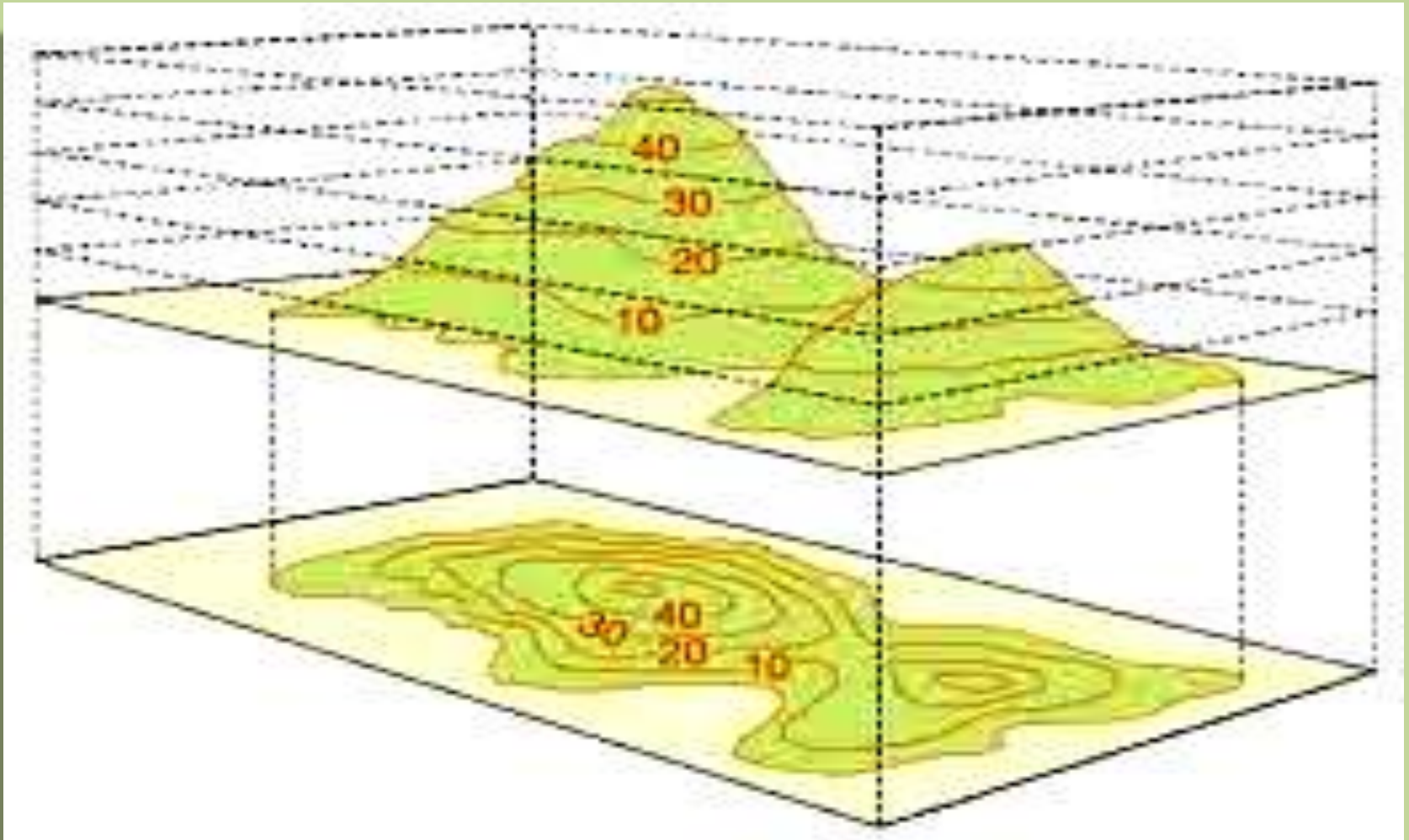# Contouring

Unit-III

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

contoured peak (side view) — contour map (top view)

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Elevation — Index Contour Lines
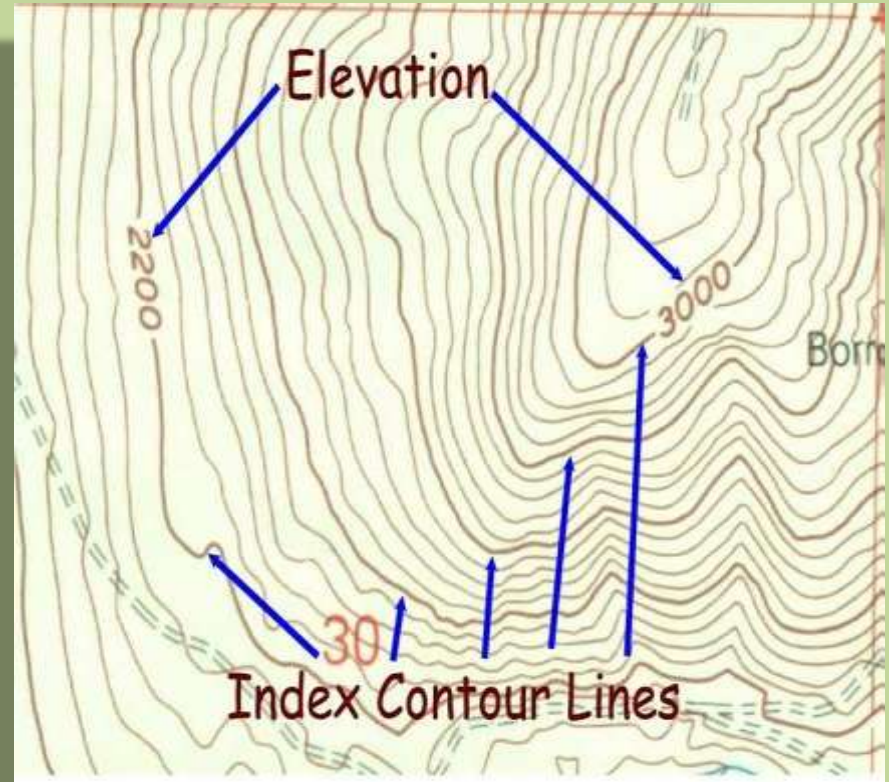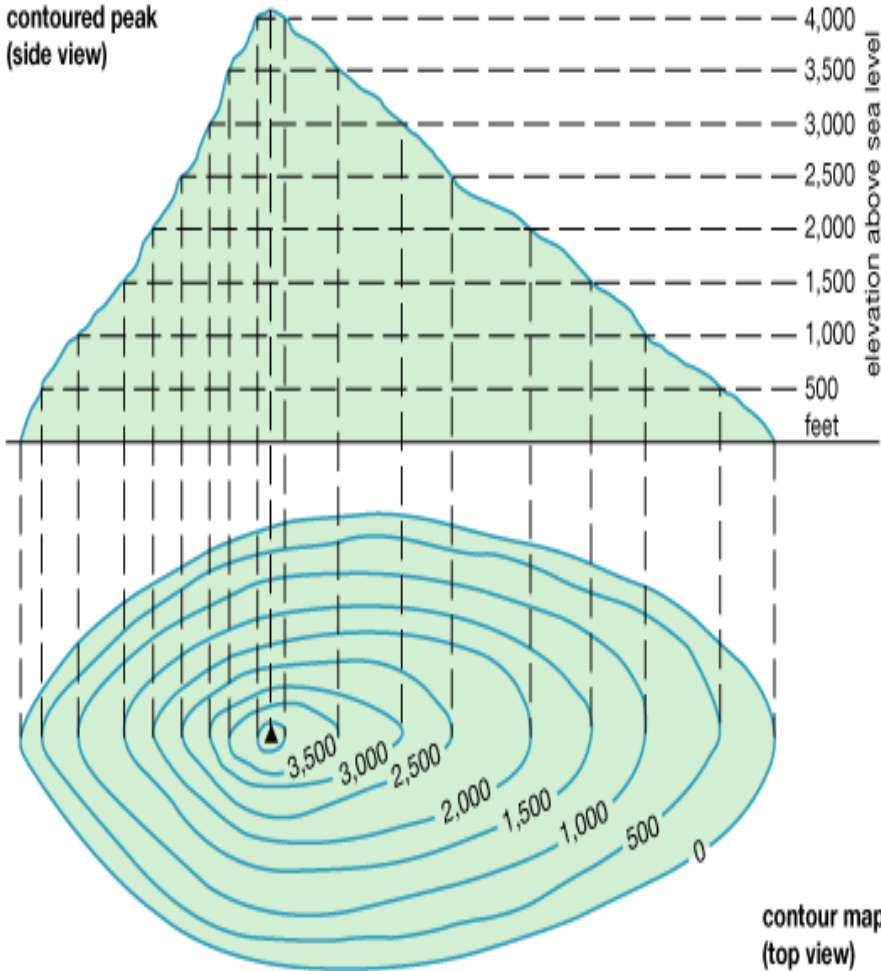
Contour Interval

- The vertical distance between two consecutive contours is known as a **contour interval.**

- For ex, a map indicates contour lines of 90 m, 89 m, 88 m and so on, the **contour interval is 1m**.

- This **interval depends** upon the following factors:

- The nature of the ground (**i.e. . Whether flat or steep)**

- The scale of the map, and The purpose of the survey.

Contour Interval
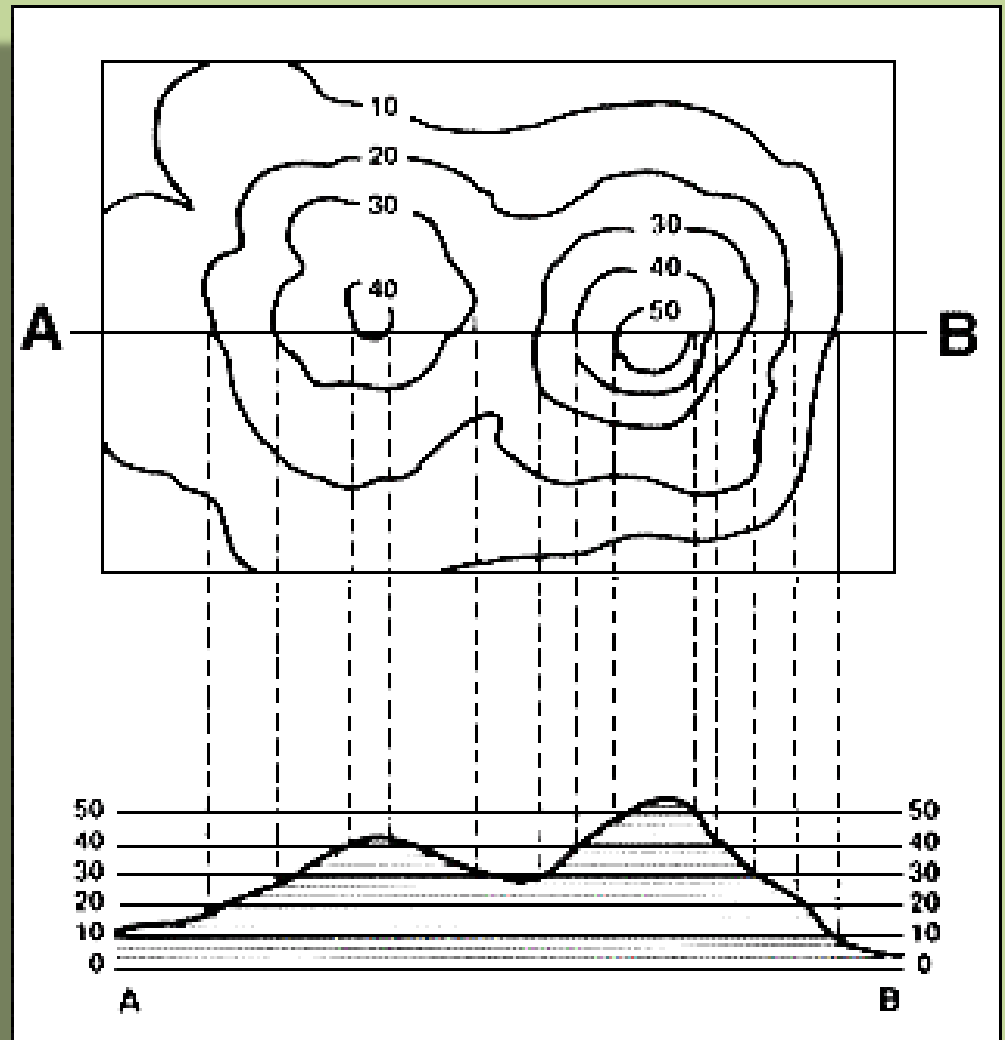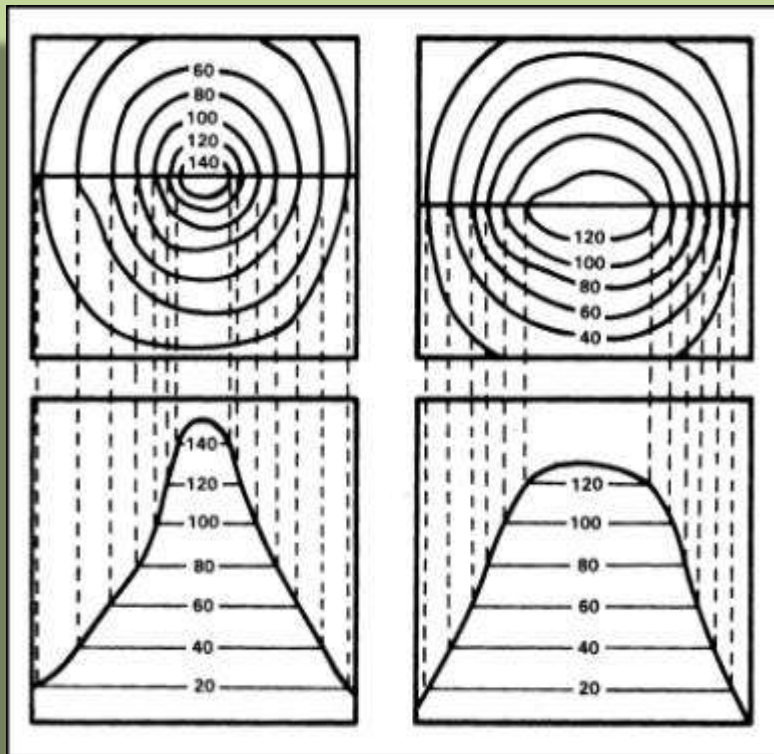
Contour Interval

- Contour intervals for flat ground are generally small, e.g.. 0.25 m, 0.5 m, 0.75 m
- The contour interval for a steep slope in a hilly area is generally greater, e.g.. 5 m, 10 m, 15 m, etc.
- Again, for a small scale map, the interval may be of 1 m, 2 m, 3 m, etc.
- Contour interval is kept large up to 2 m for projects such as highways and railways, whereas it is kept as small as 0.5 m for measurement of earthwork, building sites, dams, etc.
- It is desirable to have a constant contour interval for a particular map.

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.

Horizontal equivalent
(measured on the earth)

Vertical equivalent

300
200
100
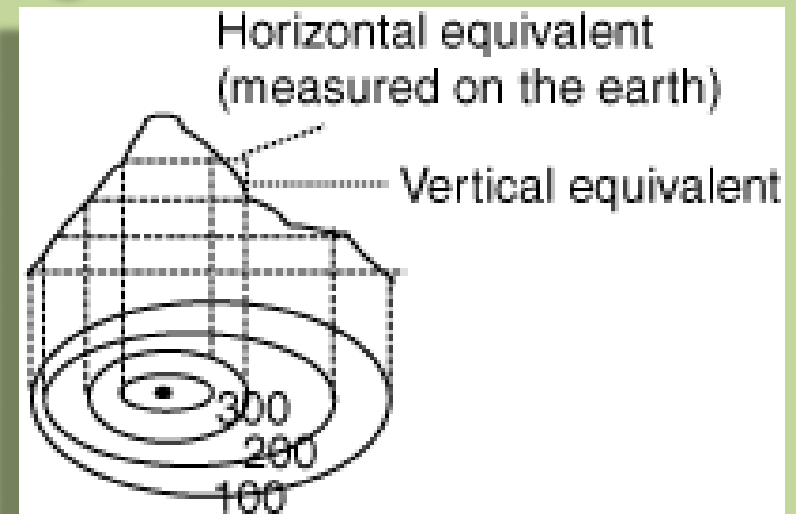
Use of Contour Map

- 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

- To **estimate the quantity of cutting, filling**, etc.

- To know the drainage characteristics of the area. It helps to s
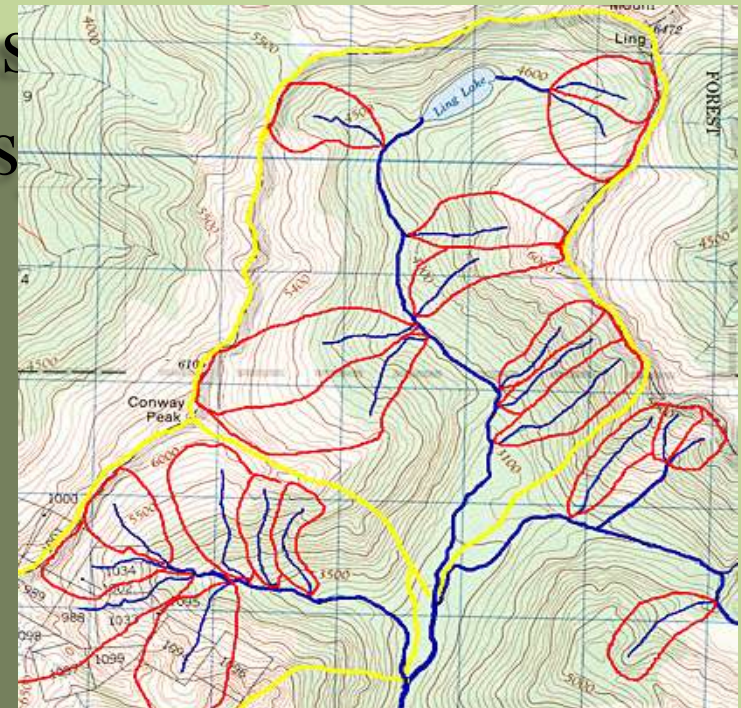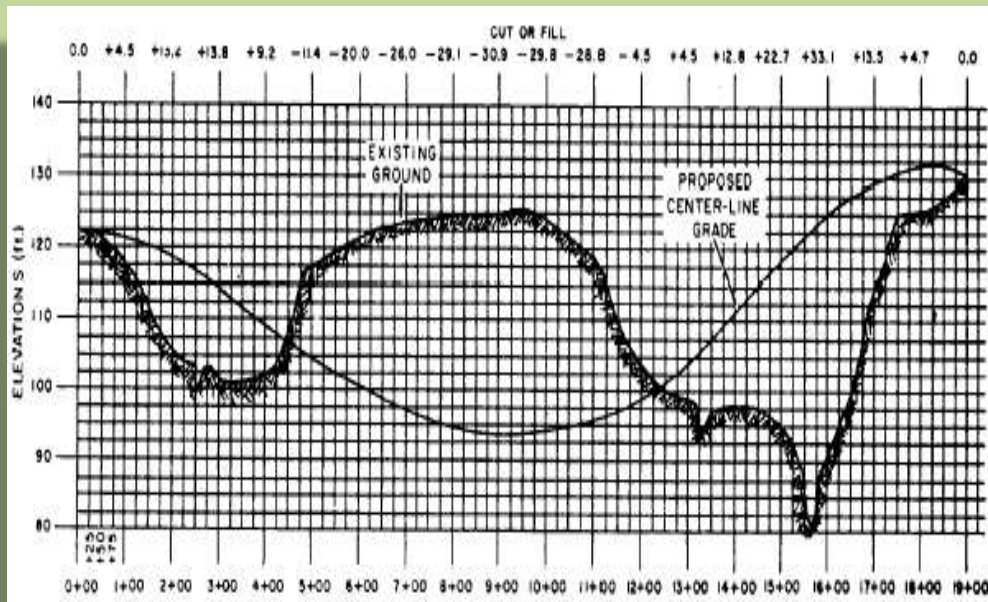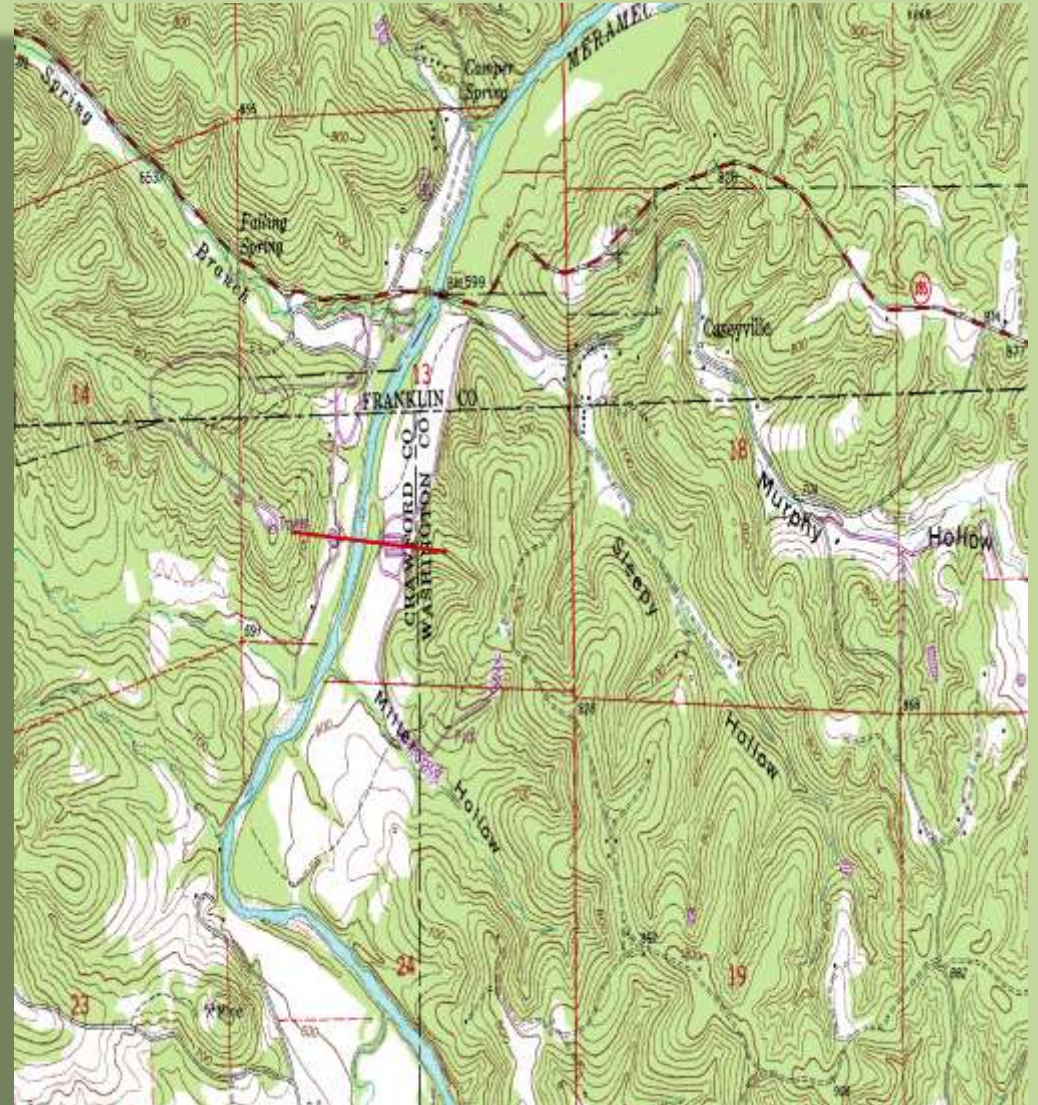
Use of Contour Map

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.
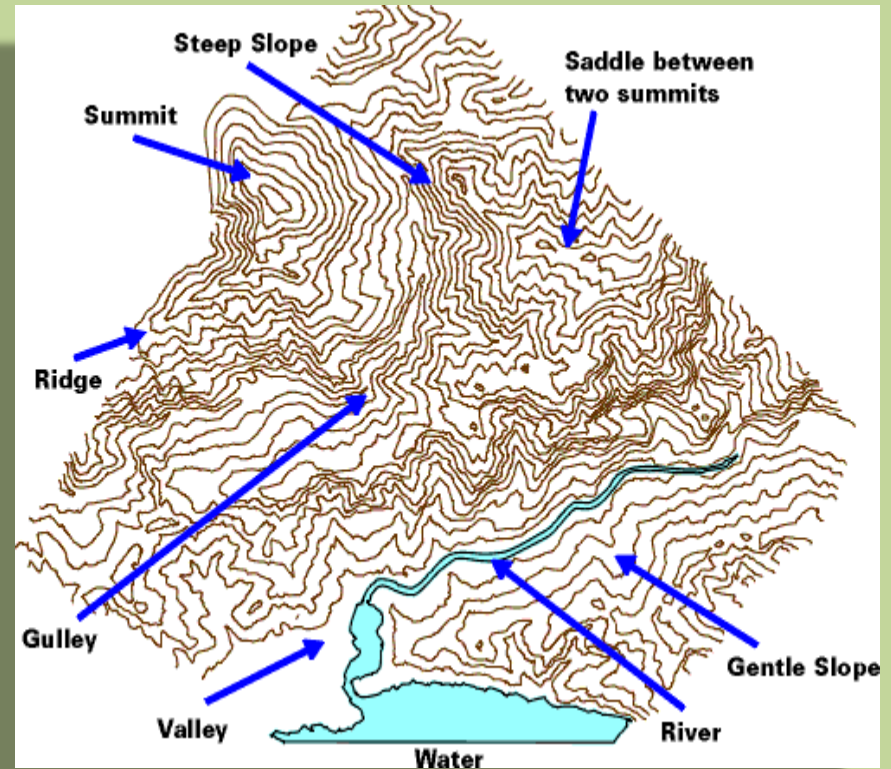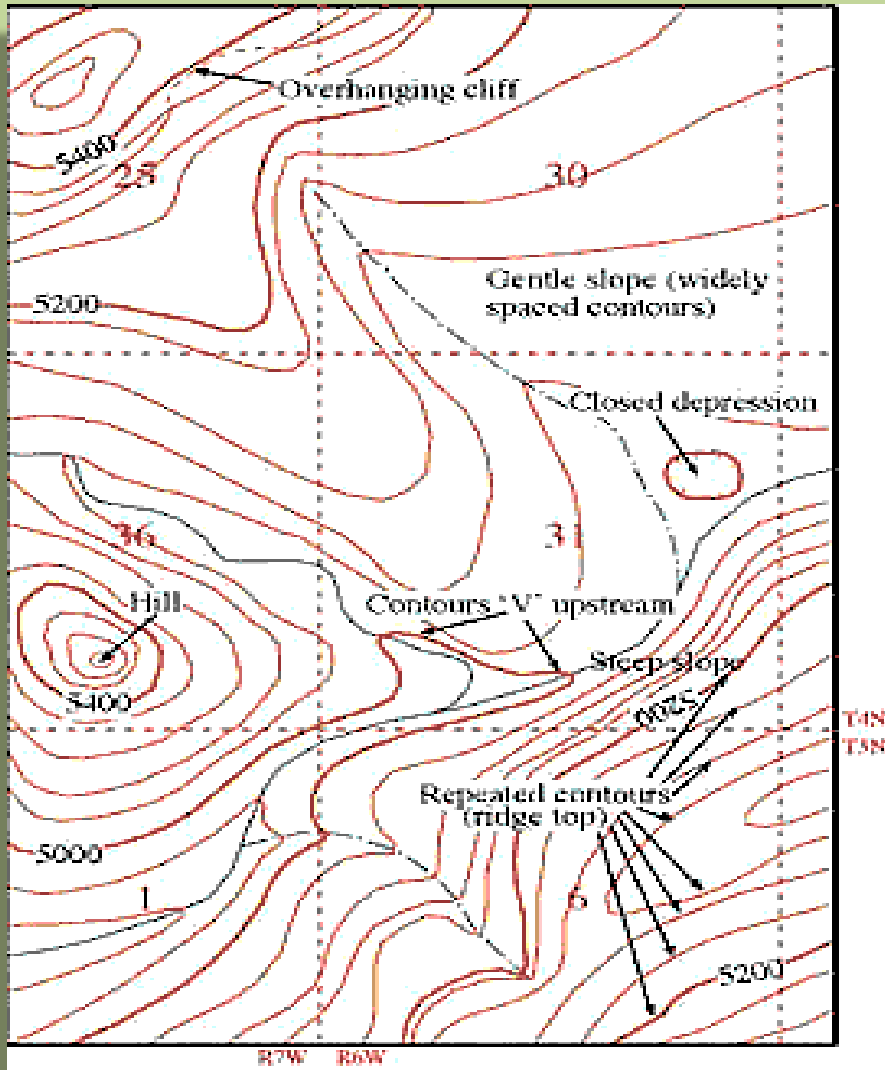
Characteristics of Contours
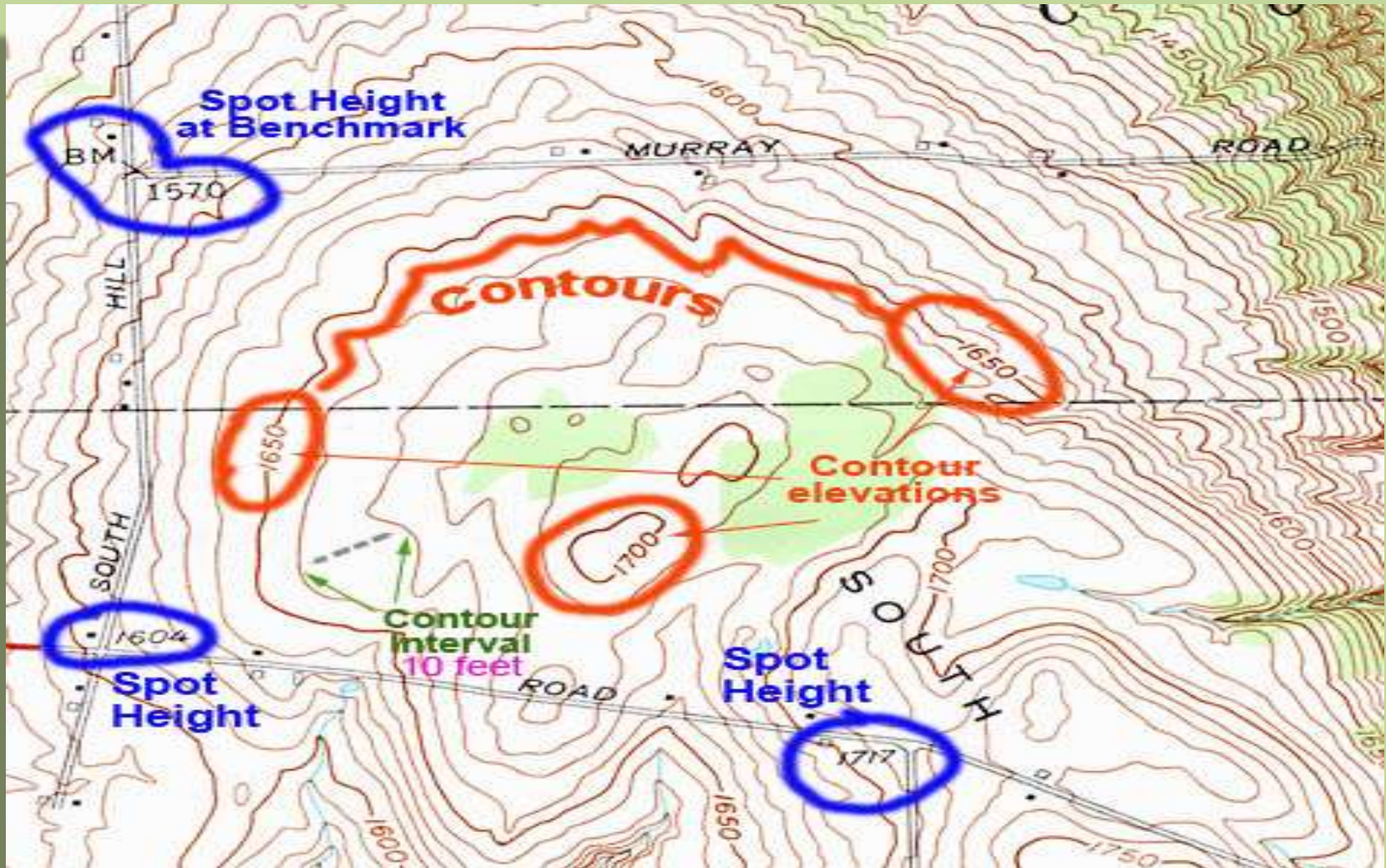
Characteristics of Contours

- *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

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
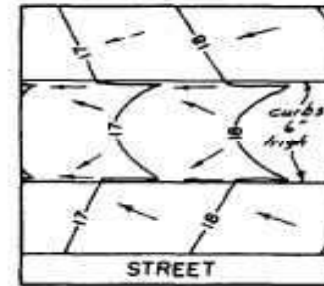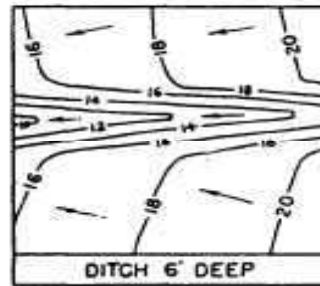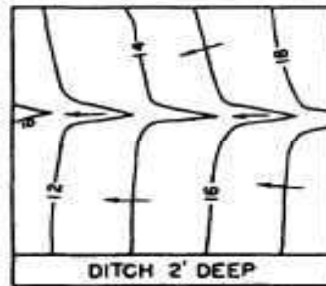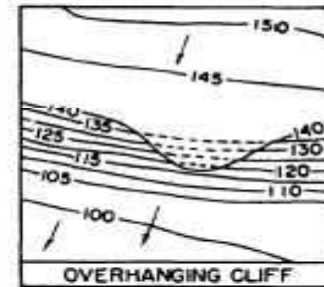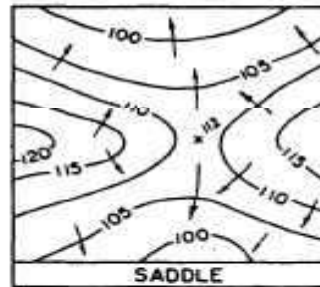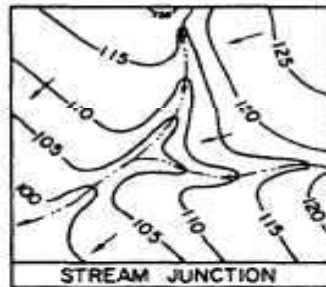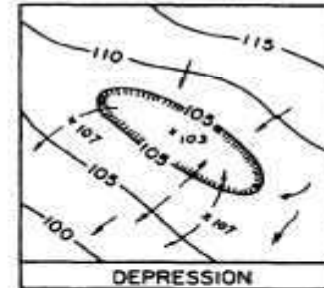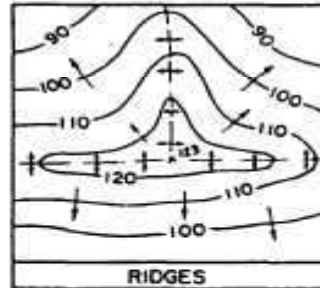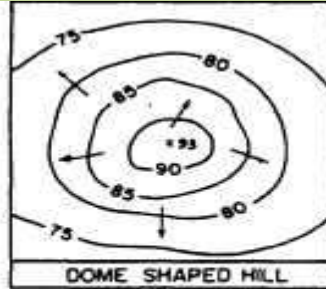
Characteristics of Contours

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.

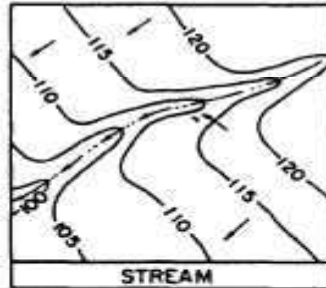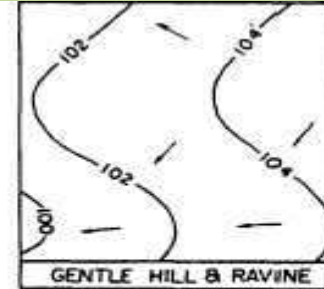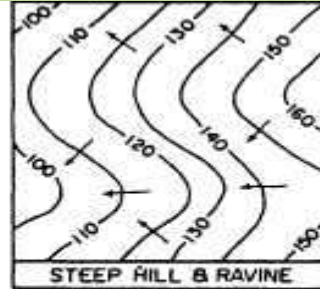2. Contour lines always separate points of higher elevation (uphill) from points of lower elevation (downhill). You must determine which direction on the map is higher and which is lower, relative to the contour line in question, by checking adjacent elevations.

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):

downstream (downhill)

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
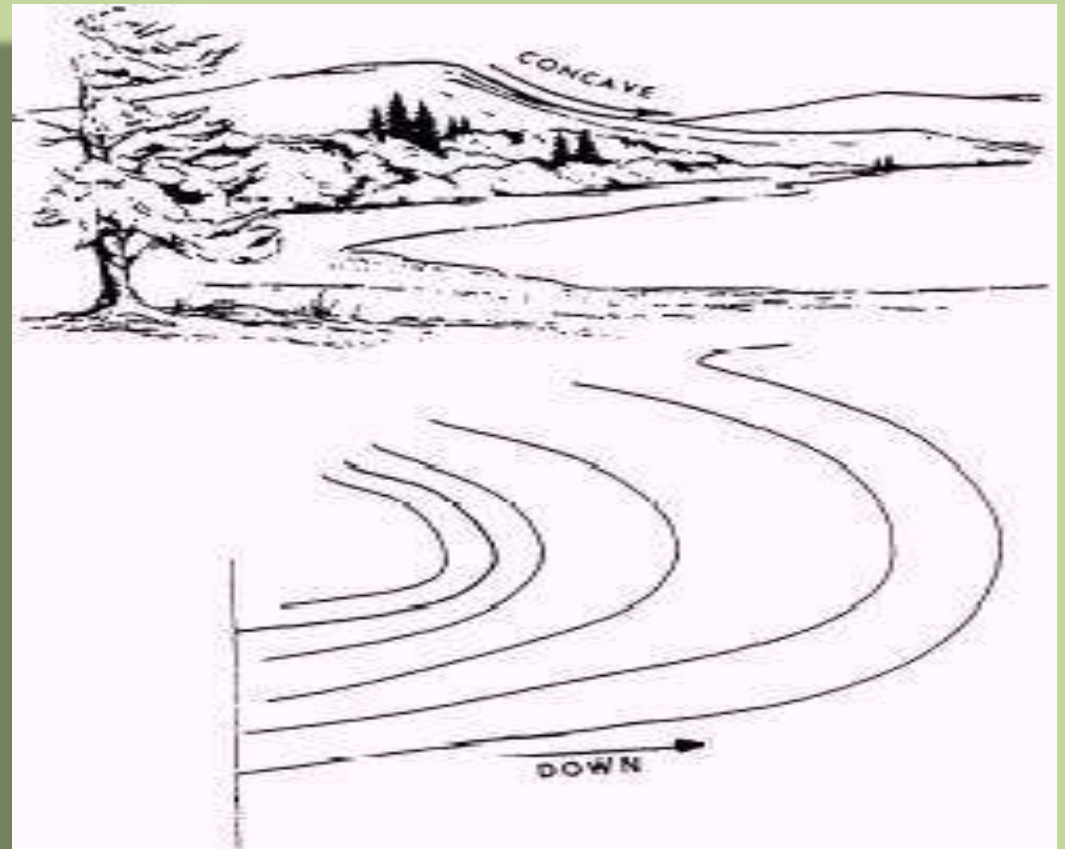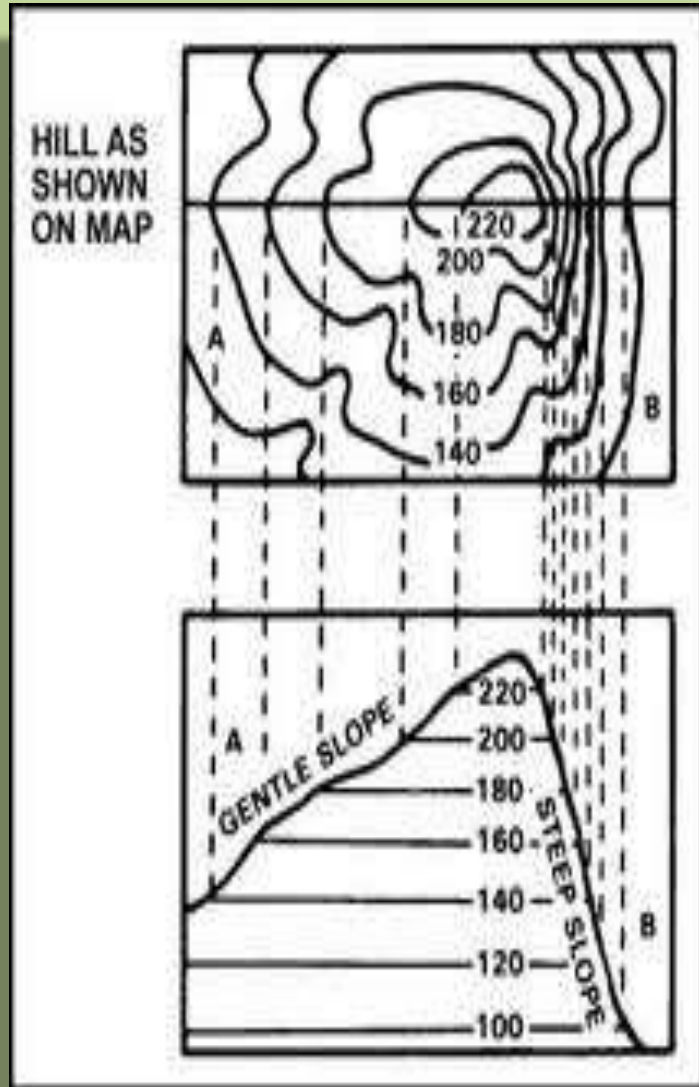
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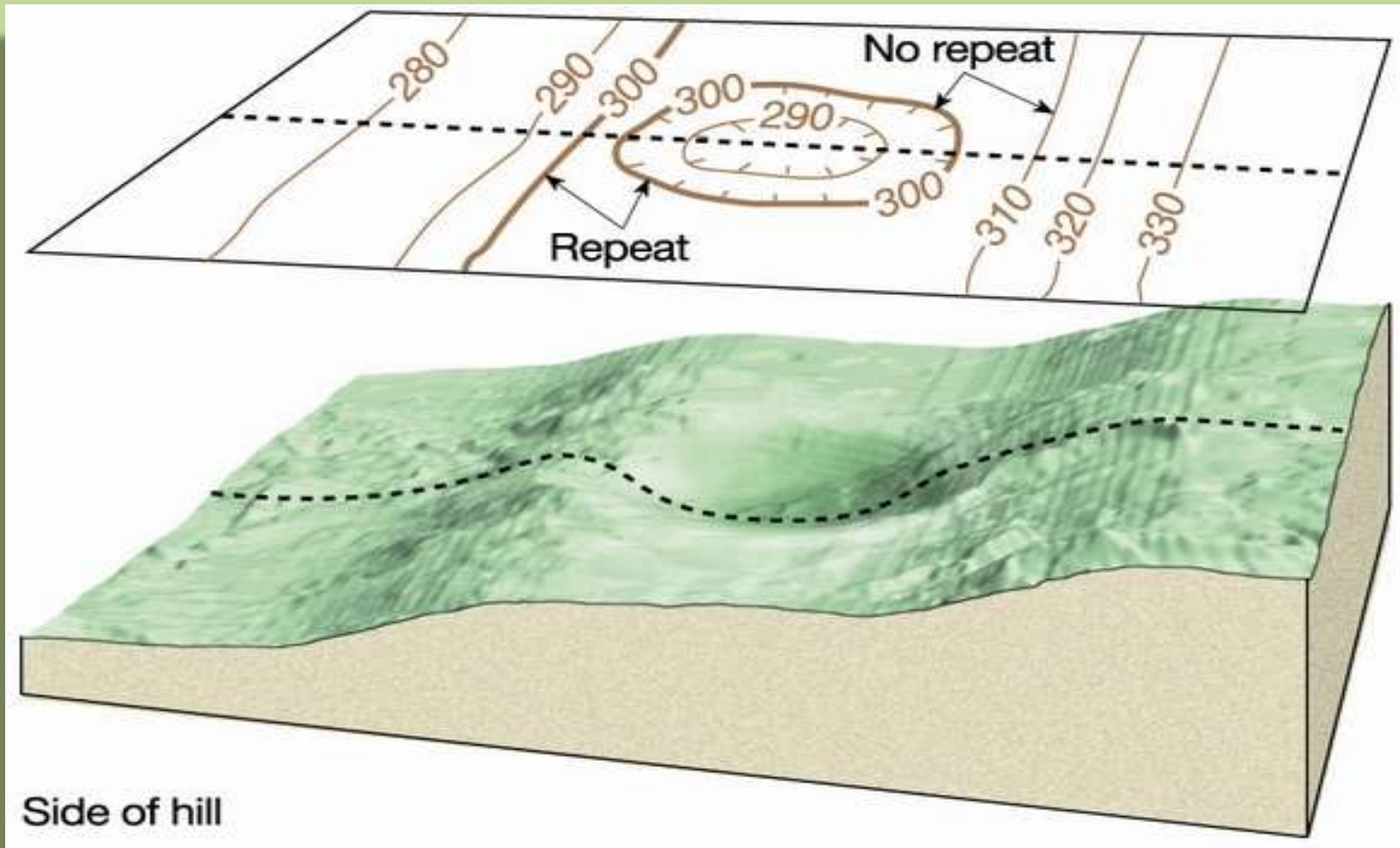
Characteristics of Contours

- **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
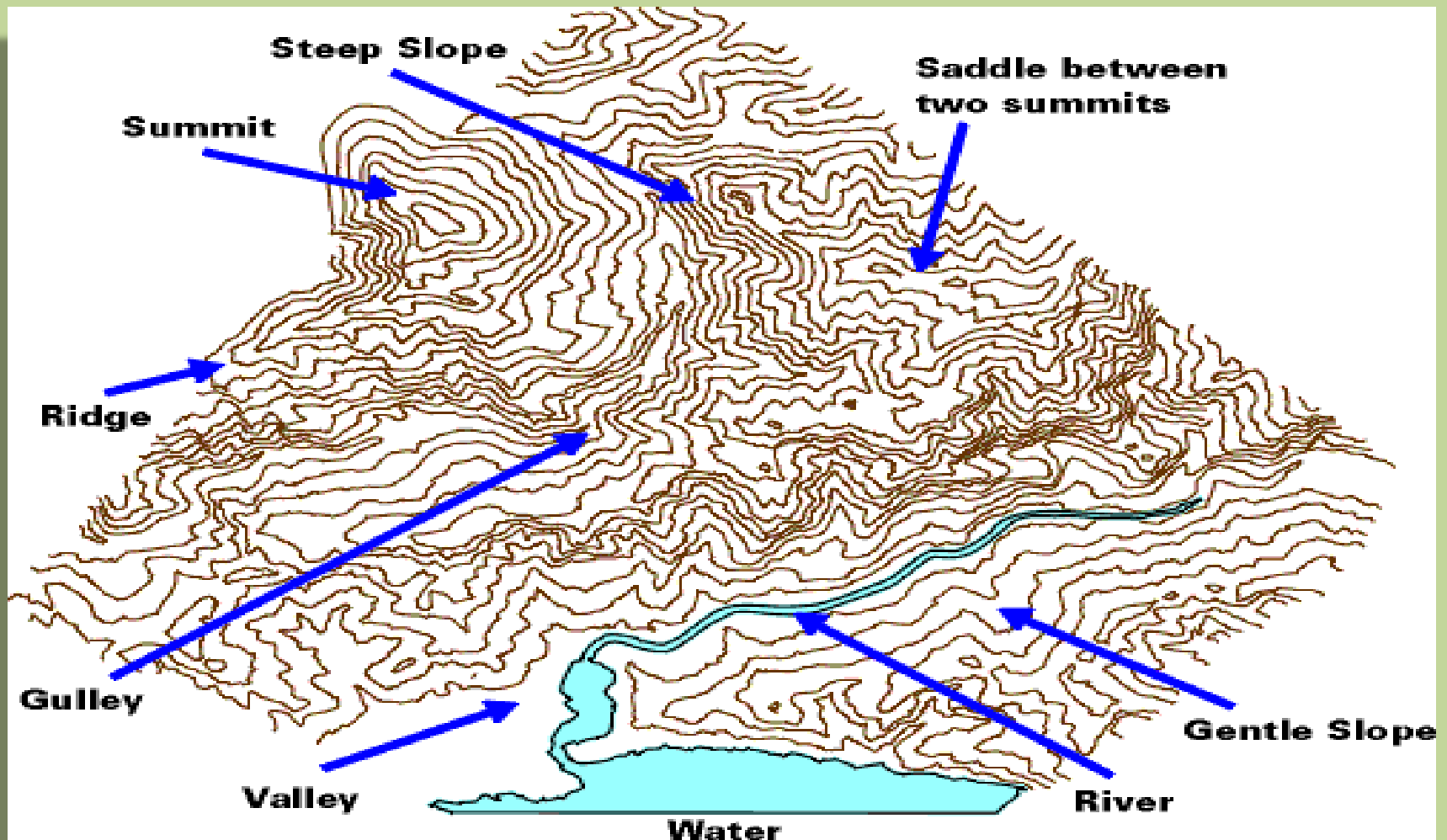
Typical Land features and their contour forms
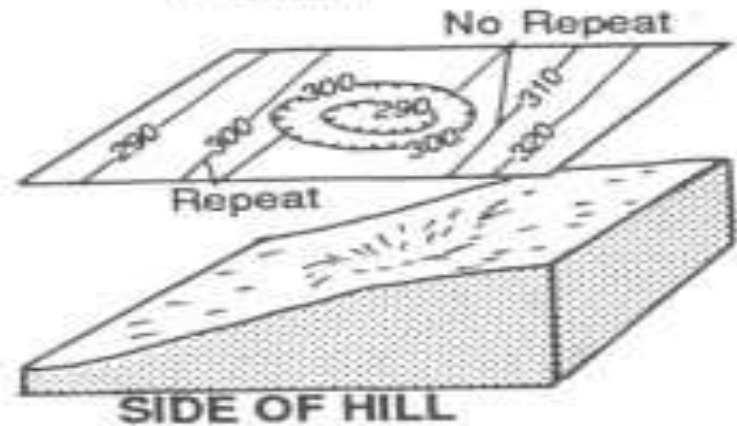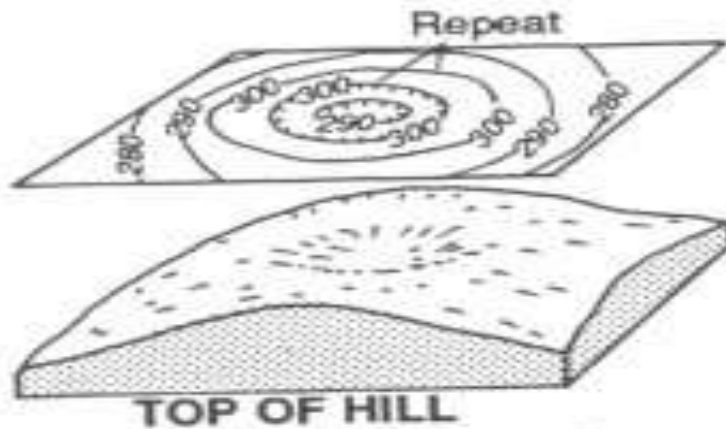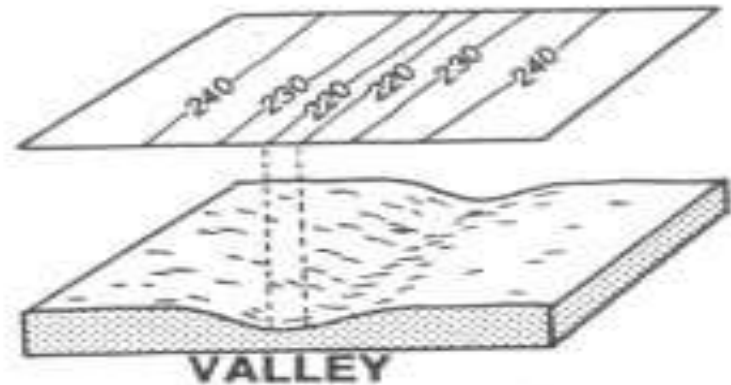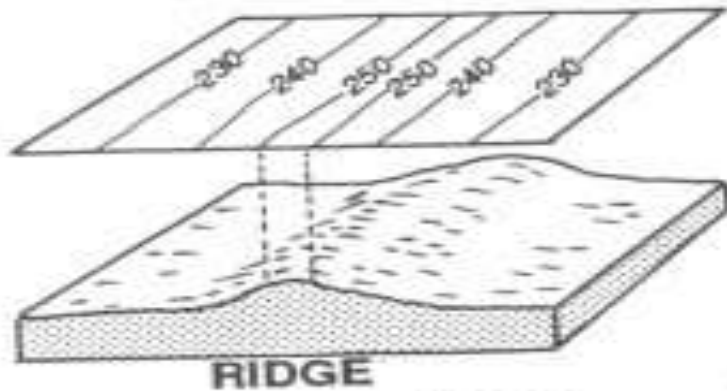
Typical Land features and their contour forms
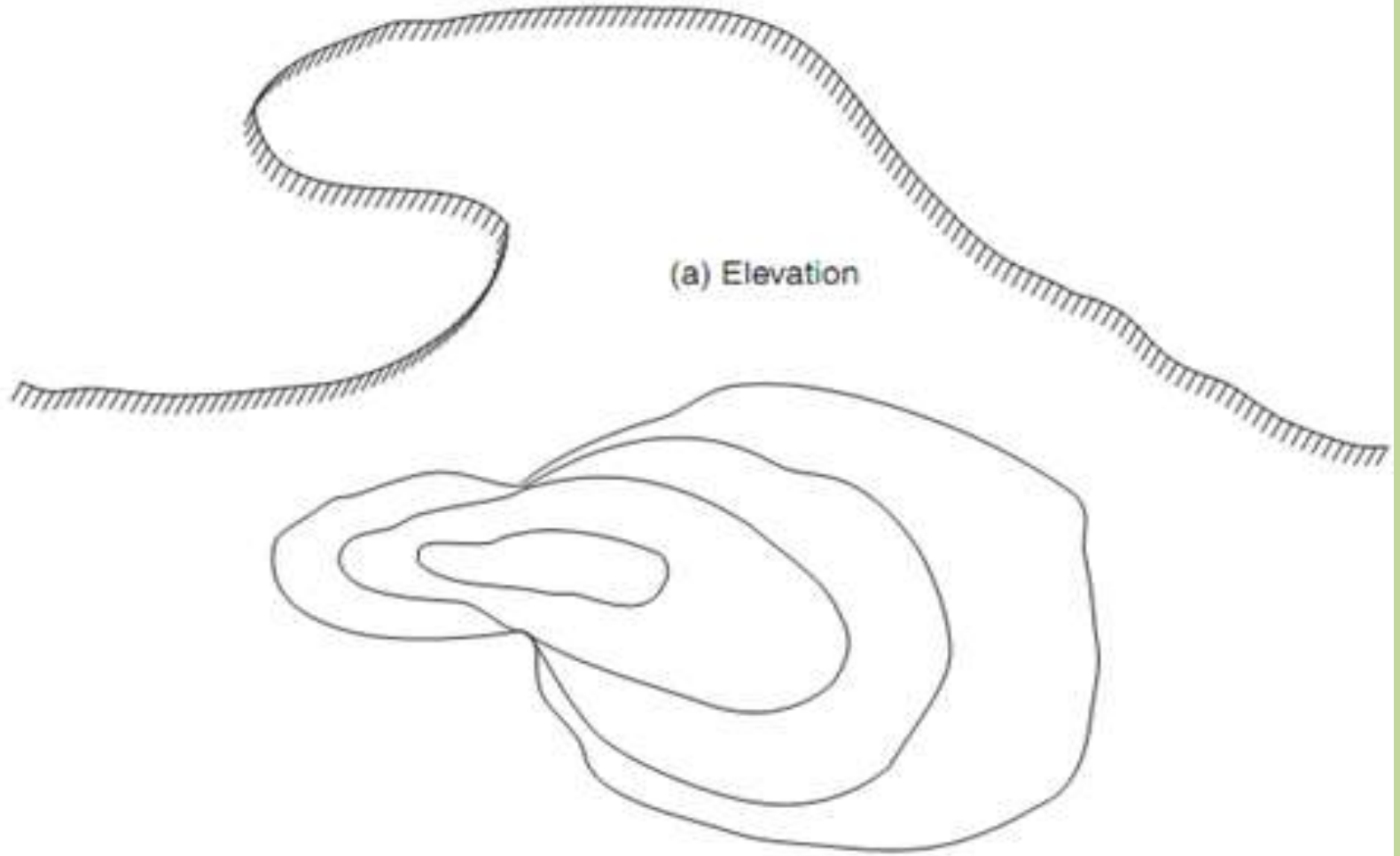
(a) Elevation

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
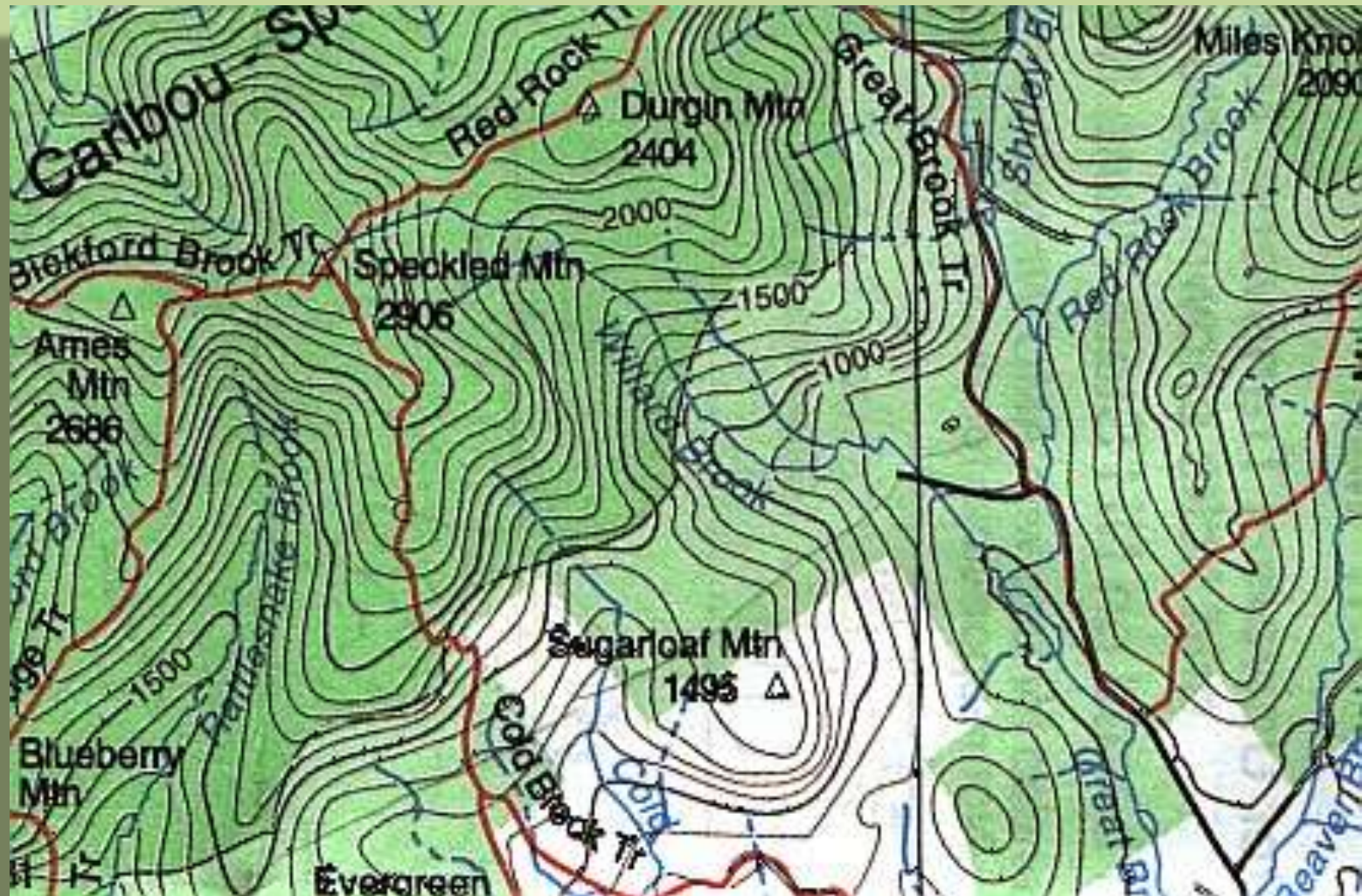
Methods of Contouring

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
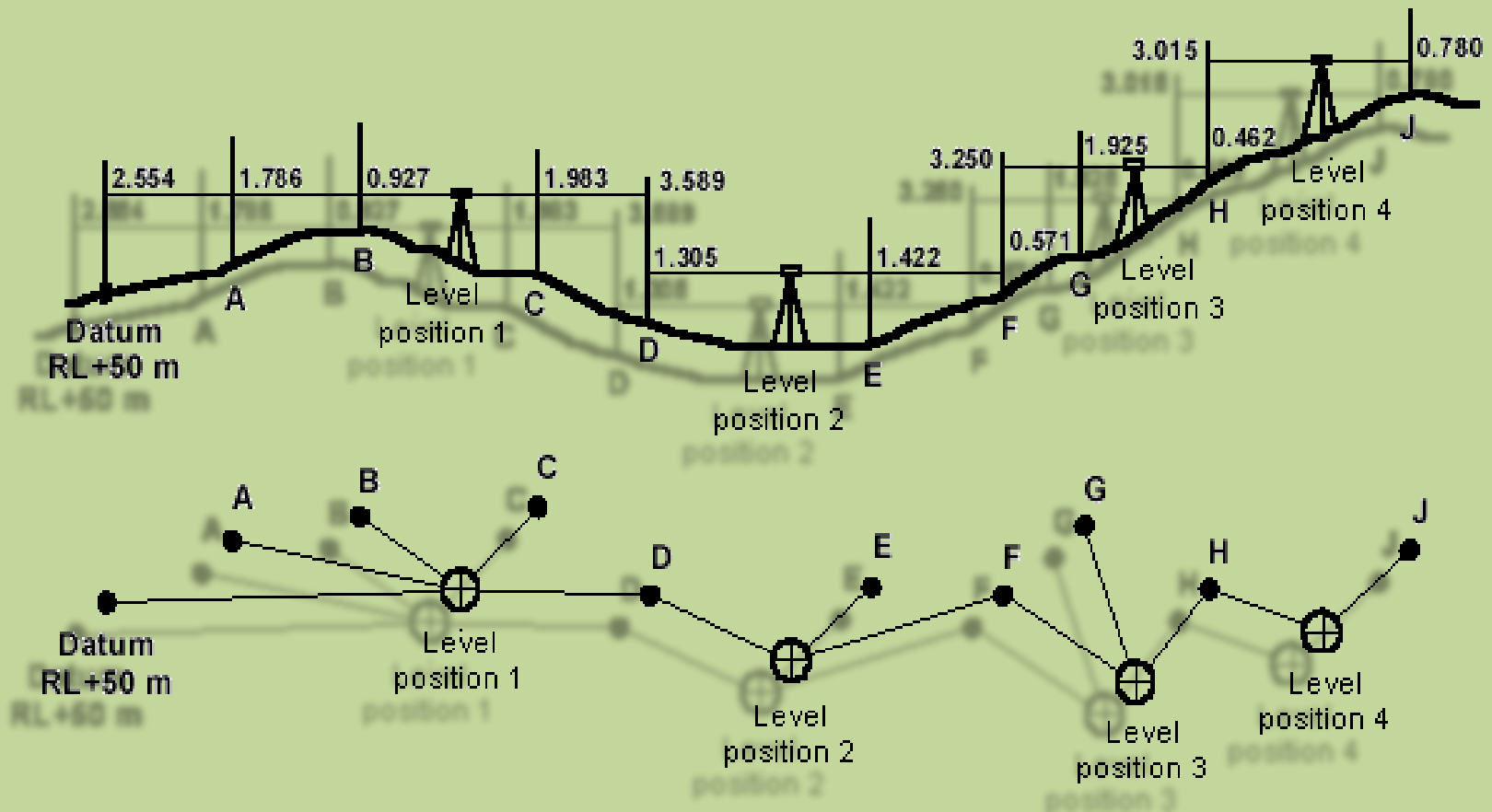
Methods of Contouring

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
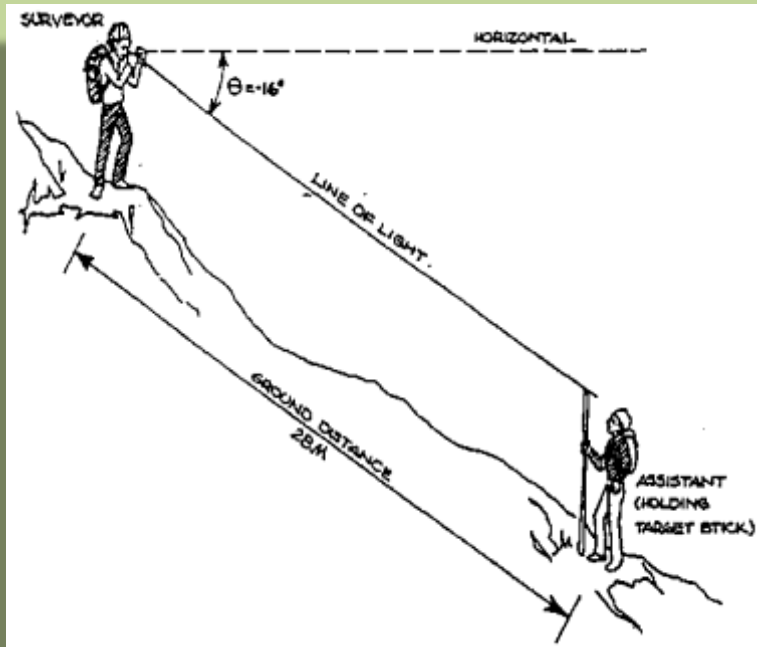
Methods of Contouring

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
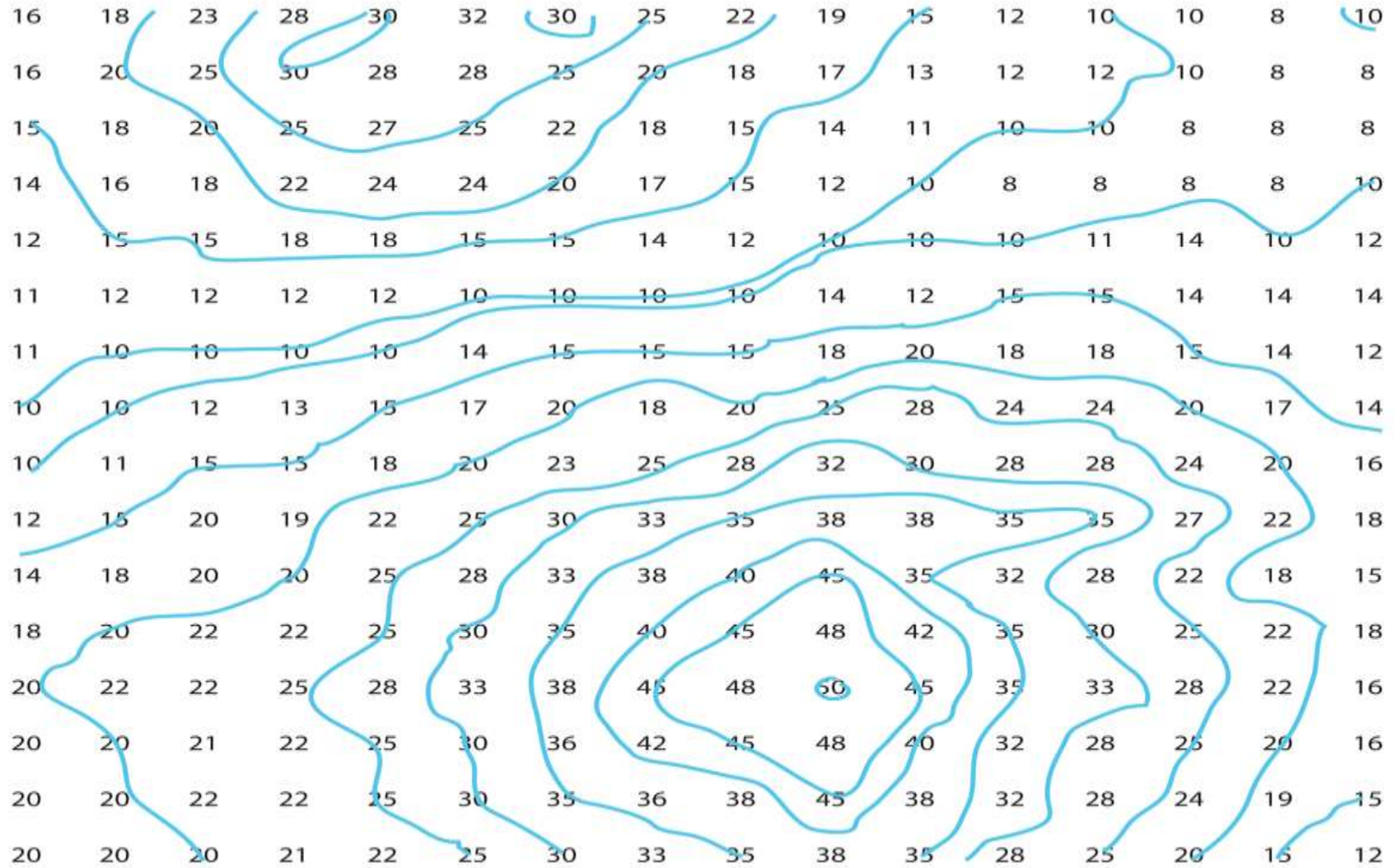
Methods of Contouring
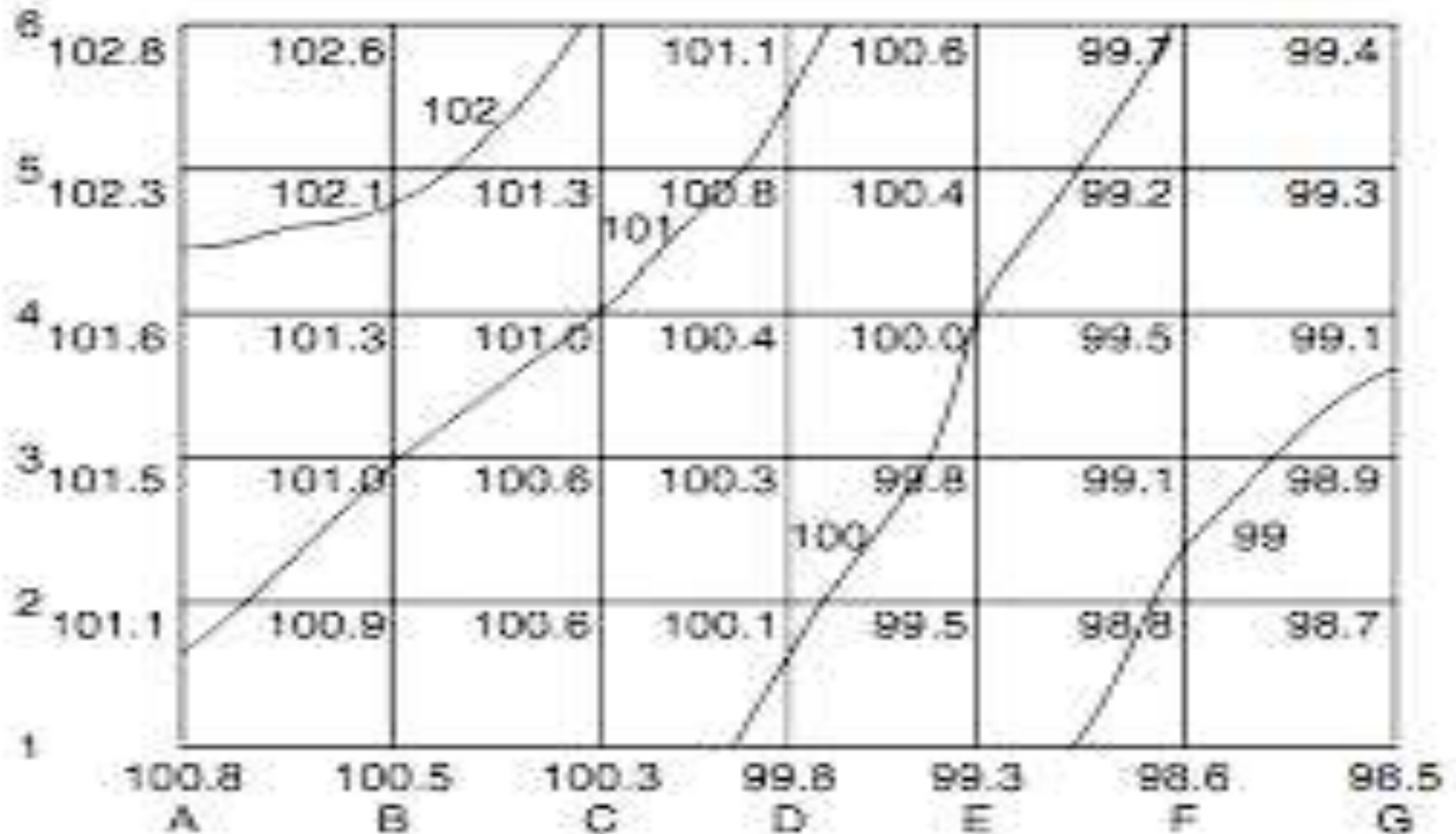
Methods of Contouring

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
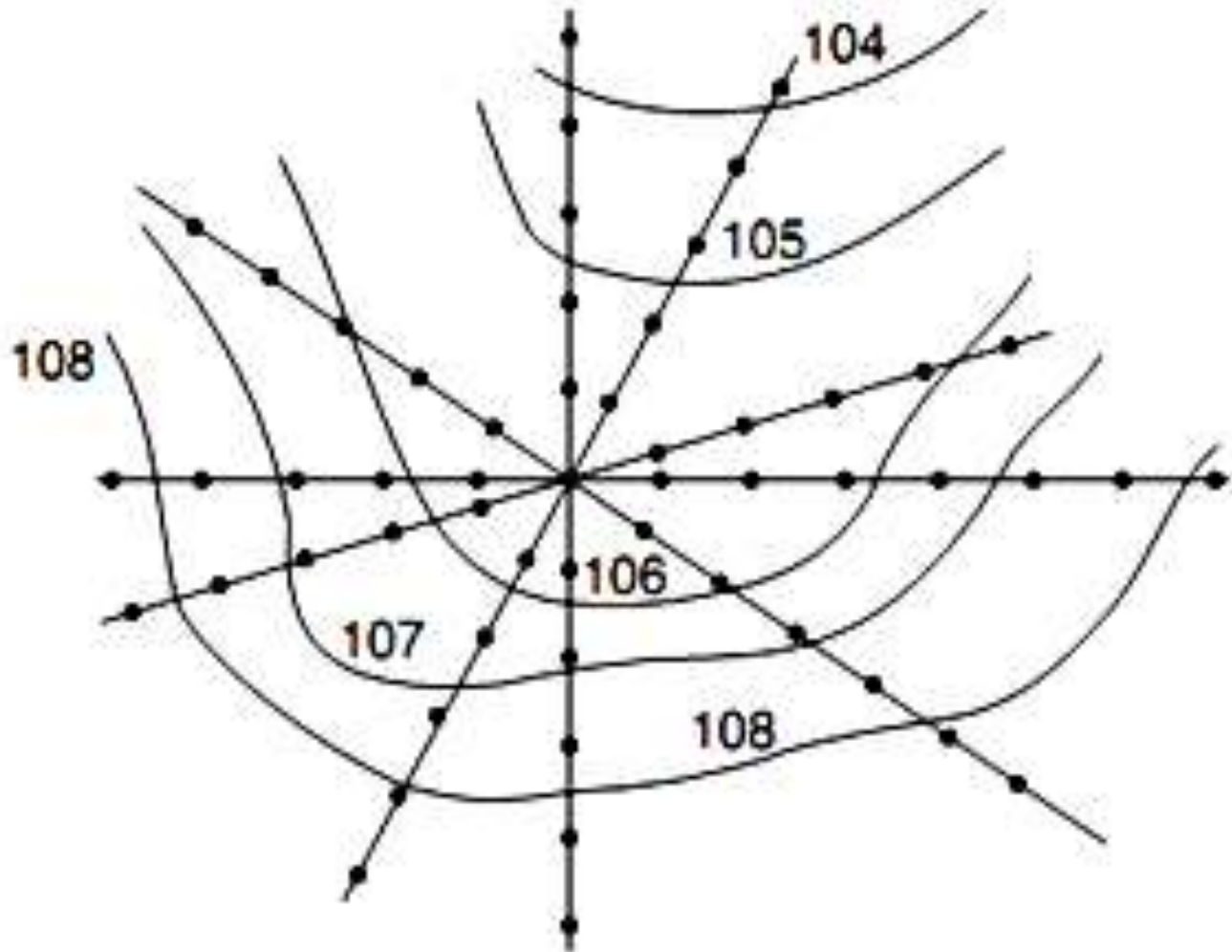
Interpolation of Contours

- 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
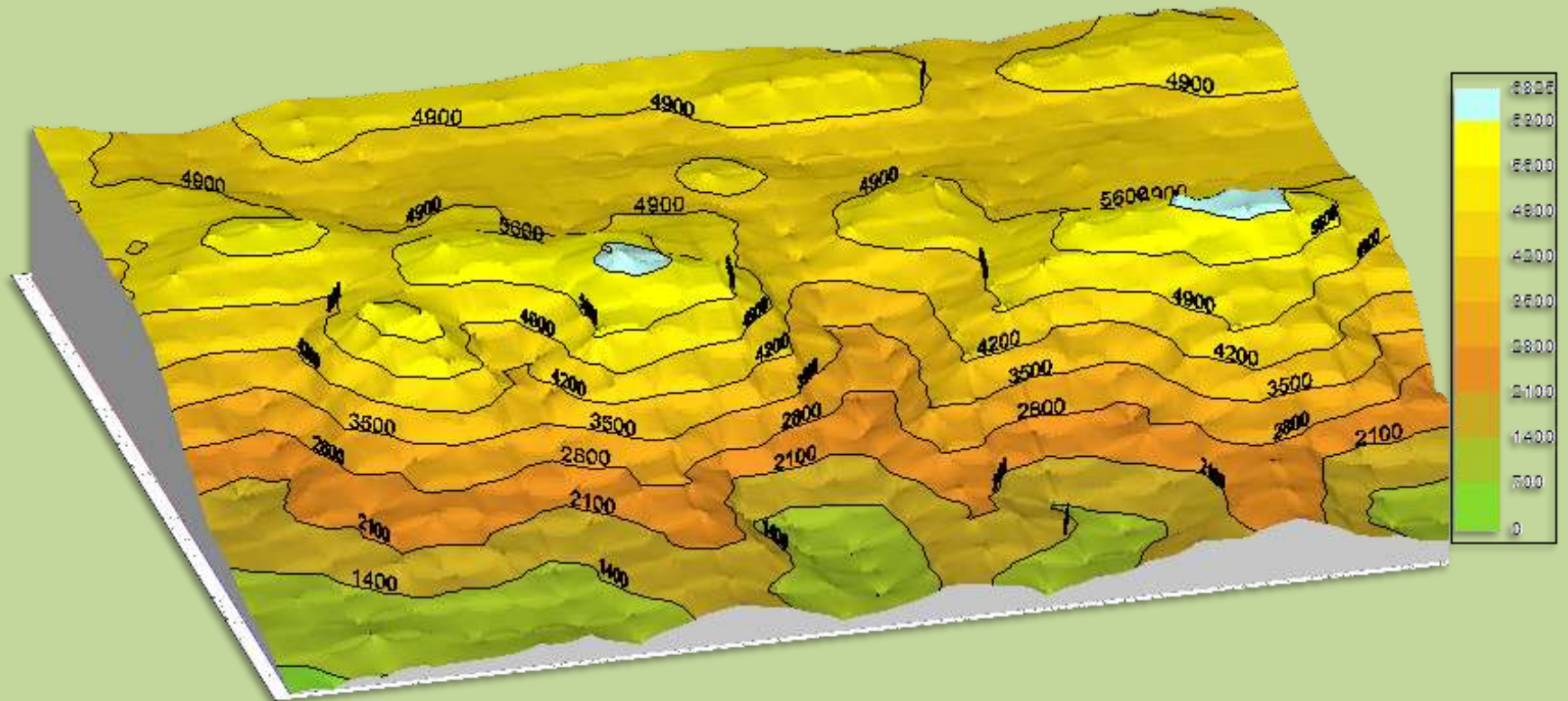
References

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                    Kanetkar and Kulkarni (2011)
- **" Surveying" Vol- I**
                        Dr. B.C. Punamia

Thanks !

GHT