RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF RNGINEERING AND TECHNOLOGY (DEPARTMENT OF CIVIL ENGINEERING)

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.

- for selecting points anyone of the following method may be used:

a. Method of square
b. Method of cross-section
c. Radial line method

BY SQUARES

- In this method, the whole area is divided into a number of squares, the sides of which may vary from 5m to 30m depending upon the nature of 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 be 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. The contour lines are then interpolated

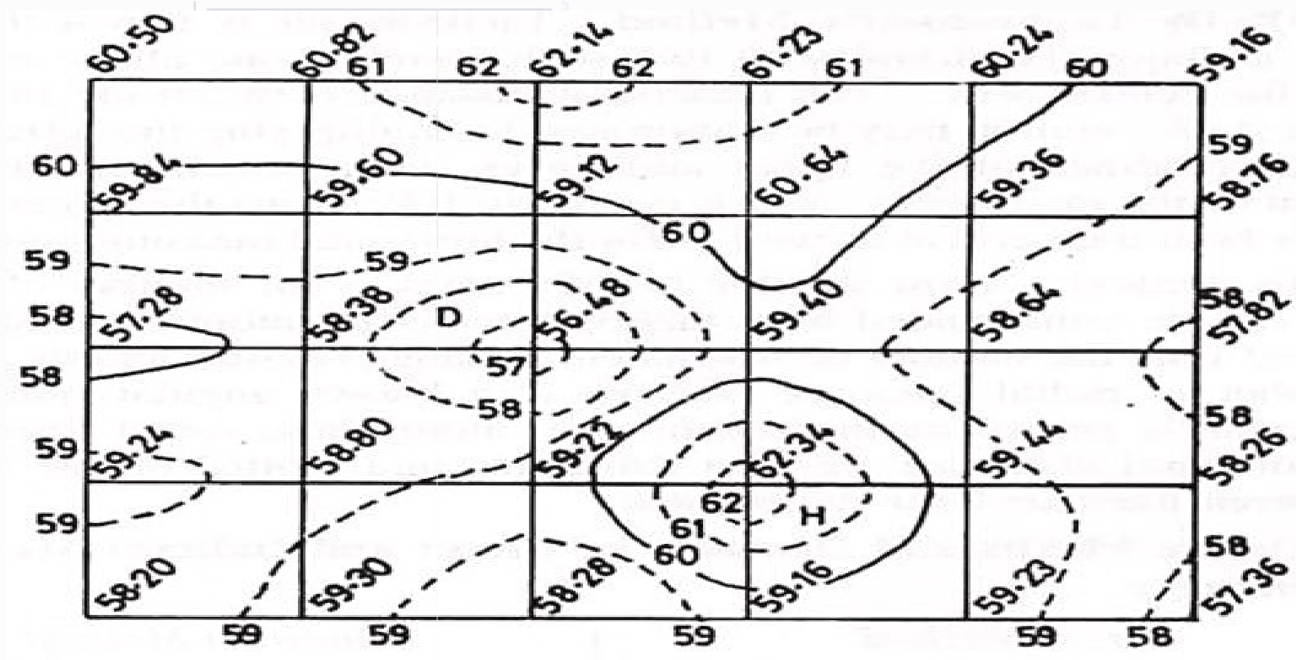

Fig. 8.9

METHODS OF CONTOUR

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 line 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 any angle to the centre line if necessary. The spacing of the cross -sections depends upon the topography of the country and the nature of the 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.

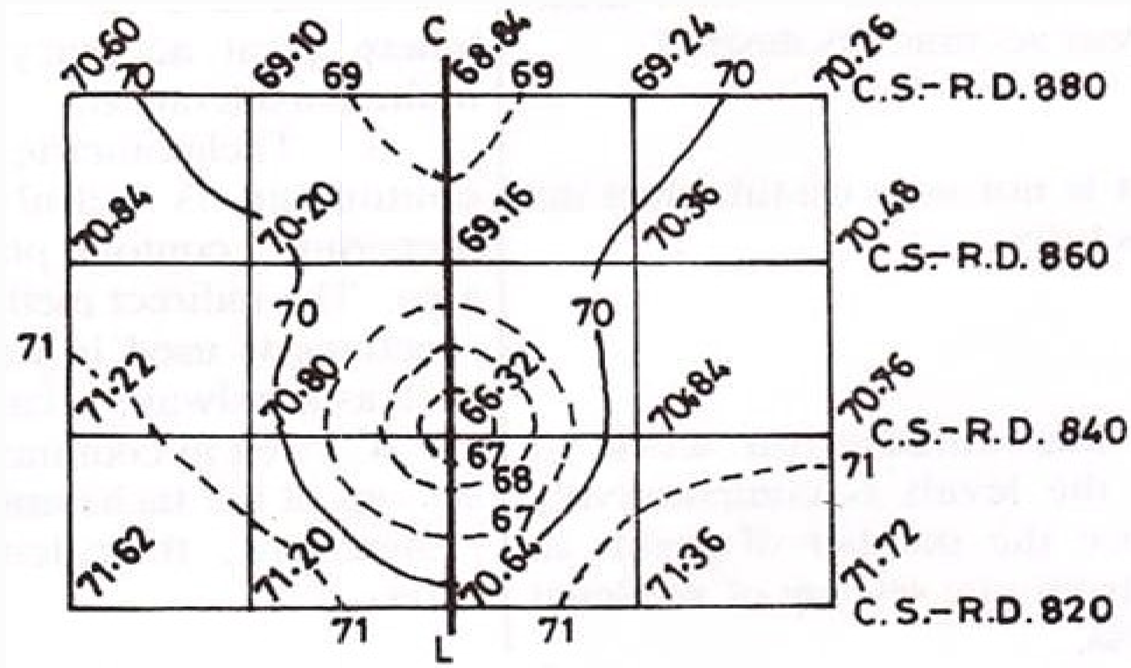

Fig. 8.10

By Tacheometric Method

- 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.
- 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.

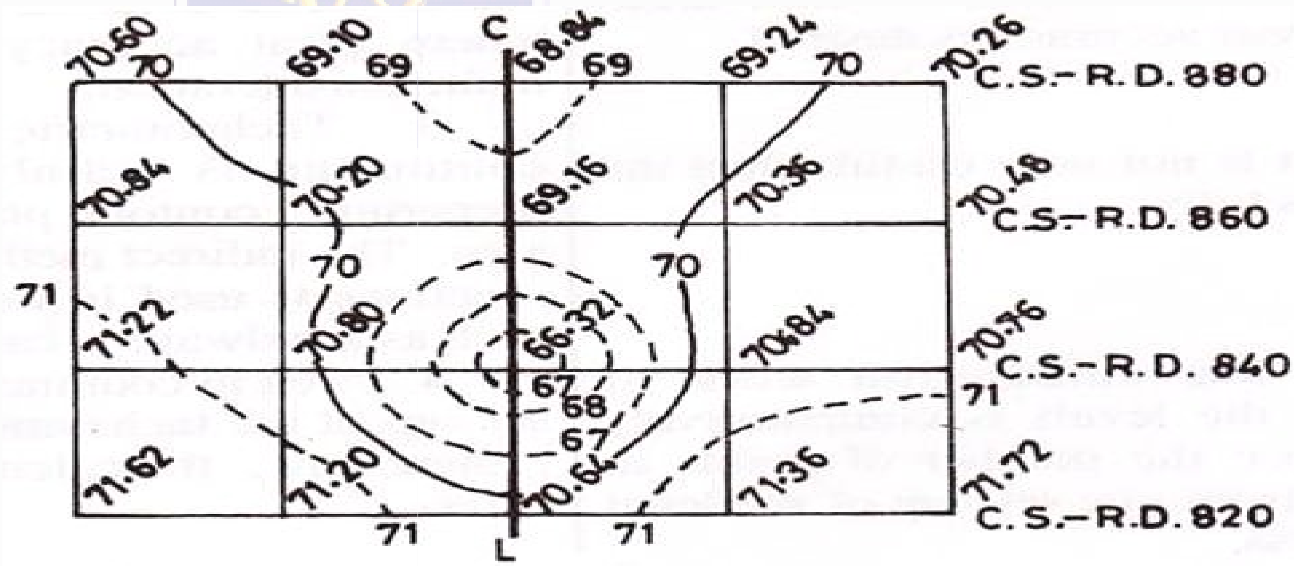

Fig. 8.10

METHODS OF CONTOUR

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

Direct Method:

I. The method is most accurate but is very slow and tedious.

II. It is used for small areas where great accuracy is desired.

III. It is not very useful when the around is hilly.

IV. 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:

I. The method is not very accurate but is cheaper, quicker and less laborious.

II. It is used for large areas where great accuracy is not the main consideration.

III. 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.

IV. Area in command from one set -up of the tacheometer is more, therefore, the calculation work is less.

INTERPOLATION OF CONTOURS

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.

The contours are interpolated as under:

- Suppose A and B are two points at a distance of 30m and the reduced levels A and B are 24.32m and 26.90m respectively. Taking the contour interval as 1m, 25 and 26m contours may be interpolated in between A and B. The difference of level between A and B is 2.58m. The difference of level between A and 25 and A and 26m contours is 0.68m and 1,68m respectively.

- Therefore the horizontal distance between A and 25 m contour =(0.68/2.58)*30and that between A and 26 m contour =(1.68/2.58)*30

- These distances are then plotted to scale on the map.

INTERPOLATION OF CONTOURS

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

Out of several graphical methods, the one in common use is explained below:

- Suppose the contour interval is 5m , then on a piece of tracing cloth, a number of parallel lines spaced at 0.5 m (usually one tenth of the contour interval) are drawn, every tenth line being made thick (Fig. 8.11). Suppose it is required to interpolate contours between two points A and B of elevations 61.5 m and 72.5m respectively.

- If the bottom line represent an elevation of 60m, then the successive thick lines will represent 65m, 70m and 75 m etc. Place the tracing cloth so that the point A is on the third line from the bottom. Now, move the tracing cloth until B is on the fifth line above the 70m thick line.

- The intersections of the thick lines 1 and 2 representing elevations of 65m and 70m and the line AB give the position of the points on the 65m and 70m contours respectively and are pricked through on the plan with a pin.

INTERPOLATION OF CONTOURS

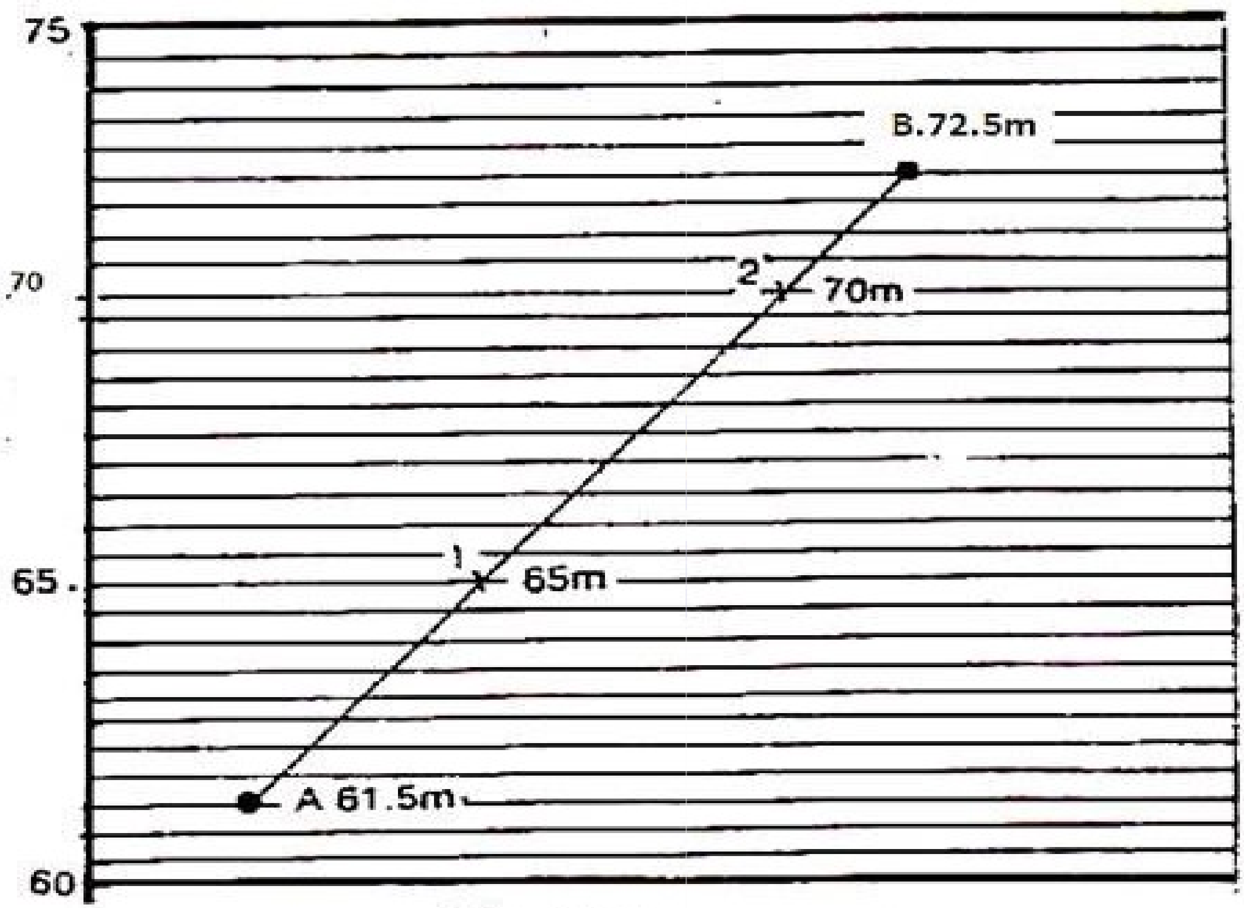

Fig. 8.11

DIFFERENCES BETWEEN DIRECT AND INDIRECT METHOD OF CONTOURING

S No	Direct Method	Indirect Method
1	Very tedious	Not tedious
2	Accurate	Less accurate
3	Slow	Fast
4	Requires more resources	Requires less resources
5	Suitable for contouring of small area.	Suitable for large areas
6	Points are physically located on the ground	Points are interpolated in the office

USE OF CONTOUR MAP

Contour maps are very useful since they provide valuable information about the terrain. Some of the uses are as follows:

I. The nature of the ground and its slope can be estimated

II. Earth work can be estimated for civil engineering projects like road works, railway, canals, dams etc.

III. It is possible to identify suitable site for any project from the contour map of the region.

IV. Inter-visibility of points can be ascertained using contour maps. This is most useful for locating communication towers.

V. To Determine Catchment Area or Drainage Area

The catchment area of a river is determined by using contour map. The watershed line which indicates the drainage basin of a river passes through the ridges and saddles of the terrain around the river. Thus, it is always perpendicular to the contour lines. The catchment area contained between the watershed line and the river outlet is then measured with a planimeter

VI. Storage capacity of a Reservoir

The storage capacity of a reservoir is determined from contour map. The contour line indicating the full reservoir level (F.R.L) is drawn on the contour map. The area enclosed between successive contours are measured by planimeter .The volume of water between F.R.L and the river bed is finally estimated by using either Trapezoidal formula or Prismoidal formula.

Tracing the Contour Gradient for Alignment of Roads, Railways and Canals etc.:

- A contour gradient may be defined as a line joining the points on different contours along the same gradient.
- Fig. 8.17 show a contour map on which the contour lines are at 2m intervals. The ground is sloping in an upward direction from A to B. Supposing it is required to trace the path of a road with a ruling gradient of 1 in 30 from the starting point A on the 80 m contour line Since the contour intervals is 2m and the gradient 1 in 30, the horizontal distance between successive points on consecutive contours is 60m (2 x 30).
- With A as centre and radius equal to 60m draw an arc cutting the 82m contour at 1. With 1 as centre and the same radius, draw an arc intersecting the 84m contour at 2 and so on for successive contours. Join these points which lie on the desired gradient. It may be noted that each of the arcs described will intersect the next contour at two points viz 1 and i, 2 and ii, 3 and iii etc. at 82, 84, 86. metre contour etc. and the points following the desired route such as 1, 2, 3, etc. should be joined.

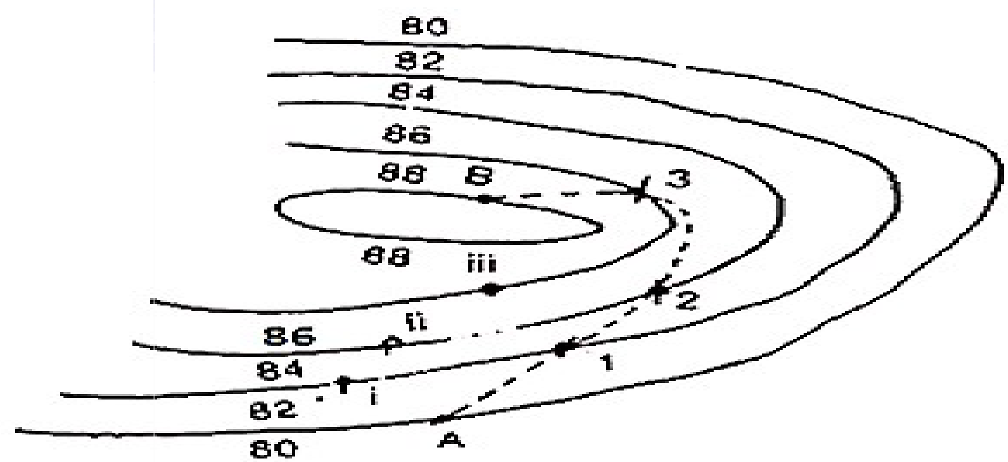

fig 8.17

Finding Volume of Earth and Capacity of a Reservoir from Contour Lines:

- The volume of earth work and capacity of a reservoir may be calculated by treatment of contour lines. This method is only approximate as in dealing with contour lines we have to assume that the surface of the ground slopes uniformly form one contour to the next and in most cases this assumption is incorrect. However sufficient accuracy can be attained if the contours are located with an interval small enough to record mirror features of the ground.

- After preparation of the contoured plan of the particular site , the area enclosed by each contour line is measured by a planimeter, knowing the vertical distance between the first and the second contour lines (the contour interval) and their areas , Volume of earth work or water between them may be calculated wither by trapezoidal formula or by some other formula.

- Let A_1, A_2, A_3 etc. = The areas within successive contour in sq. metres.

- d = the contour interval in metres

- **Then volume of the earth work or water between two adjacent contours:**

$$\text{By trapezoid formula } = \frac{d}{d}(A_1 + A_2)\text{Cu.metres)}$$

$$\text{And more accurately} = \left(\frac{d}{3}\ A_1 + A_2 + \sqrt{A_1}A_2\right)\text{cu. metres}$$

- Similarly cubic contents between successive contours may be found out, which when added together gives the required total cubical contents. This may be well understood by the following example.

THANK YOU