CONTOURING

RCI4C001 SURVEYING

Module III

Contouring: Contour interval and horizontal equivalent, characteristics of contours, methods of contouring- different and indirect method, contour gradient

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Contours:

A **contour line** is a imaginary line which connects points of equal elevation.
Such lines are drawn on the plan of an area after establishing reduced levels of several points in the area.

A numerical value placed upon a contour line to denote its elevation relative to a given datum, usually mean sea level is called **Contour Value.** The contour lines in an area are drawn keeping difference in elevation of between two consecutive lines constant.

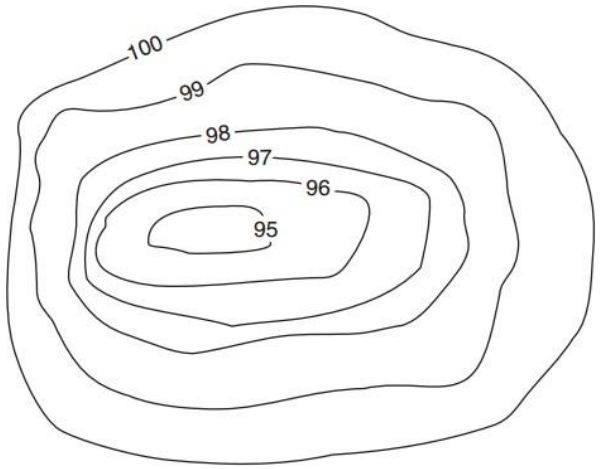
Alternatively , a contour or a contour line may be defined as **the line of intersection of a level surface** with the surface of ground. This means every point on a contour line has the same altitude as that of the assumed intersecting surface.

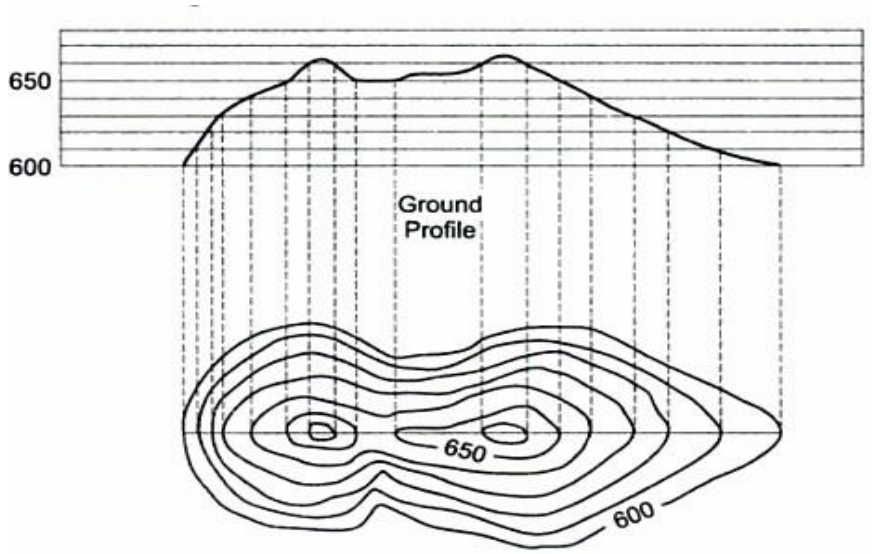
The process of tracing contour lines on the surface of the earth is called **contouring** and the maps upon which these lines are drawn are called con**tour maps**.
A contour map therefore, gives an ides of the altitudes of the surface feature as well as their relative positions in plan. Thus a contour map serves the purpose of both, a plan and a section.

Contour Interval and Horizontal Equivalent

The constant vertical distance between two consecutive contours is called the **Contour Interval** and the horizontal distance between any two adjacent contours is termed as the **horizontal equivalent.** The horizontal equivalent depends upon the slope of the ground

The **contour interval** of a contour map is the difference in elevation between successive contour lines. For example, Figure shows contours in an area with contour interval of 1 m.





On contour lines the level of lines is also written

Contour Interval

The contour interval depends upon the following factors:

(i) The nature of the ground:
In flat and uniformly sloping country, the contour interval is small, but in broken and mountainous region, the contour interval should be large otherwise the contours will come too close to each other.

(ii) The purpose and extent of the survey:
Contours interval is small if the area to be surveyed is small and the maps are required to be used for the design work or for determining the quantities of earth work etc., while wider interval shall have to be kept for large areas and comparatively less important works.

(iii) The scale of the map:
The contour interval should be in the inverse ratio to the scale of i.e. the smaller the scale, the greater the contour interval.

(iv) Time and expense of field and office work:
The smaller the interval, the greater is the amount of field -work and plotting-work.

Contour Interval

The following are the common values of the contour interval adopted for various purposes:

(a) For large scale maps of flat country, for building sites for detailed design work and for calculation of quantities of earth work: 0.2 to 0.5 m.

(b) For reservoirs and town planning schemes: 0.5 to 2 m.

(c) For location surveys: 2 to 3 m.

(d) For small scale maps of broken country and General topographical work : 3 m, 5 m, 10 m or 25 m.

Scale of Map	Type of ground	Contour Interval (m)
Large	Flat	0.2 to 0.5
	Rolling	0.5 to 1
	Hilly	1, 1.5 or 2
Intermediate	Flat	0.5,1 or 1.5
	Rolling	1, 1.5 or 2
	Hilly	2, 2.5 or 3
Small	Flat	1,2 or 3
	Rolling	2 to 5
	Hilly	5 to 10
	Mountainous	10, 25 or 50

Characteristics of Contours

- Contour lines must close, not necessarily in the limits of the plan.
- Widely spaced contour indicates flat surface.
- Closely spaced contour indicates steep ground.
- Equally spaced contour indicates uniform slope.
- Irregular contours indicate uneven surface.

Characteristics of Contours

- Approximately concentric closed contours with decreasing values towards centre indicate a pond.

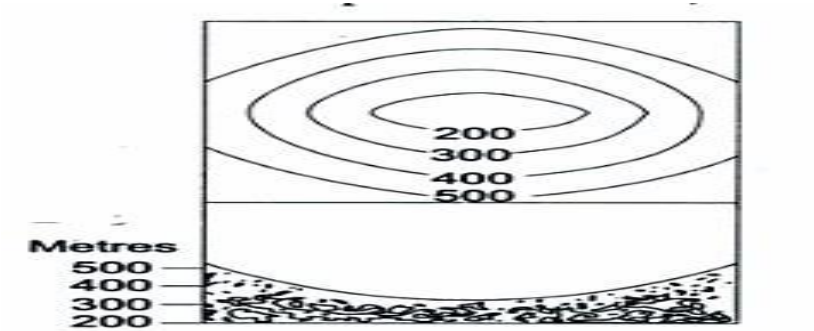


Fig. 9.6 (j) A depression

•Approximately concentric closed contours with increasing values towards centre indicate hills.

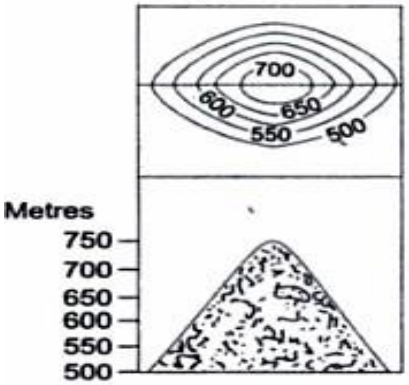


Fig. 9.6(e) A hill

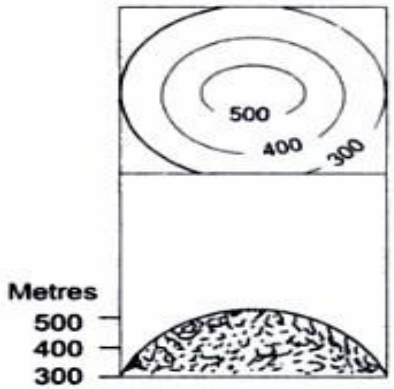


Fig. 9.6(f) A hillock

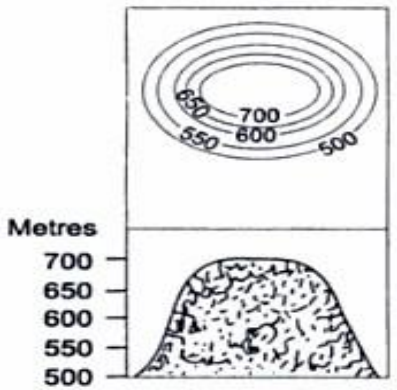
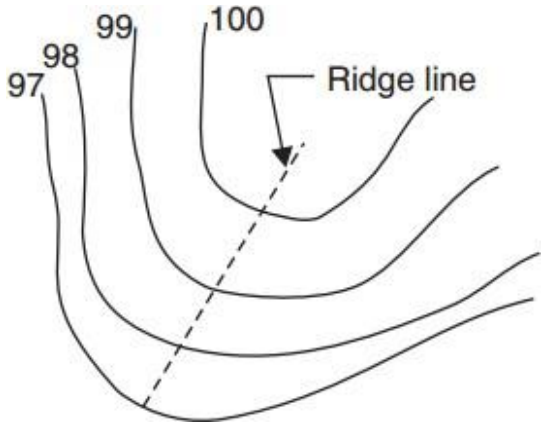


Fig. 9.6(g) A plateau

Characteristics of Contours

Contour lines with U-shape with convexity towards lower ground indicate ridge



Contour lines with V-shaped with convexity towards higher ground indicate valley

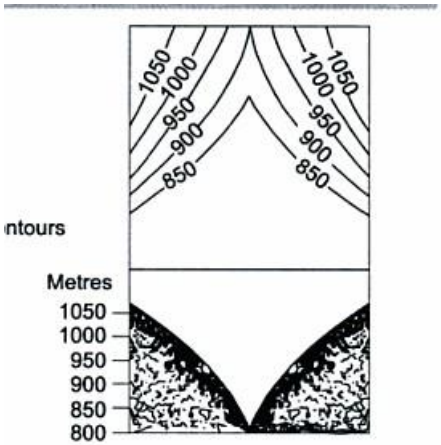
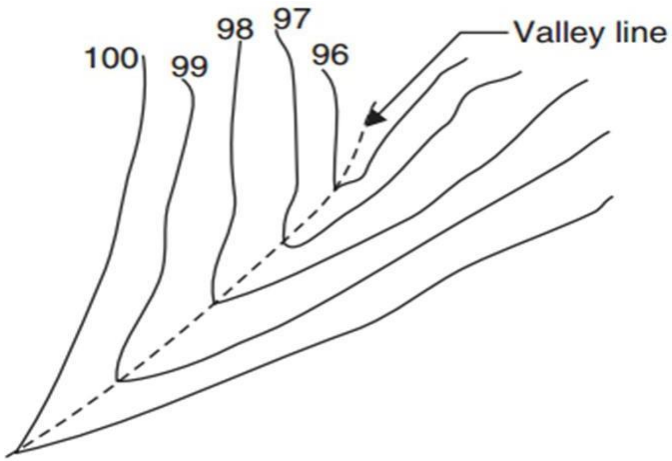


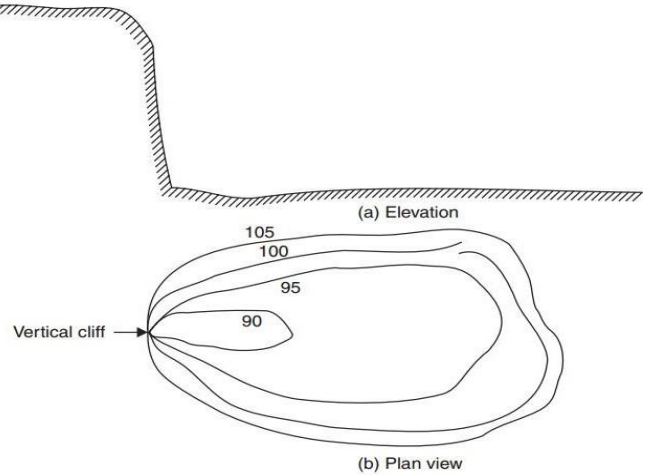
Fig. 9.6 (i) A V-shaped valley

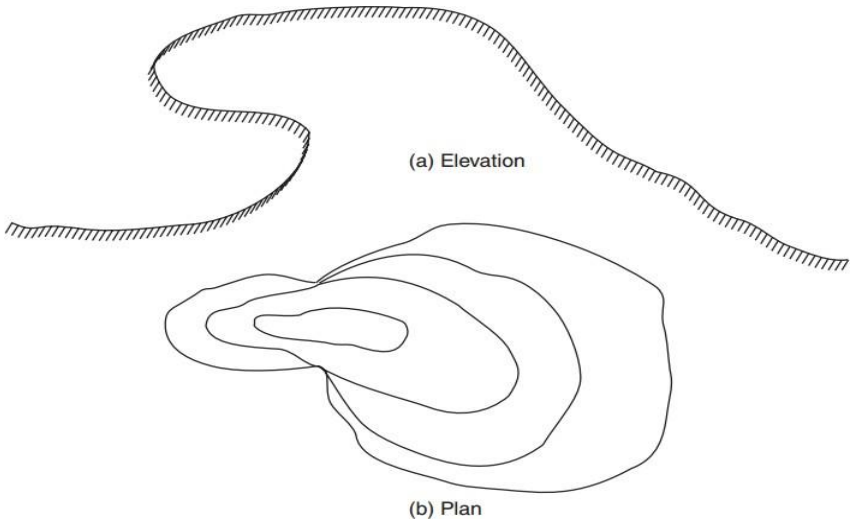


Characteristics of Contours

•Contour lines generally do not meet or intersect each other.

•If contour lines are meeting in some portion, it shows existence of a vertical cliff
In this case, several contours coincide and the horizontal equivalent becomes zero.





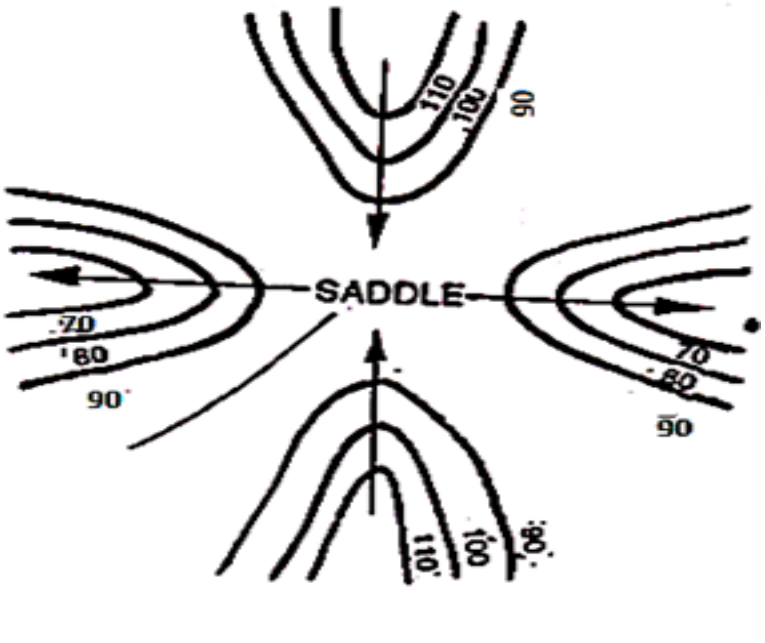
• If contour lines cross each other, it shows existence of overhanging cliffs or a cave.

Characteristics of Contours

•Depression between summits is called a saddle. It is represented by four sets of contours .

It represents a dip in a ridge or the junction of two ridges.

And in the case of a mountain range, it takes the form of a pass. Line passing through the saddles and summits gives water shed line.



Methods of Contour:

There are mainly two methods of locating contours;
(1) Direct method, and
(2) Indirect method.

1. Direct Method:
In this method, the contours to be located are directly traced out in the field by locating and making a number of points on each contour. These points are then surveyed and plotted on plan and the contours drawn through them.

This method is the most accurate but very slow and tedious as a lot of time is wasted in searching points of the same elevation for a contour. This is suitable for small areas and where great accuracy is required.

Methods of Contour:

Case 1 *: When area is oblong and cannot be controlled from single point*

Procedure:

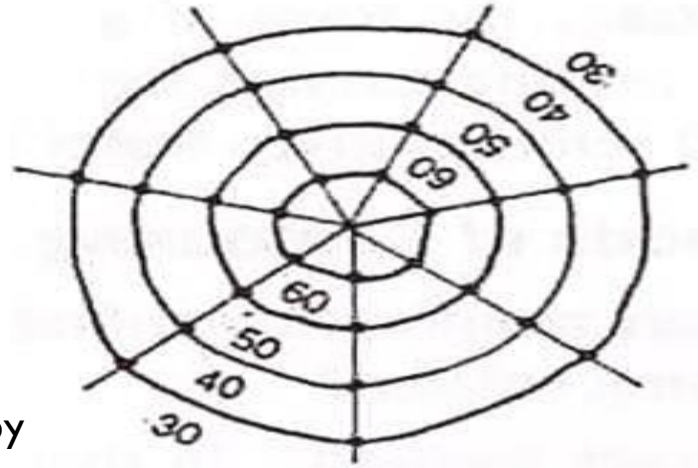
- To start with, a temporary B.M. is established near the area to be surveyed with reference to a permanent B.M. by taking flying levels. The level is then set up in such a position so that the maximum number of points can be commanded from the instrument station. The height of instrument is determined by taking a back sight on the B.M. and adding it to the R.L of the bench mark.
- The staff readings required to fix points on the various contours from the height of instrument. As an example, if the height of instrument is 72.58 m, then the staff readings required to locate the 72, 71 and 70m contours are 0.58, 1.58 and 2.58 m respectively. The staff is held on an approximate position of point and then moved up or down the slope until the desired reading is obtained.
- The point is marked with a peg. Similarly various other points are marked on each contour. The line joining all these points gives the required contour.

- It may be noted that one contour is located at a time. Having fixed the contours within the range of the instrument, the level is shifted and set up in a new position. The new height of instrument and the required staff readings are then calculated in a similar manner and the process repeated till all the contours are located.

Methods of Contour:

Case 2 **Direct Method by Radial Lines**: *When area is small and a single point in the centre can command the whole area.*

- Radial lines are laid out from the common centre by theodolite or compass and their positions are fixed up by horizontal angles and bearings.
- Temporary bench marks are first established at the centre and near the ends of the radial lines.
- The contour points are then located and marked on these lines as explained above and their positions are determined by measuring their distances along the radial lines.
- They are then plotted on the plan and the contours drawn by joining all the corresponding points



Methods of Contour:

2. Indirect Method:

In this method, the points located and surveyed are not necessarily on the contour lines but the spot levels (spot level means the R.L. of a point on the surface of the ground) are taken along the series of lines laid out over the area.

The spot levels of the several representative points representing hills, depression, ridge and valley lines, and the changes in the slope all over the area to be contoured are also observed.

Their positions are then plotted on the plan and the contours drawn by interpolation. This method of contouring is also known as contouring by spot levels.

This method is commonly employed in all kinds of surveys as this is cheaper, quicker and less tedious as compared with the direct method.

There are mainly three methods contouring under this head

Methods of Contour:

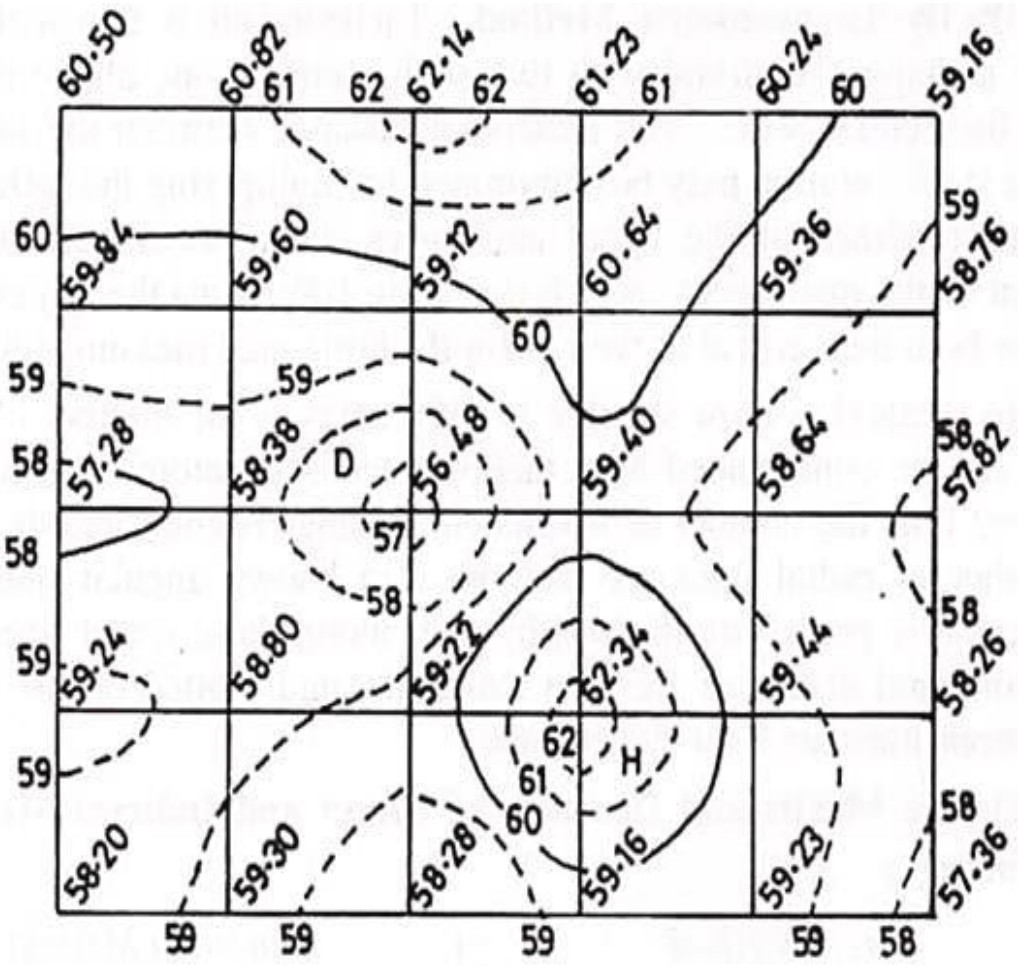
(i) By Squares:

- In this method, the whole area is divided into number of squares, the sides of which may vai from 5m to 30m depending upon the nature o the ground and the contour interval.

- The squares need not be of the same size throughout, the corners of the squares are pegged out and the reduced levels of these points are determined with a level.

- The important points within the squares may l taken when required and located by measurements from the corners.

- The squares are plotted and the reduced levels of the corners are written on the plan. T contour lines are then interploted



Methods of Contour:

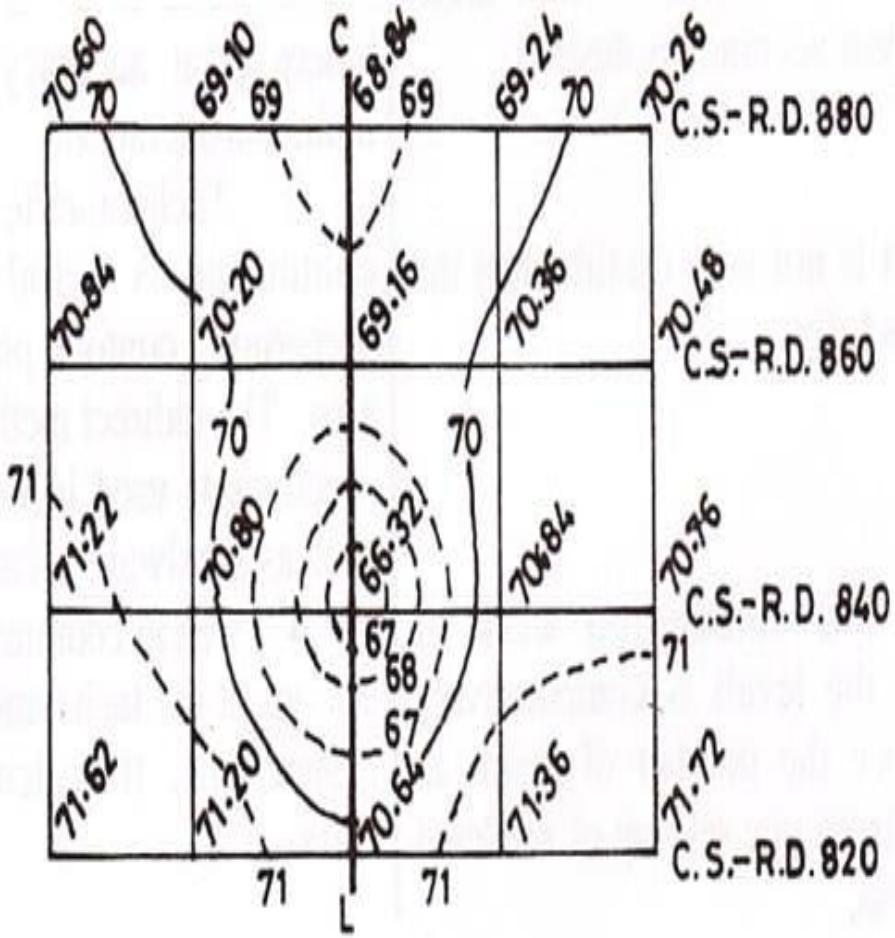
(ii) By Cross-Sections :

- This method is most suitable for survey of long narrow strips such as a road, railway canal etc.

- Cross -section ore run transverse lo the centre lin of the work and representative points are marked along the lines of cross-section. The cross-section lines need not necessarily be at right angles to the centre line of the work. This may be inclined at an angle to the centre line if necessary.

- The spacing of the cross -sections depends upon the topography of the country and the nature of th survey, the common value is 20 to 30m in hilly country and 100m in flat country.

- The levels of the points along the section line are plotted on the plan and the contour are then interpolated as usual



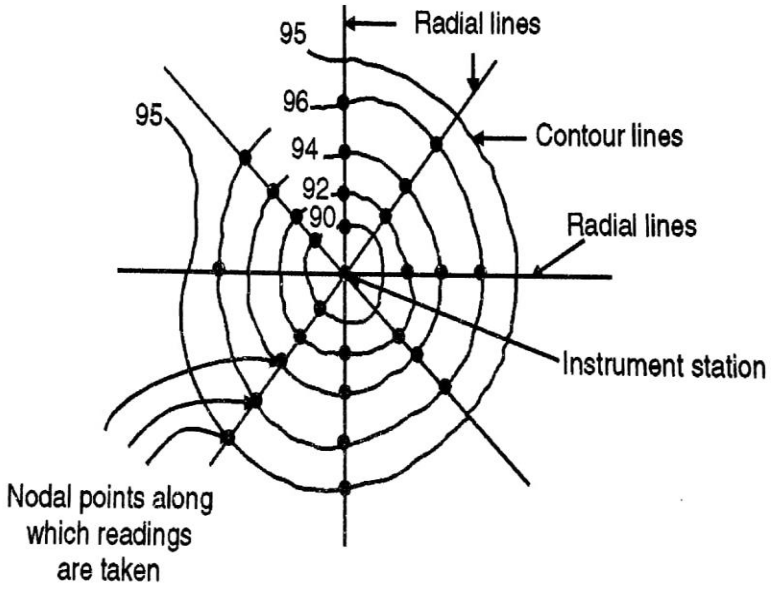
Methods of Contour:

(iii) By Tacheometric Method:

- This method is most suitable in hilly areas as the number of stations which can be commanded by a tacheometer is far more than those by a level and thus the number of instrument-settings is considerably reduced.

- A number of radial lines are laid out at a known angular interval and representative points are marked by pegs along these radial lines.

- Their elevations and distances are then calculated and plotted on the plan and the contour lines are then interpolated.



*(**Tacheometer is transit theodolite** having a diagram fitted with two stadia wires, one above and other below the central wire. The horizontal distance between the instrument and the staff -station may be determined by multiplying the difference of the staff readings of the upper and lower stadia wires with the stadia constant of the instrument, which is usually 100. Thus the tacheometer is used for both the vertical as well as for the horizontal measurements.)*

Methods of Contour:

Relative Merits and Demerits of Direct and Indirect Methods of Contouring:

Direct Method:

1. The method is most accurate but is very slow and tedious.
2. It is used for small areas where great accuracy is desired.
3. It is not very useful when the around is hilly.
4. The calculation work of reducing the levels is comparatively more since the number of points in command from one set -up of the level is very less.

Indirect Method:

1. The method is not very accurate but is cheaper, quicker and less laborious.
2. It is used for large areas where great accuracy is not the main consideration.
3. Tacheometric method of contouring is mainly used for preparing, contour plans of hilly area. The indirect method by cross -sections is used in route surveys such as a railway, a canal etc.
4. Area in command from one set -up of the tacheometer is more, therefore, the calculation work is less.

Interpolation of Contours

The process of spacing the contours proportionally between the plotted ground points is termed as interpolation of contours.

This becomes necessary in the case of indirect contouring as only the spot levels are taken in this method. The intermediate contours may also be interpolated in direct contouring if the interval is large. While interpolation of contours the ground between any two points is assumed to be uniformly sloping.

There are three methods of interpolation

(i) By Estimation:

The positions of the contour-points between ground -points are estimated roughly, and the contours are then drawn through these points. This is a rough method and is suitable for small scale maps.

(ii) By Arithmetical Calculation:

This is very but accurate method and is used for small areas where accurate results are necessary.

(iii) By Graphical Method:

Graphical method of interpolation are simpler as compared to arithmetical methods and also the results obtained are accurate

Uses of Contour Maps

1. The suitable site can be selected for construction activities.
2. Reservoir capacity can be determined.
3. Alignment for roads, canals, transmission lines are done efficiently with the help of contour map.
4. Nature of ground surface may be determined.
5. Estimating the quantities of earthwork.
6. The nature of ground i.e. flat, uniformly, sloping, undulating or hilly etc.
7. It is possible to select the most suitable and economical sites for work such as the location of roads, railways, canals, pipelines, dams, reservoirs etc. by using contour map.
8. Estimating of the volume of reservoir storage water, volume of earthwork in cutting and embankment can be done by using contour map.