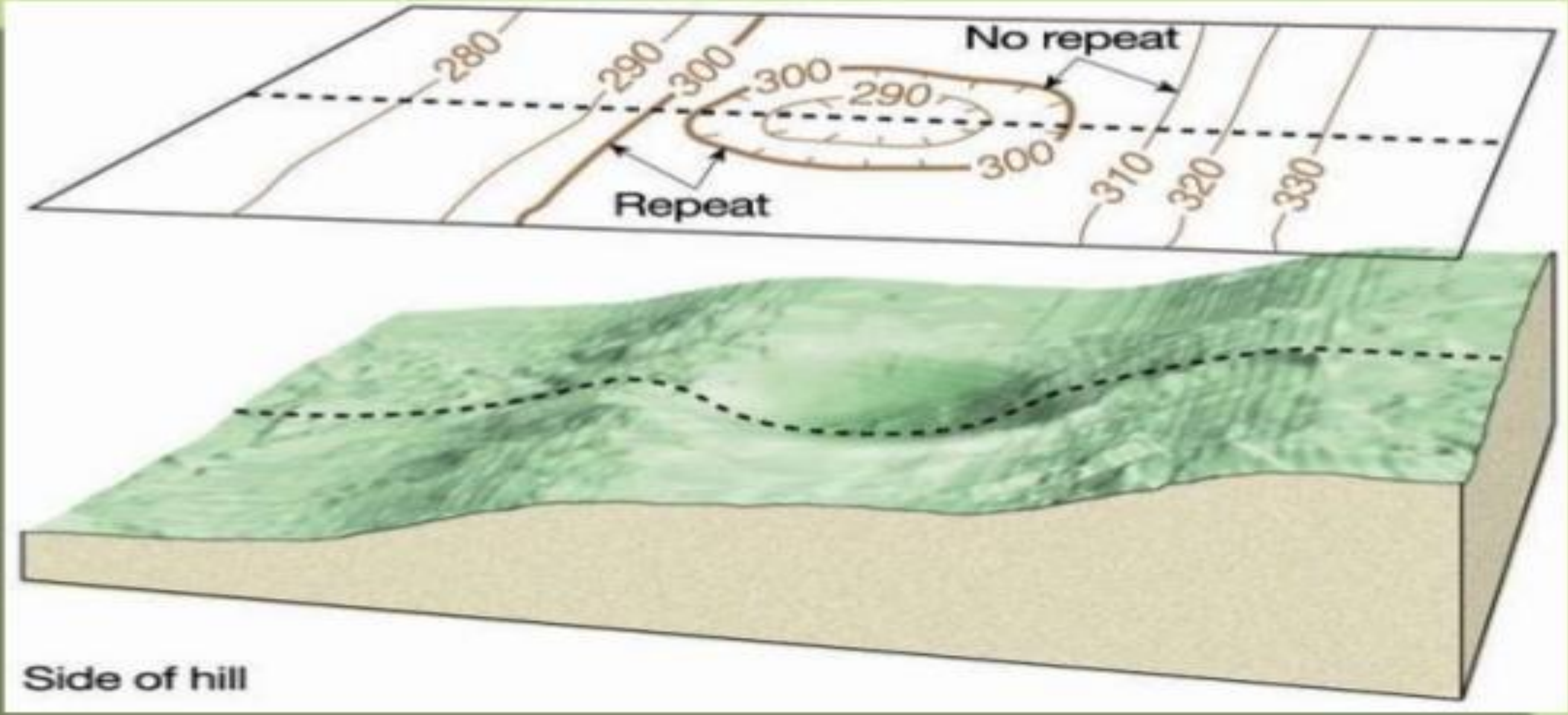


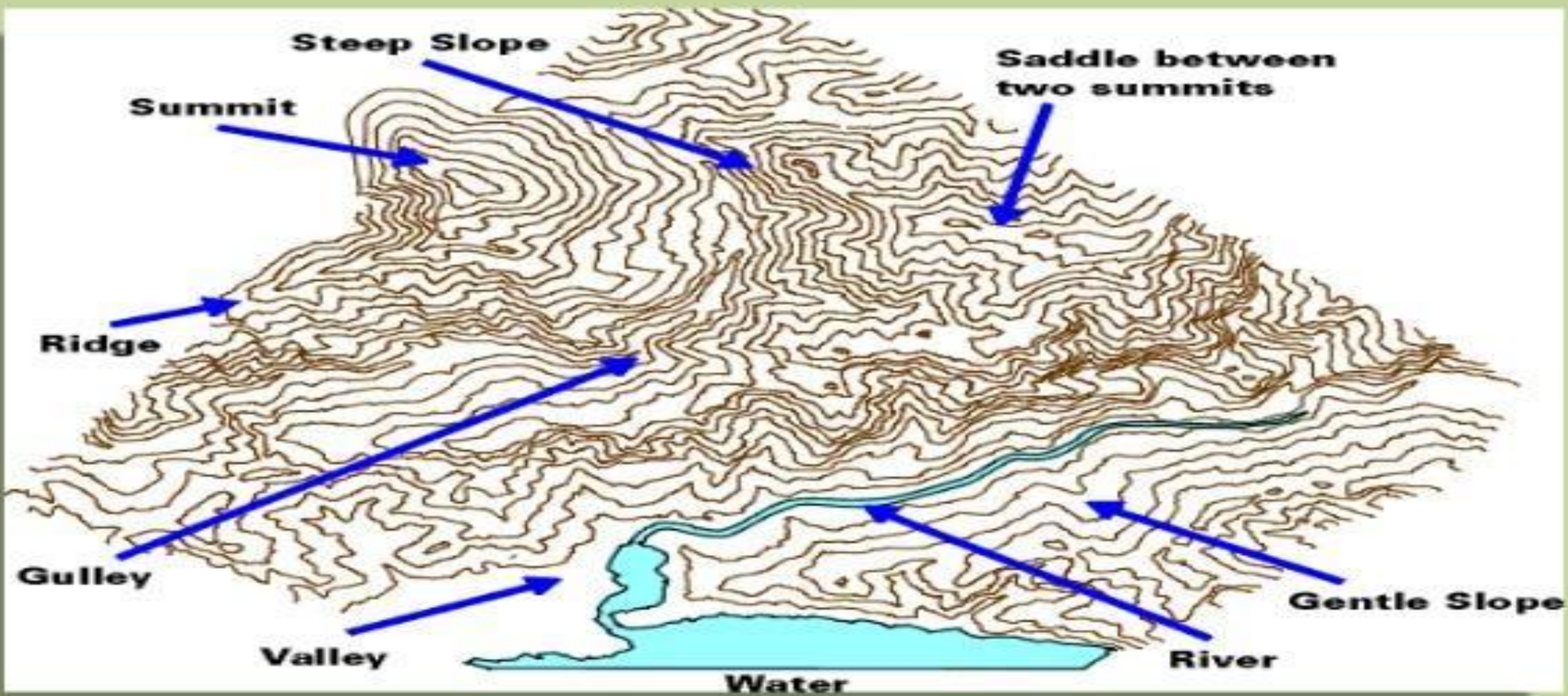
Characteristics of Contours



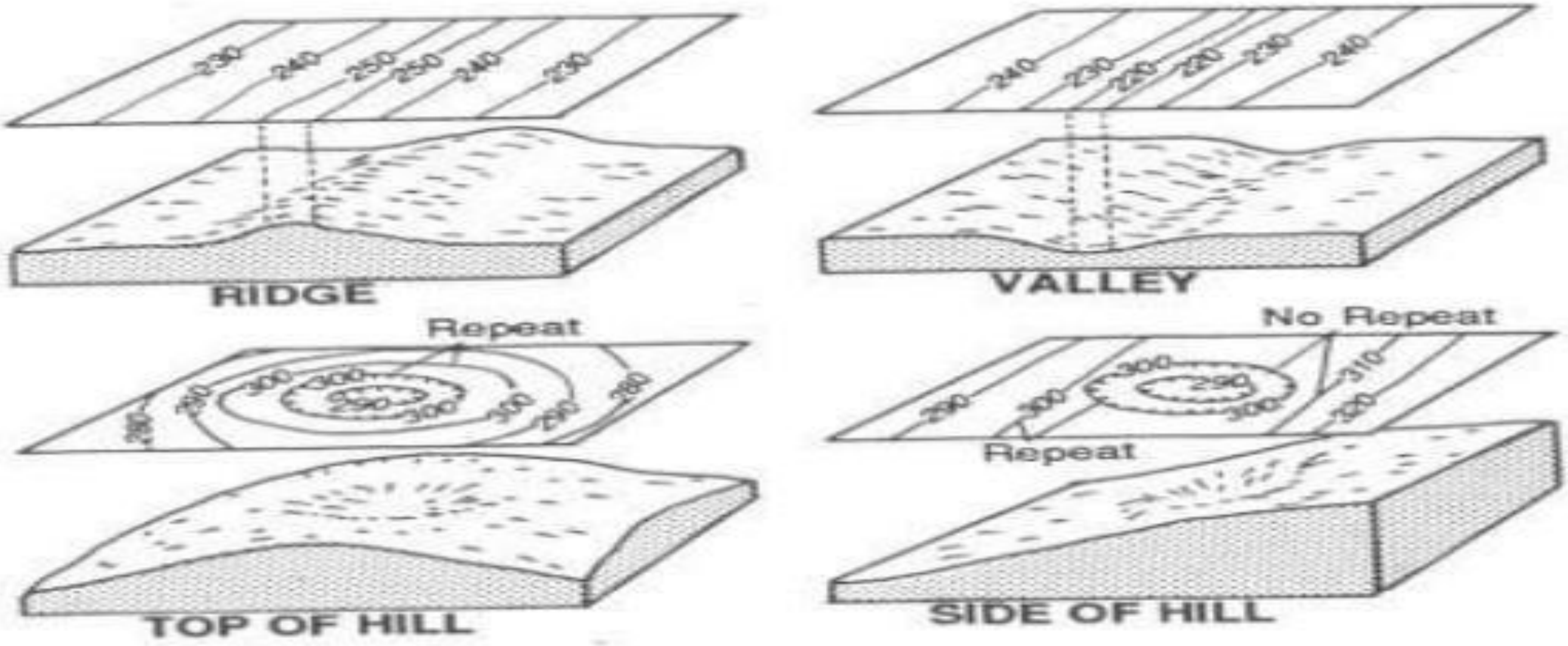
Characteristics of Contours

- **A series of closed contour always indicates a depression or summit**. The **lower values being inside the loop indicates a depression** and **the higher values being inside the loop indicates a summit**. (Hillock)
- Contour deflect uphill at valley lines and downhill at the ridge lines. Contour lines in U-shape cross a ridge and V-shape cross a valley at ridge angles. The concavity in contour lines is towards higher ground in the case of ridge and towards lower ground in the case of valley.
- **Contour lines meeting at a point** indicate a **vertical cliff**.
- **Contour lines cannot cross one another, except in the case of an overhanging cliff**. But the overhanging portion must be shown by a dotted line.

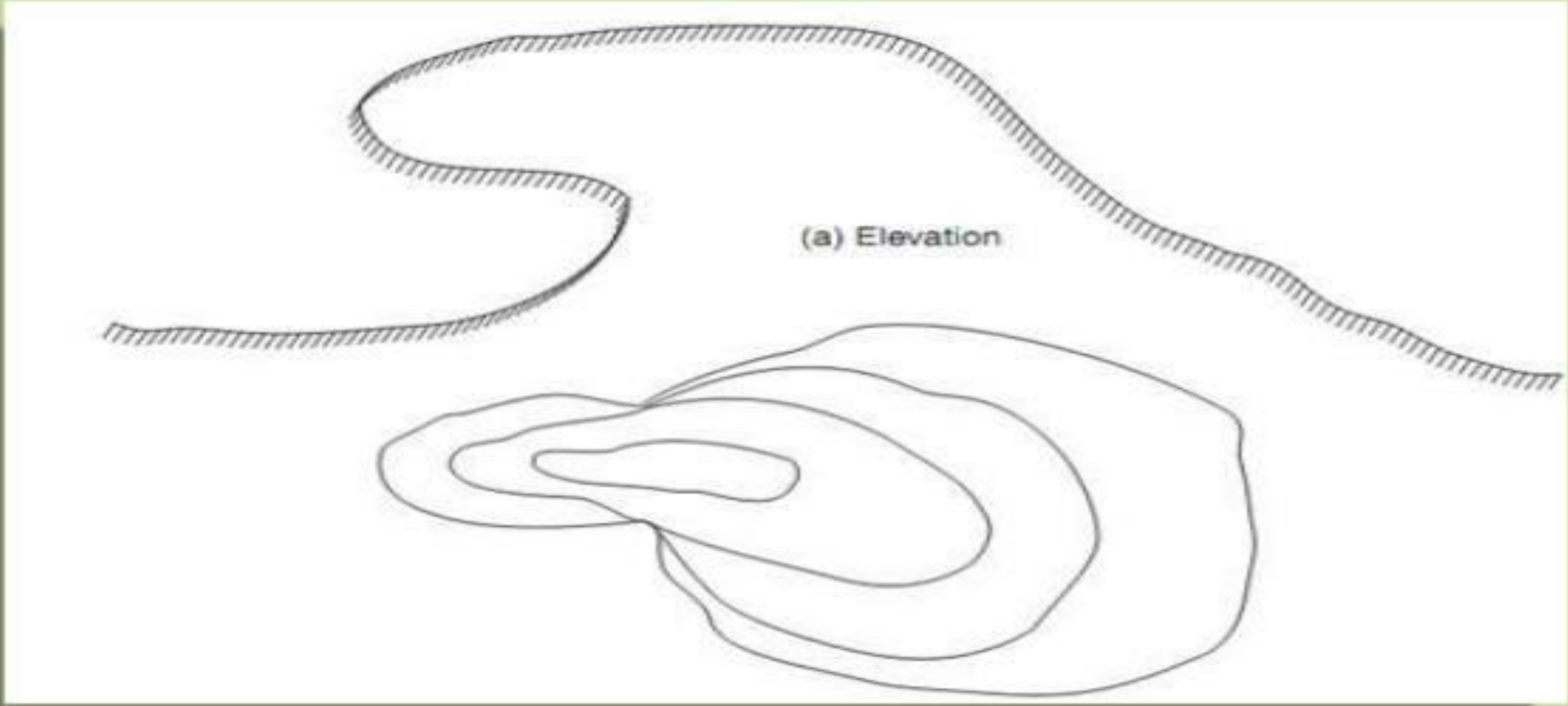
Typical Land features and their contour forms



Typical Land features and their contour forms



Typical Land features and their contour forms



Methods of Contouring

- Contouring requires the planimetric position of the points whose elevation have been determined by leveling. The methods of locating contours, therefore depending upon the instruments used to determine the horizontal as well as vertical position of several points in the area.

Methods of Contouring

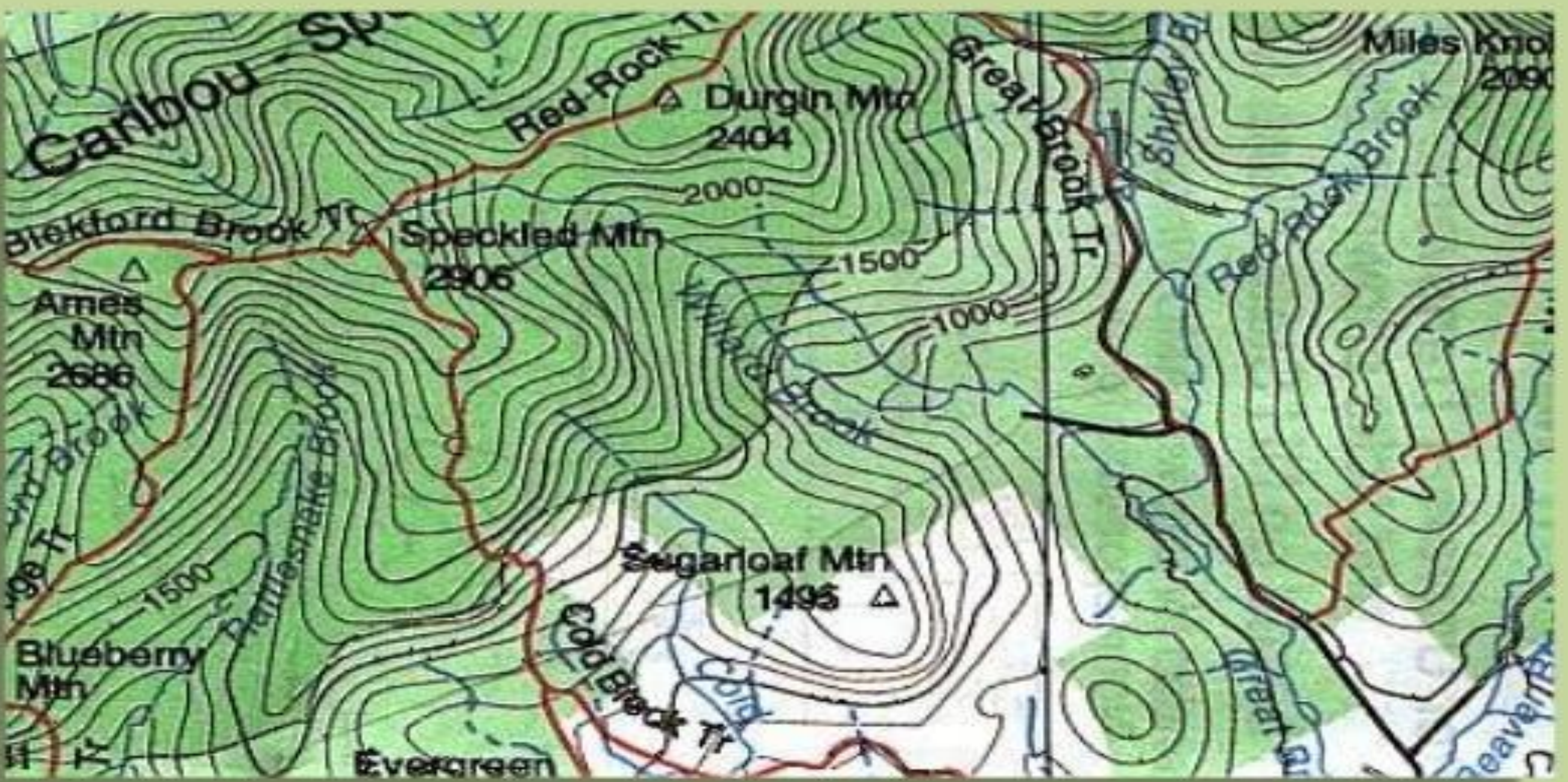
- Broadly, the method can be divided into the following two classes.
- Direct methods
- Indirect methods

Methods of Contouring

Direct Method

- In the direct method of contouring, the reduced level of various selected points on a contour line are obtained and their positions are located. The contours are then drawn by joining these points. It is a very accurate method but it is slow and tedious.
- This method is employed only for small area where superior accuracy is demanded. The method of locating contours directly consists of horizontal and vertical control. The horizontal control for a small area can be exercised by a chain or tape and a large area by compass, theodolite or plane table. For vertical control either a level and staff or a hand level may be used.

Methods of Contouring

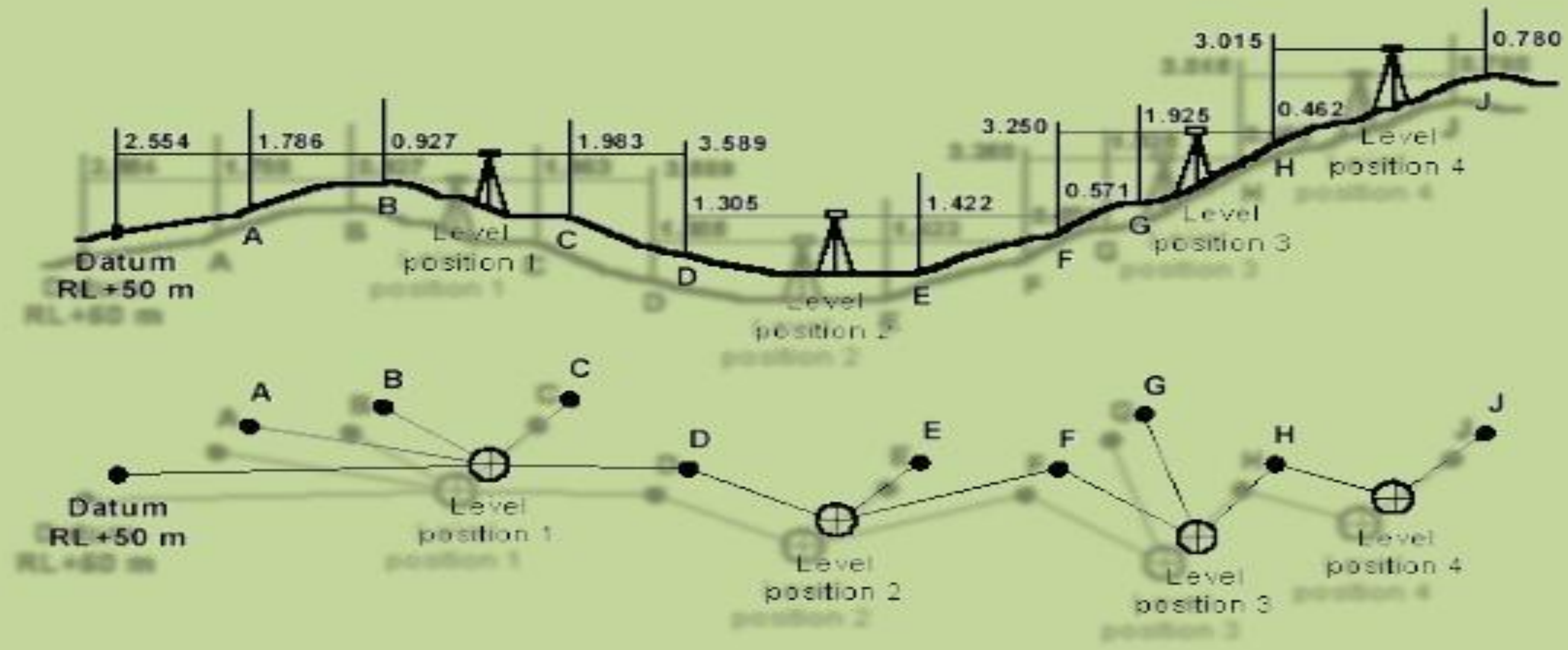


Methods of Contouring

By Level and Staff

- The method consists of locating a series of points on the ground having the same elevation by using a level and leveling staff. Instrument is setup in such a way that number of readings can be taken from the area to be surveyed. The instrument is set up and RL of HI is determined from the nearest benchmark. For a particular contour value, the staff reading is worked out. A series of points having the same staff reading is worked out, and thus the same elevations are plotted and joined by a smooth curve.

Methods of Contouring

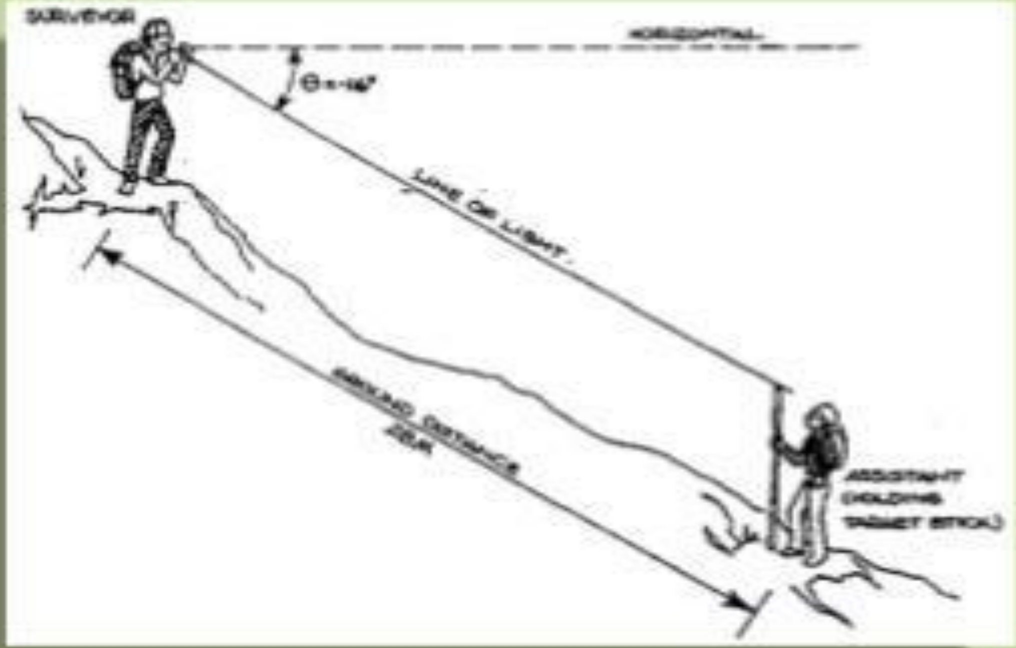


Methods of Contouring

By Hand Level

- The principle used is the same as that used in the method using a level and staff. Instead of the hand level, an abbey level may also be used. However this method is very rapid and is preferred for certain works.

Methods of Contouring



Methods of Contouring

Indirect Methods

- Indirect methods are less expensive, less time consuming and less tedious as compared with the direct methods. These methods are commonly employed in small scale survey of large areas.

Methods of Contouring

- There are three different ways of employing the indirect methods of contouring
- (i) Grid Method
- (ii) Cross-Sectional Method
- (iii) Radial line method or

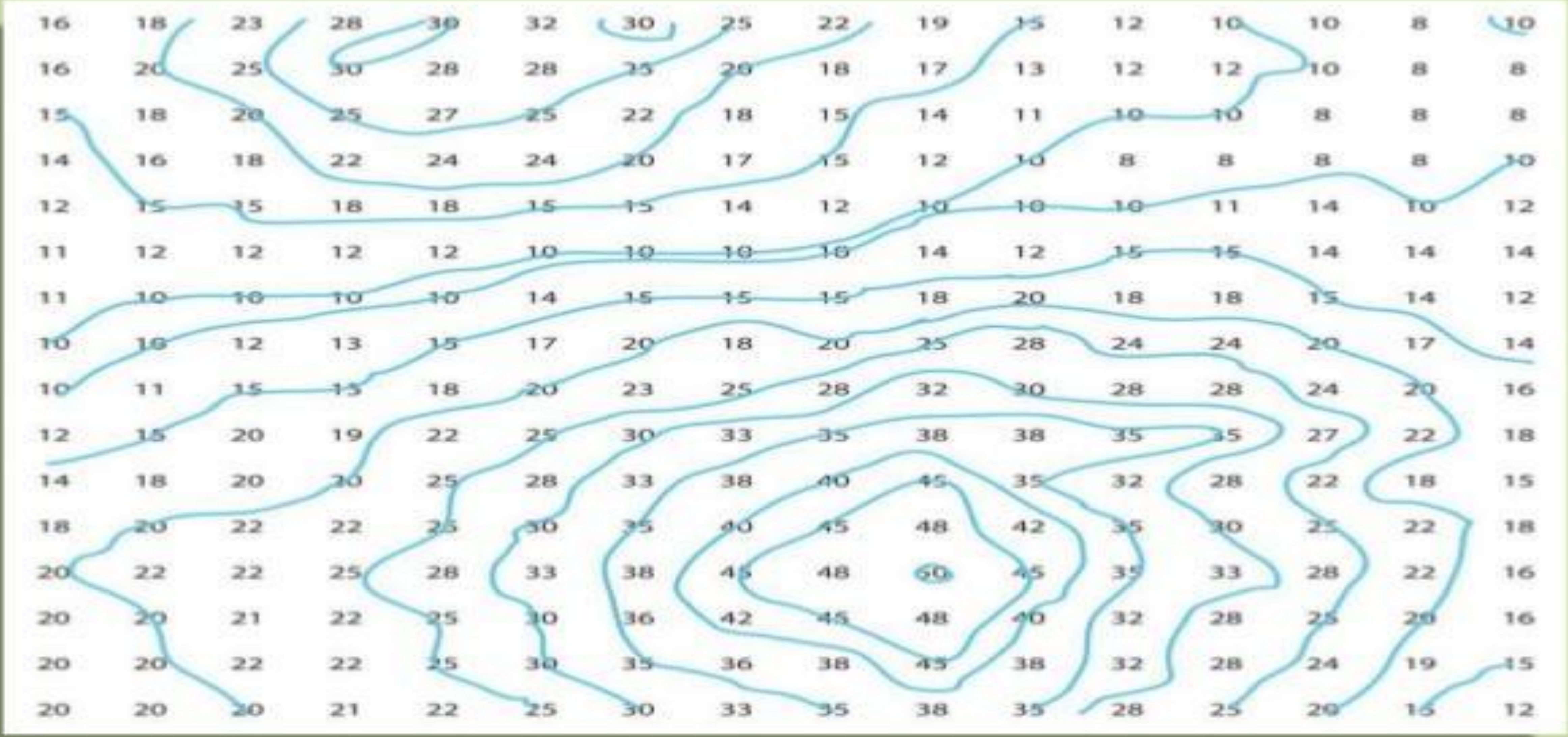
  Tachometric method

Methods of Contouring

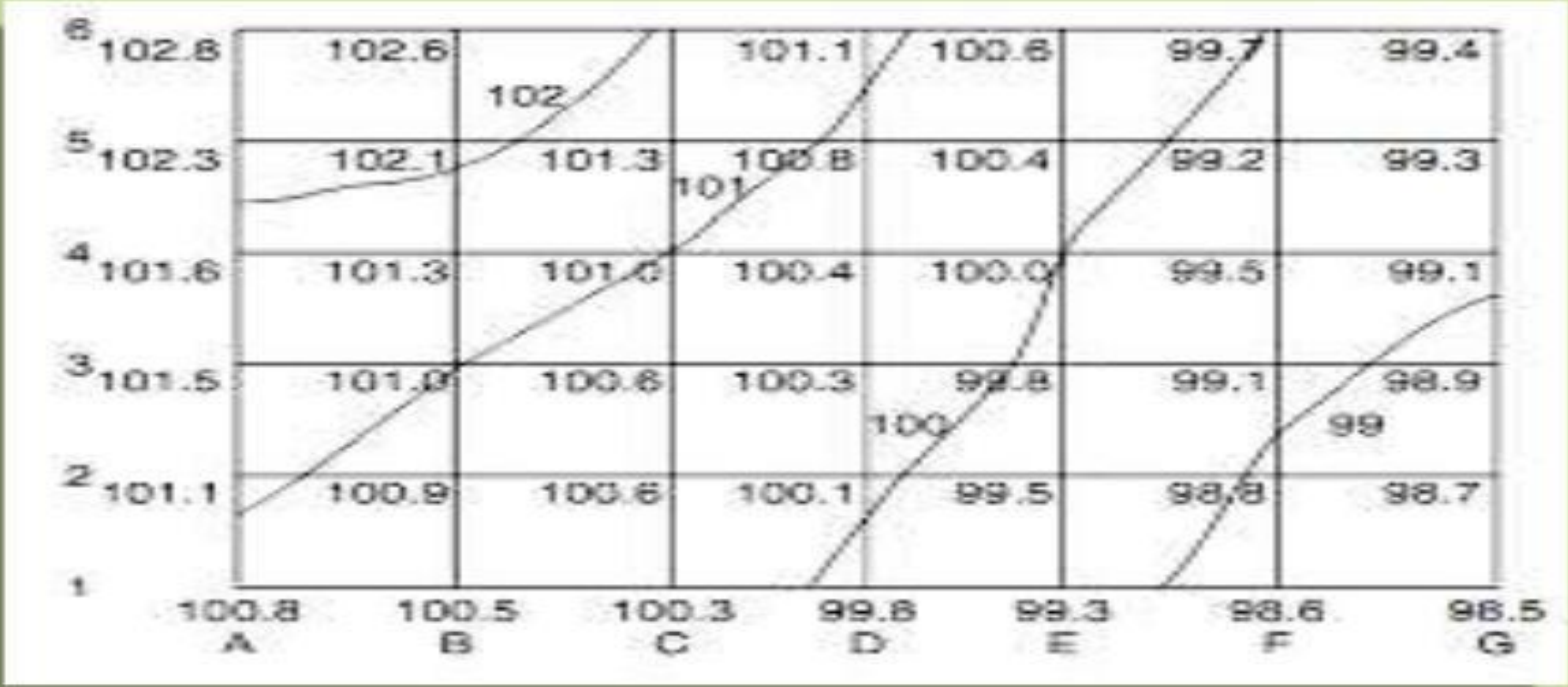
Grid Method

- If the area is not large, it is divided into a grid or series of squares. **The grid size may vary from 5m x 5 m to 25 m x 25 m** depending upon the nature of the ground, the contour interval and the scale of the map. The grid corner are marked on the ground and spot levels of these corners are then determined by normal method of leveling using a level.
- The grid is plotted to the scale of the map and the spot levels of the grid corners are entered, the contours of desired values are then locked by interpolation. This method is very suitable for a small open area where contour are required at a closed vertical interval

Methods of Contouring



Methods of Contouring



Methods of Contouring

Cross-Sectioning Method

- In this method, suitable spaced cross –sections are projected on either side of the centre line of the area. Several points are chosen at reasonable distances on either sides. The observations are made in the usual manner with a level. The cross-section lines are plotted to the scale, the points on these lines are marked and reduced levels are entered. The contours of desired values are then located by interpolation. This method is suitable for road, railway and canal survey.

Methods of Contouring

Radial Line Method or Tachometric Method

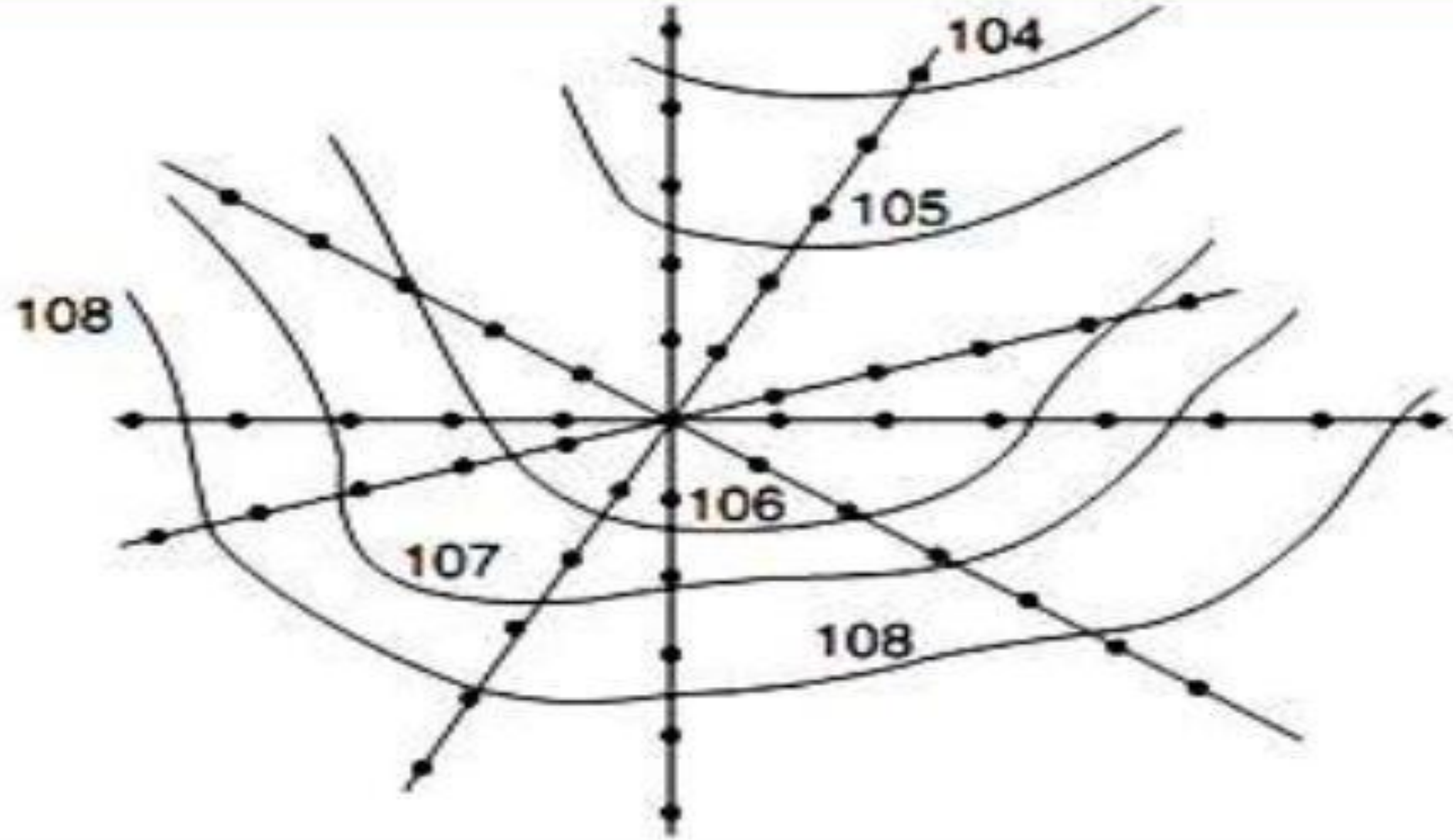
- In this method, a number of radial lines are set out at known angular interval (i.e. 15^0 or 30^0) at each station. The point are selected on a line depend on the nature of the ground surface. Instead of the level, a tachometer may be used. The observations are taken on the staff stations and elevations and distances are then calculated. A traverse and radial lines are plotted to the scale RLs of the point entered. The contour of desired values are then located by interpolation . This method is convenient in hilly area.

Methods of Contouring

- Comparison of direct and Indirect methods of contouring

Direct Method	Indirect Method
Most accurate but slow and tedious	Not so accurate but rapid and less tedious
Expensive	Cheaper
Not suitable for hilly area	Suitable for hilly area
During the work calculations can be done	Calculations are not required in the field
Calculation can not be checked after contouring	Calculation can be checked as and when required

Radial Line Method



Interpolation of Contours

- The process of locating the contours proportionately between the plotted point is termed interpolation may be done by:
- Estimation
- Arithmetical Calculation
- Graphical Method

Interpolation of Contours

Estimation

- The points on the required contour are located by eye judgment or estimation between points whose elevations are already known. This method is good for small scale maps. It is assumed that slope between the ground points is uniform.

Interpolation of Contours

Arithmetic Calculations

- This methods is used when high accuracy is required and scale of the map is of intermediate or large. In this method the distances between two points of known elevation are accurately measured. Then with the help of arithmetic calculations, the positions of the required elevation points are computed.

Interpolation of Contours

Graphical Method

- When high accuracy is required and many interpolation are to be made, this method of plotting contours proves to be most rapid and convenient. For this purpose tracing paper is used.

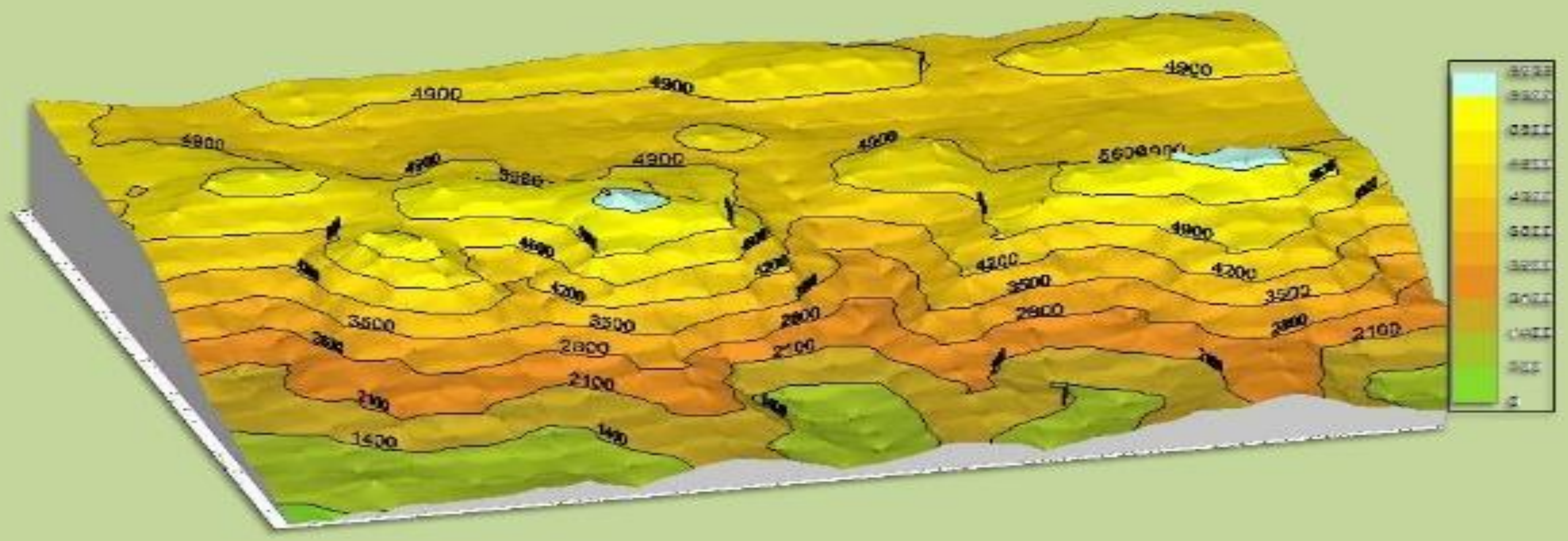
Plotting of a Contour Map

- Before plotting the contour map, suitable scale is selected.
- e.g. 1 cm = 1 m, 1 cm = 2 m, 1 cm = 2.5 m, 1 cm = 4 m or 1 cm = 5 m etc. Here 1 cm = 2m is selected.
- A horizontal line is drawn as the centre line
- The chainages are marked along the horizontal line according to the scale.
- Ground levels are written from the level book according to the chainage.

Plotting of a Contour Map

- The cross-section (L/s and R/S) are also plotted (perpendicular lines) at each of the chainage.
- By interpolation contours are joined by smooth curves keeping in mind the characteristics of contour.
- First find out maximum and minimum RL values and then first plot full values contour lines i.e.. 47 , 48, 49 etc. Contour interval is 1 m. After plotting these contour lines reduces contour interval and it is taken 0.5 m and contour lines i.e. 47.5, 48.5, 49.5 etc are plotted.
- Contour lines are then inked.

Plotting of a Contour Map



Chapter -2

THEODOLITE SURVEYING

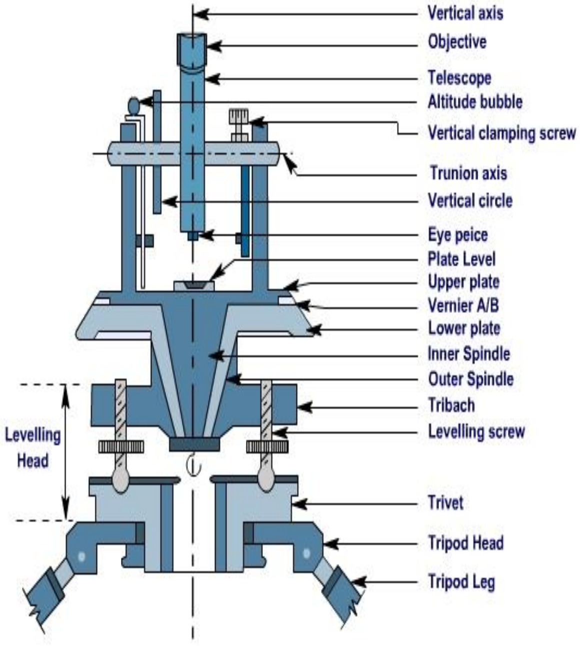


Figure 20.4 Sectional view of a Thedolite

So far we have been measuring horizontal angles by using a *Compass* with respect to *meridian*, which is *less accurate* and also it is not possible to measure vertical angles with a Compass.

So when the objects are at a considerable distance or situated at a considerable elevation or depression ,it becomes necessary to measure horizontal and vertical angles more precisely. So these measurements are taken by an instrument known as a *theodolite*.

THEODOLITE SURVEYING

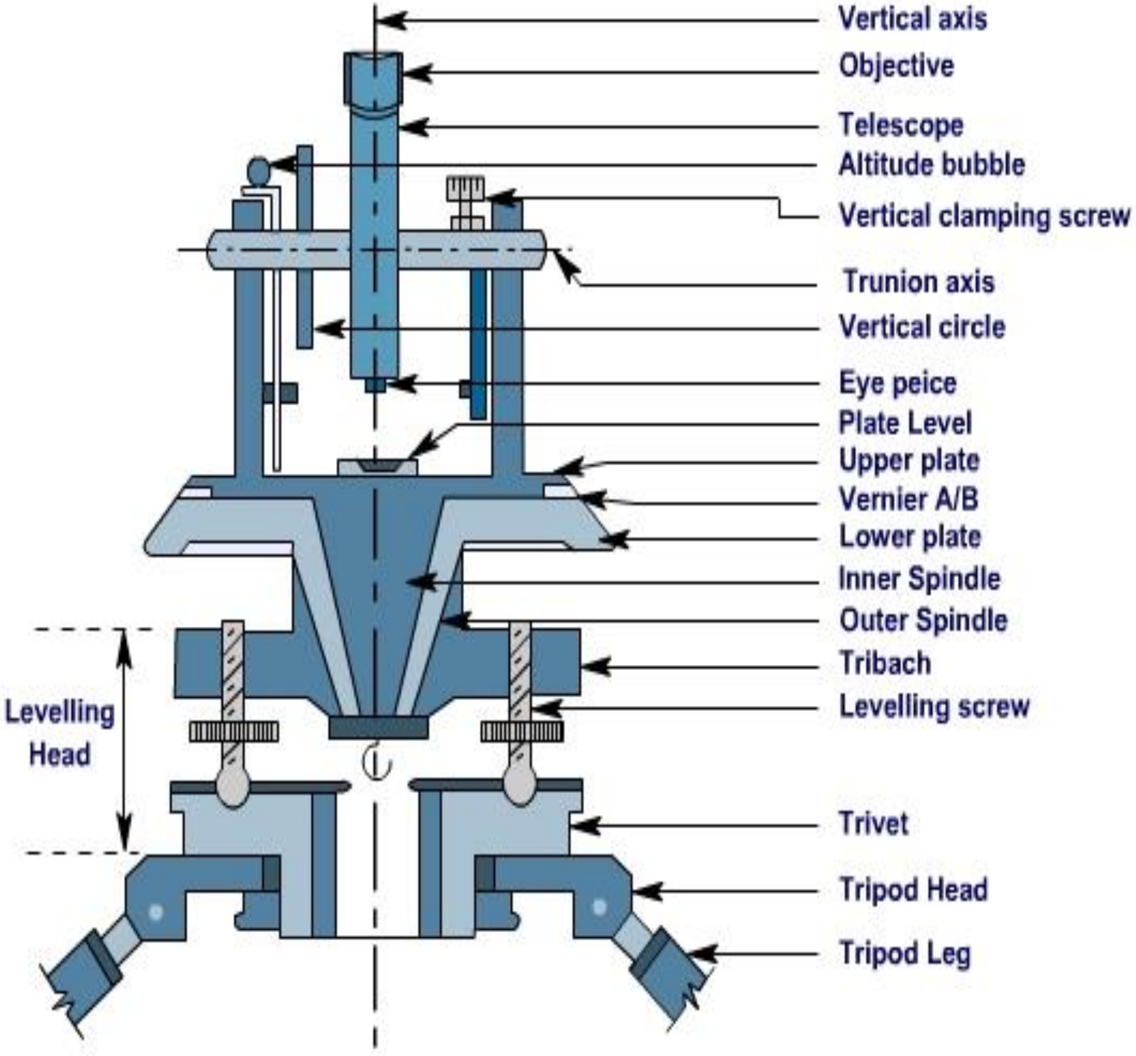
The system of surveying in which the angles are measured with the help of a theodolite, is called Theodolite surveying.

THEODOLITE

The Theodolite is a most accurate surveying instrument mainly used for :

- **Measuring horizontal and vertical angles.**
- **Locating points on a line.**
- **Prolonging survey lines.**
- **Finding difference of level.**
- **Setting out grades**
- **Ranging curves**
- **Tacheometric Survey**

TRANSIT VERNIER THEODOLITE



TRANSIT VERNIER THEODOLITE

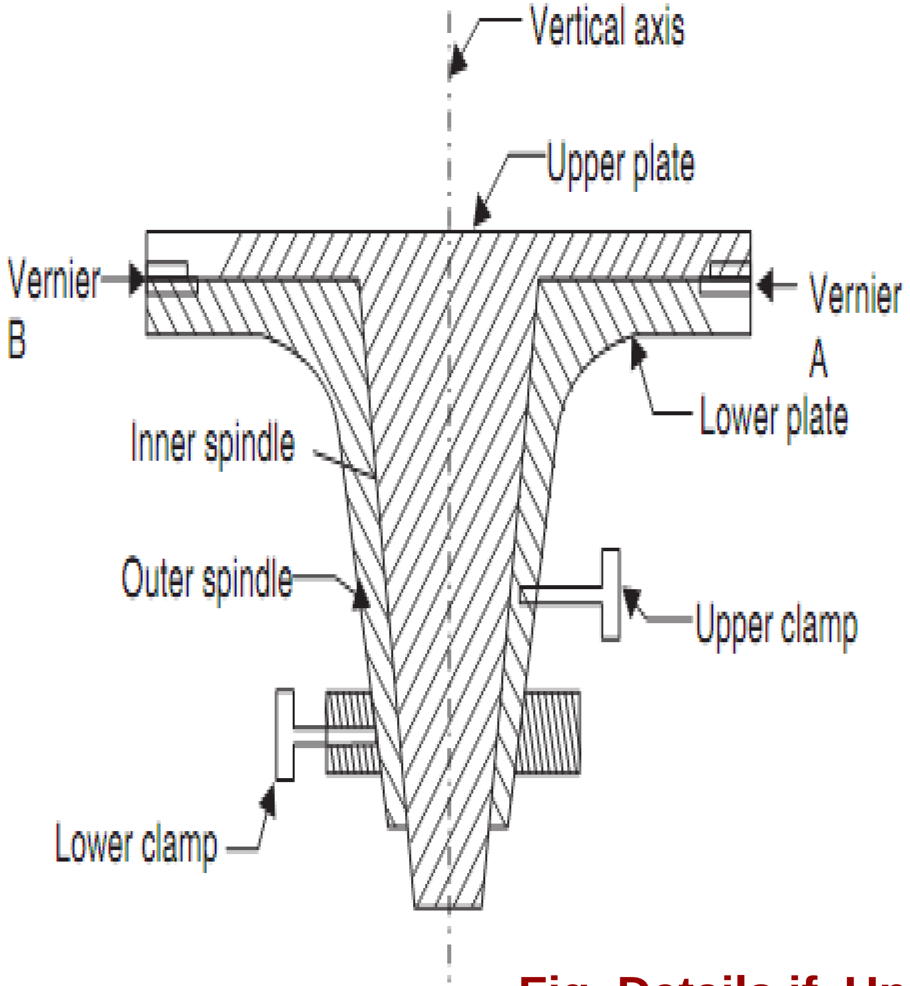
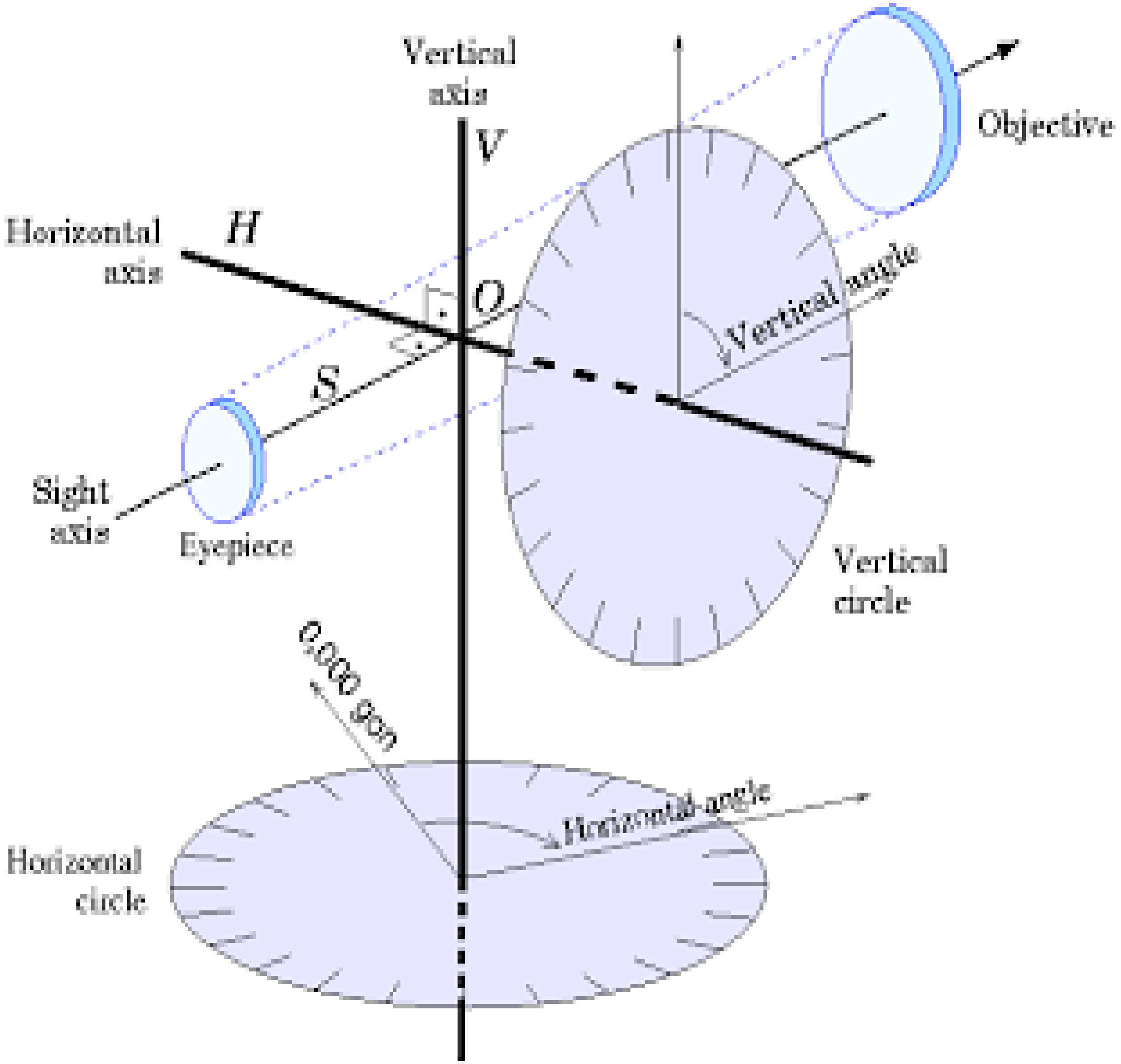
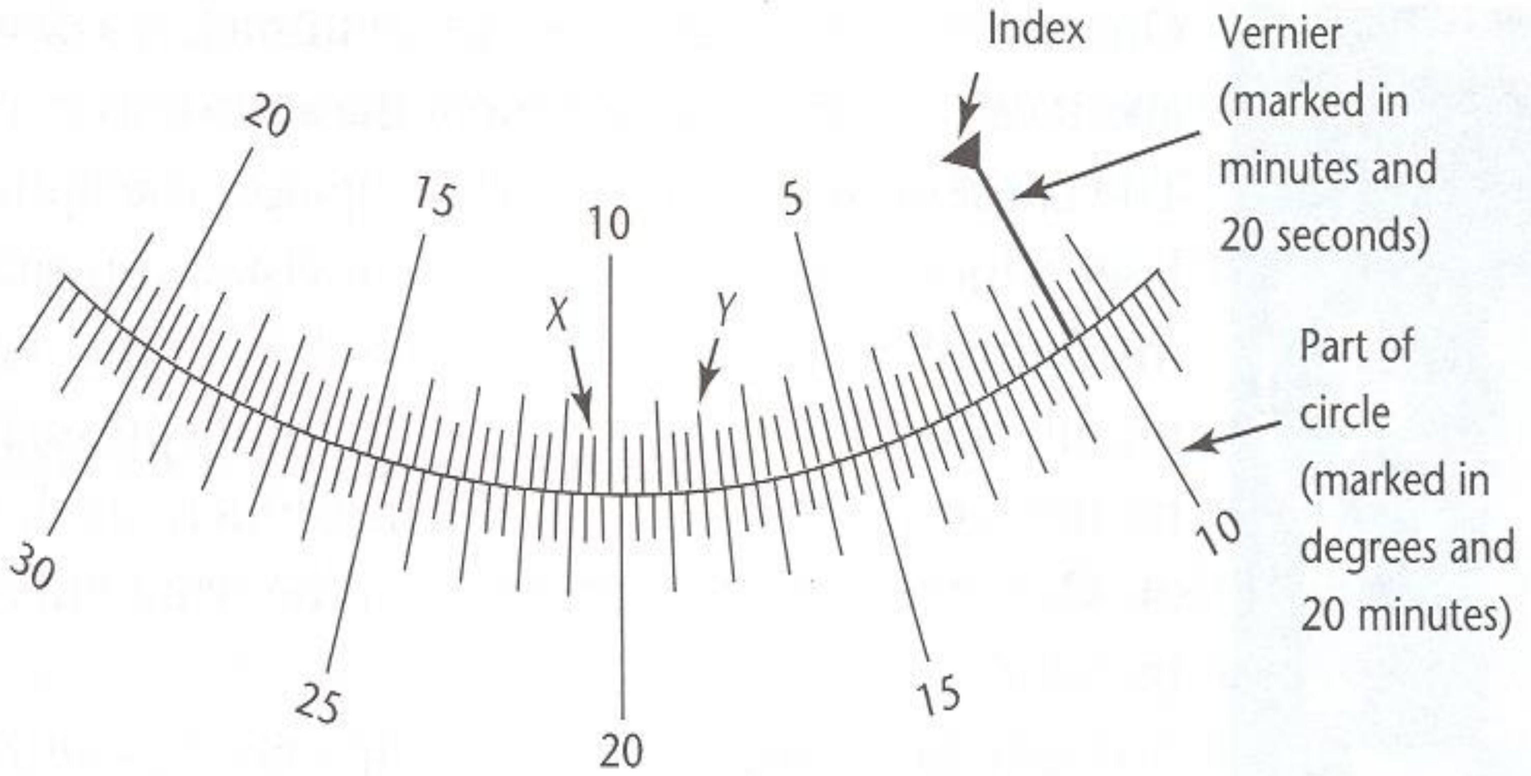


Fig. Details if Upper & Lower Plates.

TRANSIT VERNIER THEODOLITE





Index
Vernier
(marked in
minutes and
20 seconds)
Part of
circle
(marked in
degrees and
20 minutes)
20
15
10
5
X
Y
30
25
20
15
10

CLASSIFICATION OF THEODOLITES

Theodolites may be classified as ;

A.

i) Transit Theodolite.

ii) Non Transit Theodolite.

B.

i) Vernier Theodolites.

ii) Micrometer Theodolites.

CLASSIFICATION OF THEODOLITES

A. Transit Theodolite: **A theodolite is called a transit theodolite when its telescope can be transited i.e revolved through a complete revolution about its horizontal axis in the vertical plane, whereas in a-**

Non-Transit type, **the telescope cannot be transited. They are inferior in utility and have now become *obsolete.***

CLASSIFICATION OF THEODOLITES

B. Vernier Theodolite: For reading the graduated circle if verniers are used ,the theodolite is called as a Vernier Theodolite.

Whereas, if a *micrometer* is provided to read the graduated circle the same is called as a Micrometer Theodolite.

Vernier type theodolites are commonly used .

SIZE OF THEODOLITE

A theodolite is designated by diameter of the graduated circle on the lower plate.

The common sizes are *8cm to 12 cm* while *14 cm to 25 cm* instrument are used for *triangulation work*.

Greater accuracy is achieved with larger theodolites as they have bigger graduated circle with larger divisions hence used where the survey works require high degree of accuracy.

DESCRIPTION OF A

TRANSIT VERNIER THEODOLITE

A Transit vernier theodolite essentially consist of the following :

1. **Levelling Head.**
2. **Lower Circular Plate.**
3. **Upper Plate.**
4. **Telescope.**
5. **Vernier Scale.**
6. **T- Frame.**
7. **Plumb –bob.**
8. **Tripod Stand.**

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

1. **Centering** : Centering means setting the theodolite exactly over an instrument- station so that its vertical axis lies immediately above the station- mark. It can be done by means of plumb bob suspended from a small hook attached to the vertical axis of the theodolite.

   The centre shifting arrangement if provided with the instrument helps in easy and rapid performance of the centring.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

2. Transiting :

Transiting is also known as *plunging* or *reversing*. It is the process of turning the telescope about its horizontal axis through 180^0 in the vertical plane thus bringing it upside down and making it point , exactly in opposite direction.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

3. Swinging the telescope

It means turning the telescope about its vertical axis in the horizontal plane.

A swing is called *right* or *left* according as the telescope is rotated clockwise or counter clockwise.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

4. Face Left

If the vertical circle of the instrument is on the left side of the observer while taking a reading ,the position is called the *face left* and

the observation taken on the horizontal or vertical circle in this position, is known as the *face left observation*

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

5. Face Right

If the vertical circle of the instrument is on the right side of the observer while taking a reading ,the position is called the *face right* and

the observation taken on the horizontal or vertical circle in this position, is known as the *face right observation.*

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

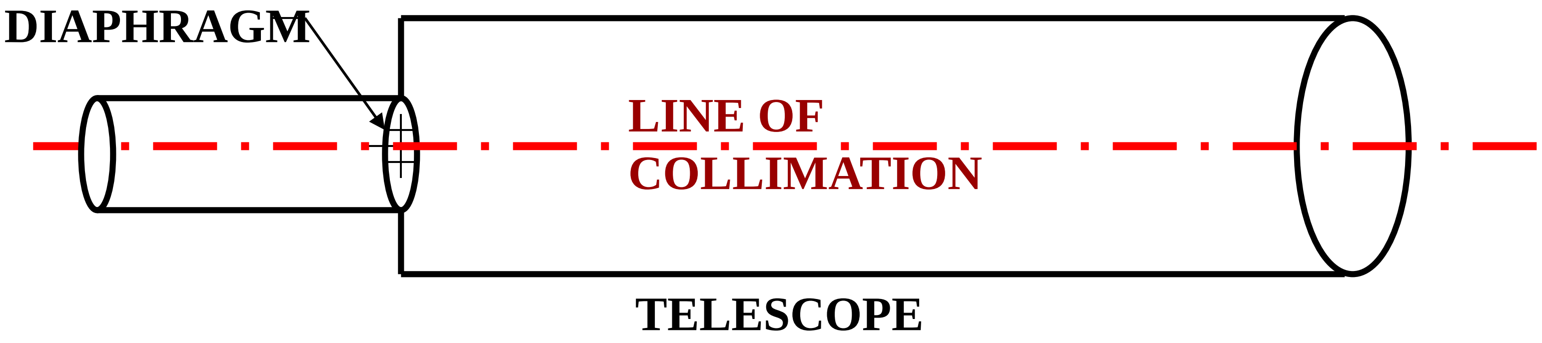
6. Changing Face

It is the operation of bringing the vertical circle to the right of the observer ,if originally it is to the left , and vice – versa.

It is done in two steps; Firstly revolve the telescope through 180^0 in a vertical plane and then rotate it through 180^0 in the horizontal plane i.e first transit the telescope and then swing it through 180^0.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

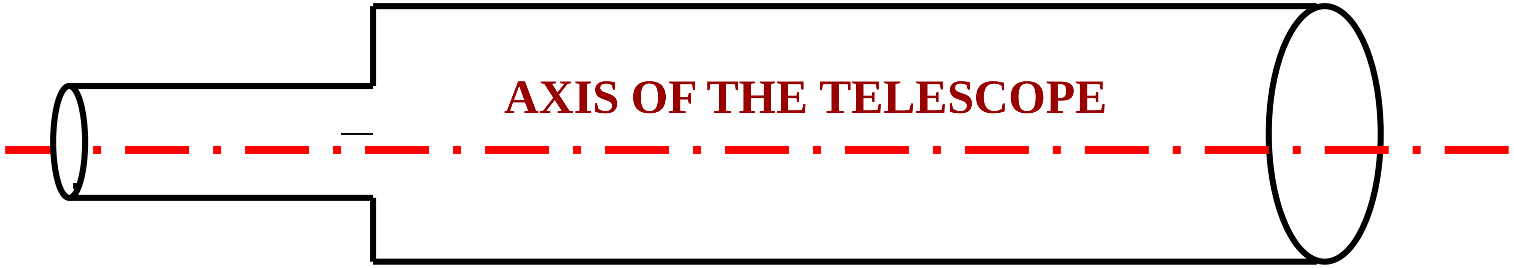
7. Line of Collimation



It is also known as the line of sight .It is an imaginary line joining the intersection of the cross- hairs of the diaphragm to the optical centre of the object- glass and its continuation.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

8. Axis of the telescope



It is also known an imaginary line joining the optical centre of the object- glass to the centre of eye piece.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

9. Axis of the Level Tube

It is also called the **bubble line.**

It is a *straight* line *tangential* to the *longitudinal curve* of the level tube at the centre of the tube. It is **horizontal** when the **bubble** is in the **centre**.

TERMS USED IN MANIPULATING A TRANSIT VERNIER THEODOLITE.

10. Vertical Axis

It is the axis about which the telescope can be rotated in the horizontal plane.

11. Horizontal Axis

It is the axis about which the telescope can be rotated in the vertical plane.

It is also called the *trunion axis*.

ADJUSTMENT OF A THEODOLITE

The adjustments of a theodolite are of two kinds :-

1. **Permanent Adjustments.**
2. **Temporary Adjustments.**

1) Permanent adjustments: The permanent adjustments are made to establish the relationship between the *fundamental lines* of the theodolite and , once made , they last for a long time. They are essential for the accuracy of observations.

ADJUSTMENT OF A THEODOLITE

1. **Permanent adjustments:** The permanent adjustments in case of a transit theodolites are :-

i) **Adjustment of Horizontal Plate Levels**. The axis of the plate levels must be perpendicular to the vertical axis.

ii) **Collimation Adjustment.** The line of collimation should coincide with the axis of the telescope and the axis of the objective slide and should be at right angles to the horizontal axis.

iii) **Horizontal axis adjustment.** The horizontal axis must be perpendicular to the vertical axis.

ADJUSTMENT OF A THEODOLITE

1. **Permanent adjustments (contd.):**

iv) Adjustment of Telescope Level or the Altitude Level Plate Levels. The axis of the telescope levels or the altitude level must be parallel to the line of collimation.

v) Vertical Circle Index Adjustment. The vertical circle vernier must read zero when the line of collimation is horizontal.

ADJUSTMENT OF A THEODOLITE

2. Temporary Adjustment

The temporary adjustments are made at each set up of the instrument before we start taking observations with the instrument. There are three temporary adjustments of a theodolite:-

i) Centering.

ii) Levelling.

iii) Focussing.

MEASUREMENT OF HORIZONTAL ANGLES:

There are three methods of measuring horizontal angles:-

i) Ordinary Method.

ii) Repetition Method.

iii) Reiteration Method.

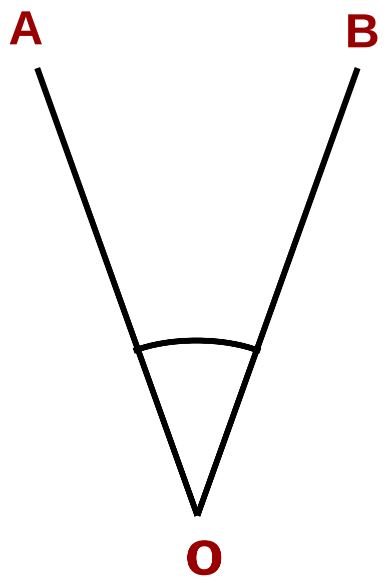
MEASUREMENT OF HORIZONTAL ANGLES:

i) Ordinary Method. To measure horizontal angle AOB:-

i) Set up the theodolite at station point O and level it accurately.

ii) Set the vernier A to the zero or 360^0 of the horizontal circle. Tighten the upper clamp.

iii) Loosen the lower clamp. Turn the instrument and direct the telescope towards A to bisect it accurately with the use of tangent screw. After bisecting accurately check the reading which must still read zero. Read the vernier B and record both the readings.



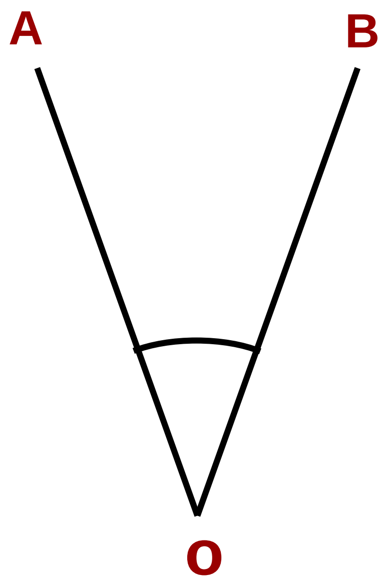
HORIZONTAL ANGLE AOB

MEASUREMENT OF HORIZONTAL ANGLES:

i) Ordinary Method. To measure horizontal angle AOB:-

iv) Loosen the upper clamp and turn the telescope clockwise until line of sight bisects point B on the right hand side. Then tighten the upper clamp and bisect it accurately by turning its tangent screw.

v) Read both verniers. The reading of the vernier a which was initially set at zero gives the value of the angle AOB directly and that of the other vernier B by deducting 180^0 .The mean of the two vernier readings gives the value of the required angle AOB.



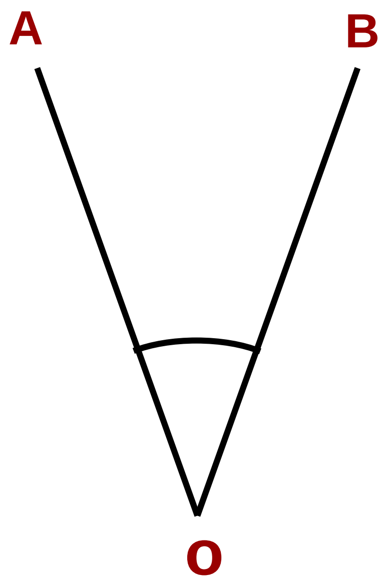
HORIZONTAL ANGLE AOB

MEASUREMENT OF HORIZONTAL ANGLES:

i) Ordinary Method. To measure horizontal angle AOB:-

vi) Change the face of the instrument and repeat the whole process. The mean of the two vernier readings gives the second value of the angle AOB which should be approximately or exactly equal to the previous value.

vii) The mean of the two values of the angle AOB ,one with face left and the other with face right ,gives the required angle free from all instrumental errors.



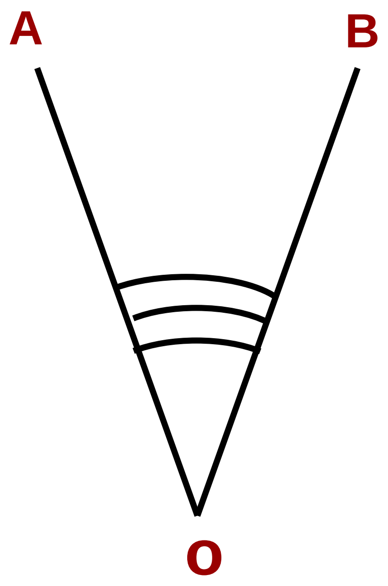
HORIZONTAL ANGLE AOB

MEASUREMENT OF HORIZONTAL ANGLES:

ii) Repetition Method.

This method is used for very accurate work. In this method ,the same angle is added several times mechanically and the correct value of the angle is obtained by dividing the accumulated reading by the no. of repetitions.

The No. of repetitions made usually in this method is six, three with the face left and three with the face right .In this way ,angles can be measured to a finer degree of accuracy than that obtainable with the least count of the vernier.



HORIZONTAL ANGLE AOB

MEASUREMENT OF HORIZONTAL ANGLES:

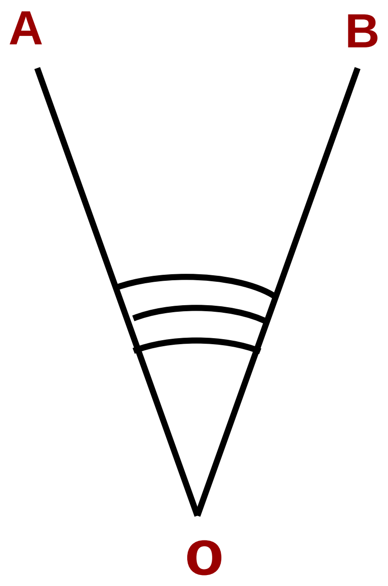
ii) Repetition Method.

To measure horizontal angle by repetitions:-

i) Set up the theodolite at starting point O and level it accurately.

ii) Measure The horizontal angle AOB.

iii) Loosen the lower clamp and turn the telescope clock – wise until the object (A) is sighted again. Bisect B accurately by using the upper tangent screw. The verniers will now read the *twice* the value of the angle now.



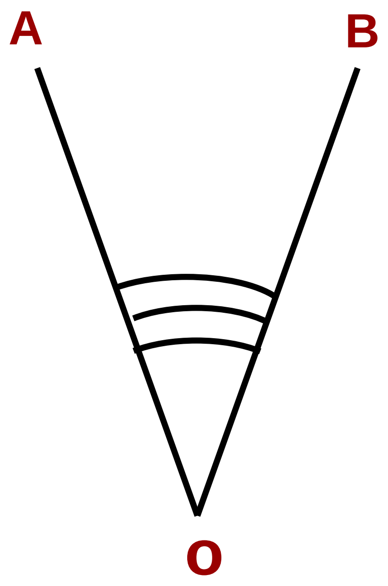
HORIZONTAL ANGLE AOB

MEASUREMENT OF HORIZONTAL ANGLES:

ii) Repetition Method contd...

iv) Repeat the process until the angle is repeated the required number of times (usually 3). Read again both verniers . The final reading after *n repetitions* should be approximately n X (angle). *Divide* the *sum* by the *number of repetitions* and the result thus obtained gives the *correct value of the angle* AOB.

v) Change the face of the instrument. Repeat exactly in the same manner and find another value of the angle AOB. The *average* of two readings gives the required precise value of the angle AOB.



HORIZONTAL ANGLE AOB

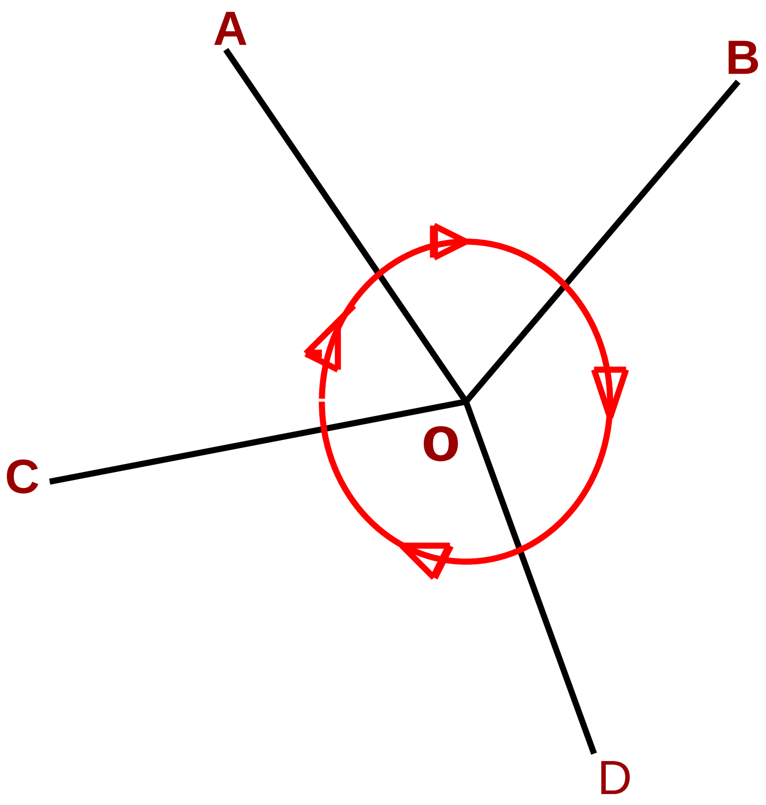
MEASUREMENT OF HORIZONTAL ANGLES:

iii) Reiteration Method.

This method is another *precise* and comparatively *less tedious* method of measuring the horizontal angles.

It is generally preferred when *several angles* are to be measured at a particular station.

This method consists in measuring several angles successively and finally closing the horizon at the starting point. The *final reading* of the vernier A should be *same* as its *initial reading*.



Reiteration Method

MEASUREMENT OF HORIZONTAL ANGLES:

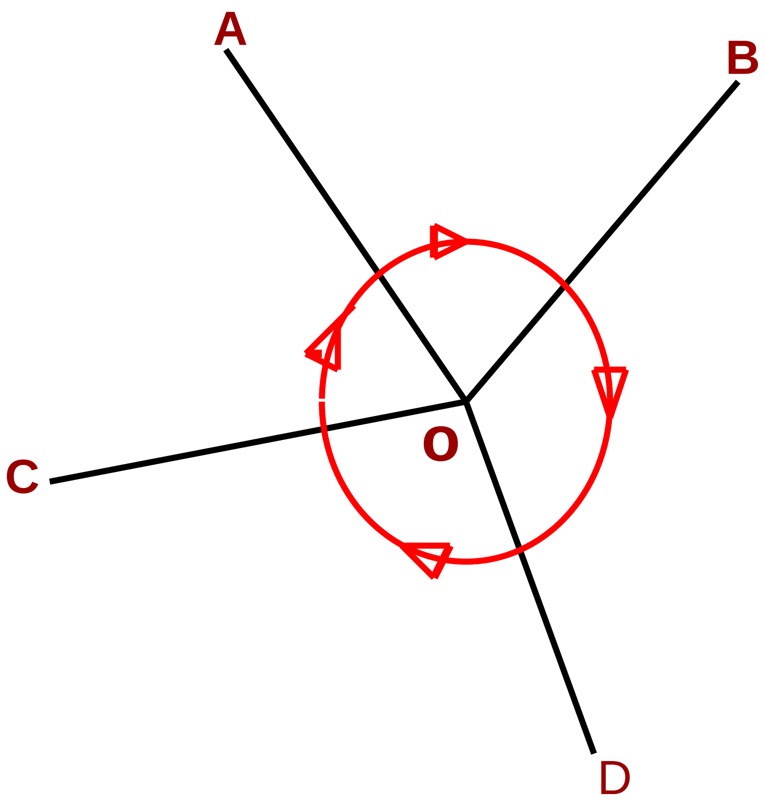
iii) Reiteration Method.

…If not ,the discrepancy is equally distributed among all the measured angles.

Procedure

Suppose it is required to measure the angles AOB,BOC and COD. Then to measure these angles by repetition method :

i) Set up the instrument over station point O and level it accurately.



Reiteration Method

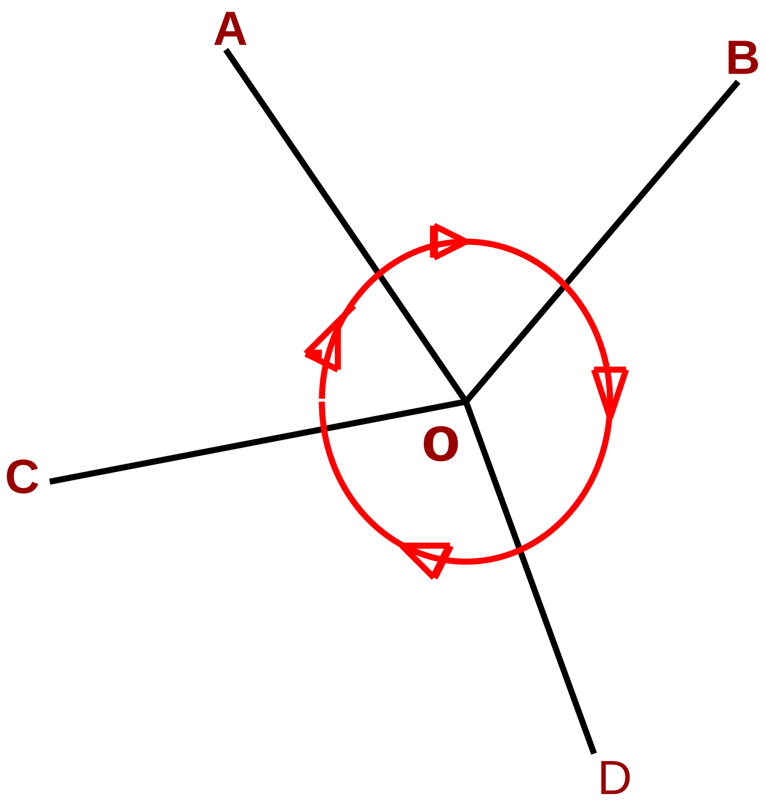
MEASUREMENT OF HORIZONTAL ANGLES:

iii) Reiteration Method.

Procedure

ii) Direct the telescope towards point A which is known as referring object. Bisect it accurately and check the reading of vernier as 0 or 360^0. Loosen the lower clamp and turn the telescope clockwise to sight point B exactly. Read the verniers again and The mean reading will give the value of angle AOB.

iii) Similarly bisect C & D successively, read both verniers at-



Reiteration Method

MEASUREMENT OF HORIZONTAL ANGLES:

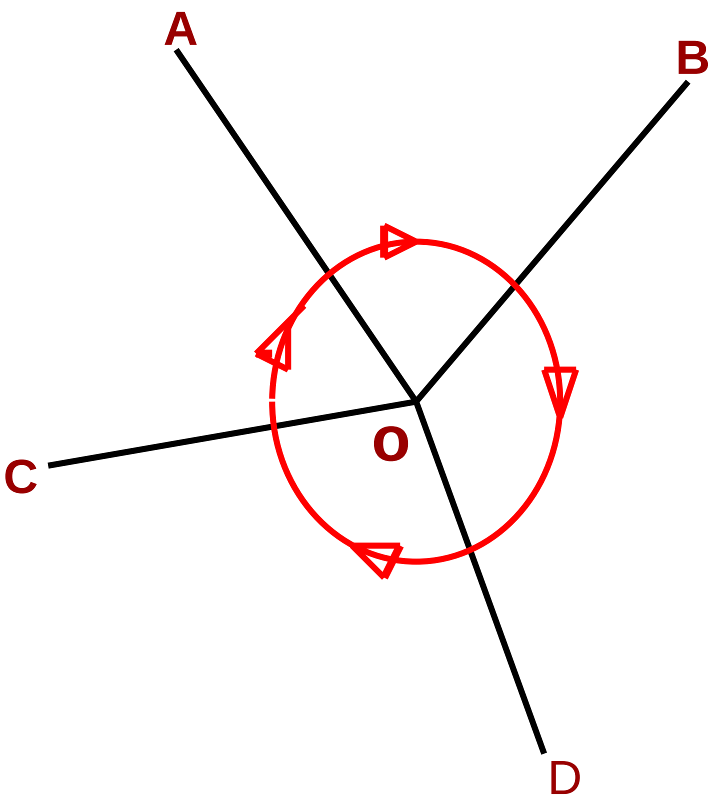
iii) Reiteration Method (contd.).

Procedure. each bisection, find the value of the angle BOC and COD.

iv) Finally close the horizon by sighting towards the referring object (point A).

v) The vernier A should now read 360^0. If not note down the error .This error occurs due to *slip* etc.

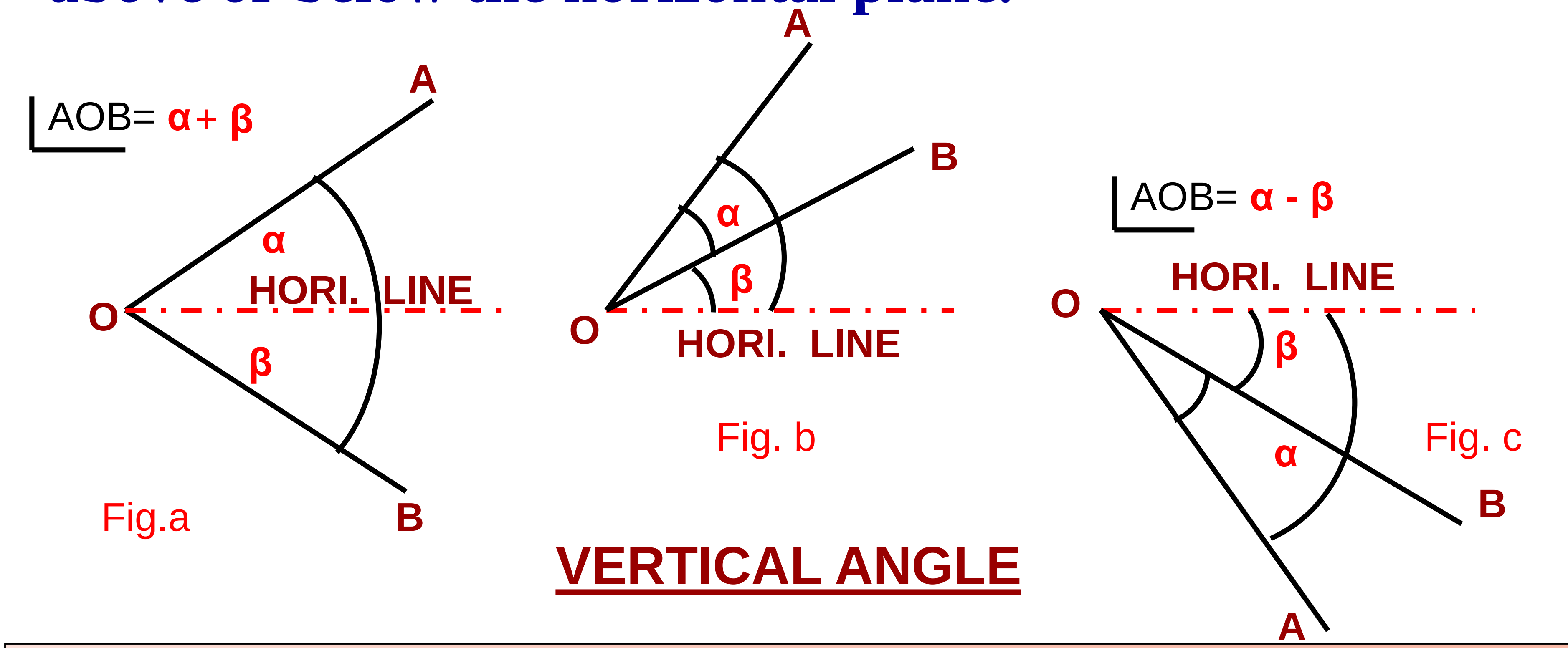
vi) If the error is small, it is *equally distributed* among the several angles .If *large* the readings should be *discarded* and a new set of readings be taken.



Reiteration Method

MEASUREMENT OF VERTICAL ANGLES:

Vertical Angle : **A vertical angle is an angle between the *inclined line of sight* and the *horizontal*. It may be an angle of *elevation* or *depression* according as the object is above or below the horizontal plane.**



VERTICAL ANGLE

MEASUREMENT OF VERTICAL ANGLES:

To Measure the Vertical Angle of an object A at a station O:

(i) Set up the theodolite at station point O and level it accurately with reference to the altitude bubble.

(ii) Set the zero of vertical vernier exactly to the zero of the vertical circle clamp and tangent screw.

(iii) Bring the bubble of the altitude level in the central position by using clip screw. The line of sight is thus made horizontal and vernier still reads zero.

(iv) Loosen the vertical circle clamp screw and direct the telescope towards the object A and sight it exactly by using the vertical circle tangent screw.

MEASUREMENT OF VERTICAL ANGLES:

(v) Read both verniers on the vertical circle, The mean of the two vernier readings gives the value of the required angle.

(vi) Change the face of the instrument and repeat the process. The mean of of the two vernier readings gives the second value of the required angle.

(vii) The average of the two values of the angles thus obtained, is the required value of the angle free from instrumental errors.

MEASUREMENT OF VERTICAL ANGLES:

For measuring Vertical Angle between two points A &B

i) Sight A as before , and take the mean of the two vernier readings at the vertical circle. Let it be α

ii) Similarly, sight B and take the mean of the two vernier readings at the vertical circle. Let it be β

iii) The sum or difference of these dings will give the value of the vertical angle between A and B according as one of the points is above and the other below the horizontal plane. or both points are on the same side of the horizontal plane Fig b & c

READING MAGNETIC BEARING OF A LINE

To find the bearing of a line AB as shown in fig .below

i) Set up the instrument over A and level it accurately

ii) Set the vernier to the zero of the horizontal circle.

iii) Release the magnetic needle and loosen the lower clamp.

iv) Rotate the instrument till magnetic needle points to North. Now clamp the lower clamp with the help of lower tangent screw .Bring the needle exactly against the mark in order to bring it in magnetic meridian. At this stage the line of sight will also be in magnetic meridian.

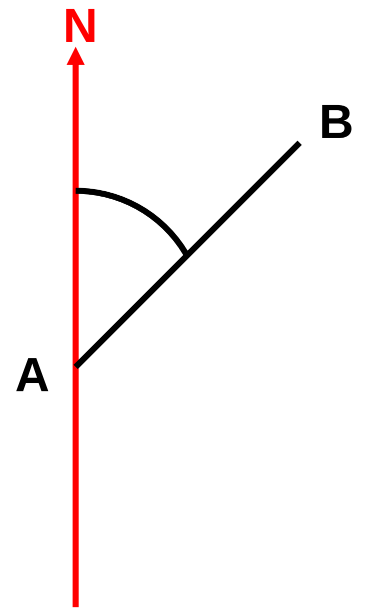


Fig.
Magnetic Bearing of a Line

READING MAGNETIC BEARING OF A LINE

iv) Now loose the upper clamp and point the telescope towards B .With the help of upper tangent screw ,bisect B accurately and read both the verniers .The mean of the two readings will be recorded as magnetic bearing of line.

v) Change the face of the instrument for accurate magnetic bearing of the line and repeat .the mean of the two values will give the correct bearing of the line AB.

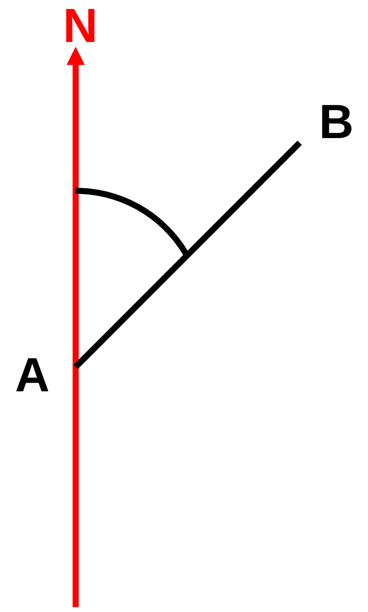


Fig.

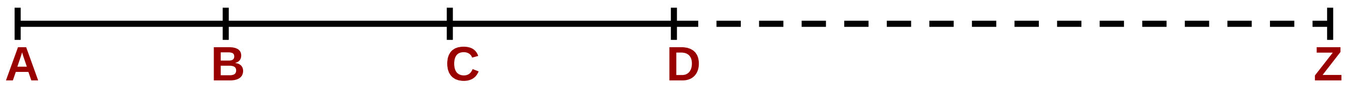
Magnetic Bearing of a Line

PROLONGING A STRAIGHT A LINE

There are two methods of prolonging a given line such as AB

(1) Fore sight method ,and (2) Back Sight Method

(1)Fore Sight Method. As shown in the fig. below



i) Set up the theodolite at A and level it accurately .Bisect the point b correctly. Establish a point C in the line beyond B approximately by looking over the top of the telescope and accurately by sighting through the telescope.

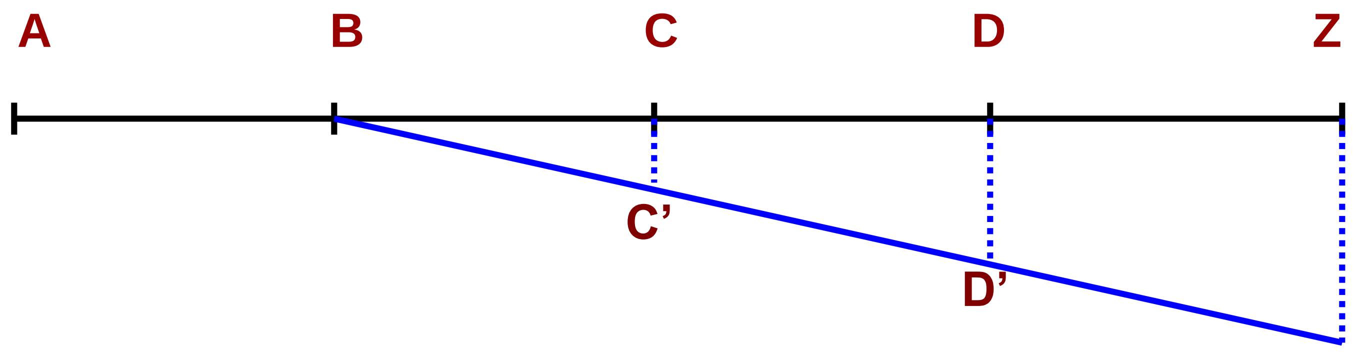
ii) Shift the instrument to B ,take a fore sight on C and establish a point D in line beyond C.

Fig.

iii) Repeat the process until the last point Z is reached.

PROLONGING A STRAIGHT A LINE

(2) Back Sight Method. As shown in the fig. below



i) Set up the instrument at B and level it accurately .

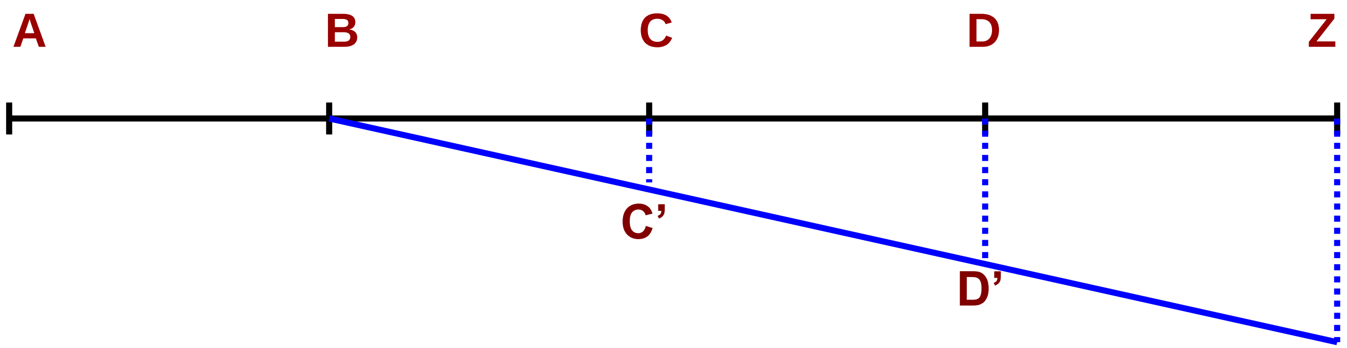
ii) Take a back sight on A.

iii) Tighten the upper and lower clamps, transit the telescope and establish a point C in the line beyond B.

iv) Shift the theodolite to C ,back sight on B transit the telescope and establish a point D in line beyond C. Repeat the process until the last point (Z) is established.

PROLONGING A STRAIGHT A LINE

(2) Back Sight Method.(contd.) As shown in the fig. below



Now if the instrument is in adjustment, the points A,B,C,D and Z will be in one line, which is straight but if it is not in adjustment i.e. line of collimation is not perpendicular to the horizontal axis ,then C', D' and Z' will not be in a straight line.

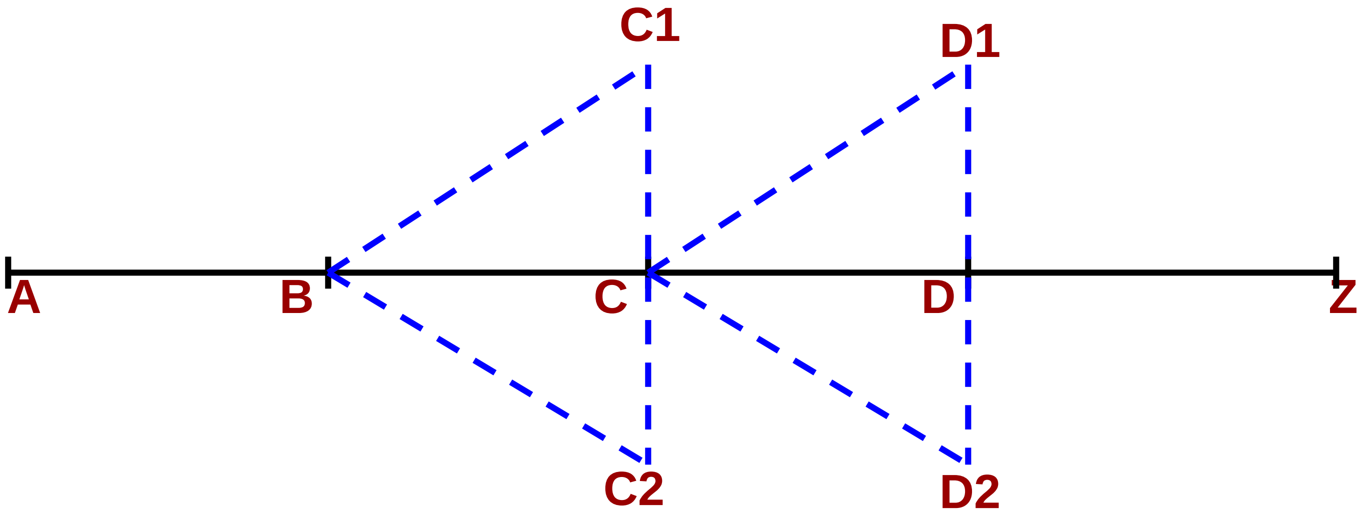
PROLONGING A STRAIGHT A LINE

Double reversing Method

When the line is to be prolonged with *high precision* or when the *instrument* is in *imperfect adjustment*, the process of *double sighting* or *double reversing*, is used.

Suppose the line AB is to be prolonged to a point Z.

Procedure: As shown below:



Double Sighting / Reversing Method

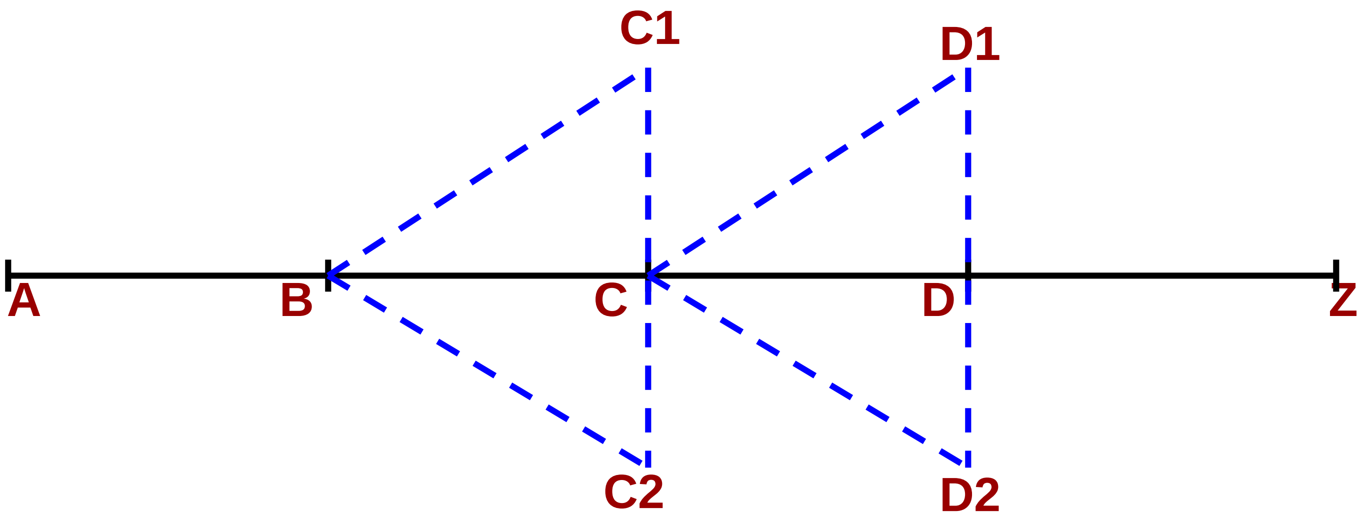
PROLONGING A STRAIGHT A LINE

Double reversing Method

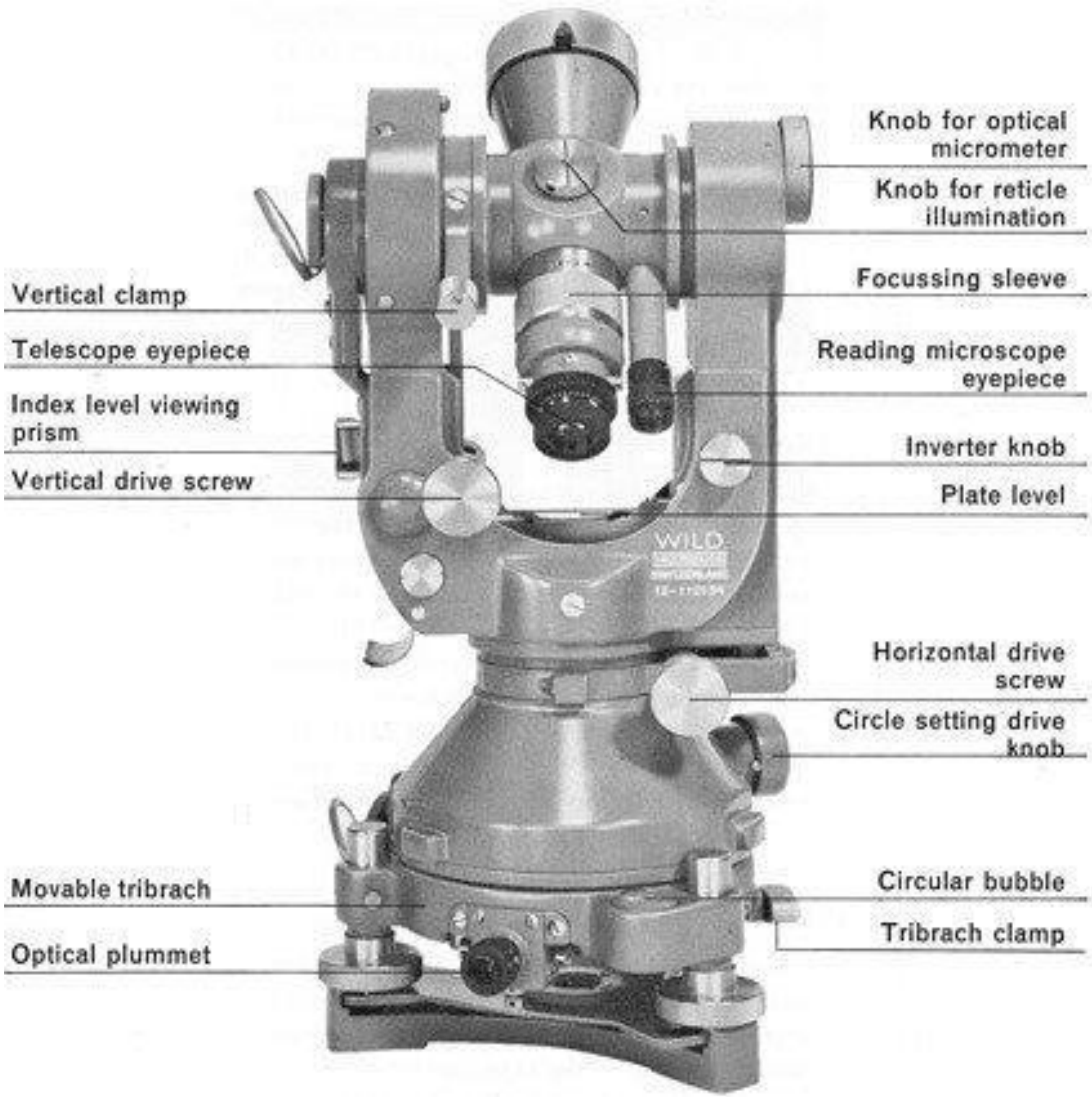
i) Set up the theodolite at B and level it accurately.

ii) With the face of instrument left, back sight on A and clamp both the upper and lower motions.

iii) Transit the telescope and set a point C_1 ahead in line.



Double Sighting / Reversing Method


Knob for optical micrometer
Knob for reticle illumination
Focussing sleeve
Reading microscope eyepiece
Inverter knob
Plate level
Horizontal drive screw
Circle setting drive knob
Circular bubble
Tribrach clamp
Vertical clamp
Telescope eyepiece
Index level viewing prism
Vertical drive screw
Movable tribrach
Optical plummet
WILD

Thank you