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Surveying: is the art of determining the relative position of distinctive features on the surface of the earth or beneath the surface of the earth by means of measurement of distances, directions and elevations.

### Divisions of surveying

1. Plane surveying  
The surveys in which earth surface is assumed as a plane and the curvature of the earth is ignored.
2. Geodetic surveying  
The surveys in which curvature of the earth is taken into account and higher degree of accuracy in linear as well as angular observations is achieved.

### Classification of surveying

The classification is based on the nature of the field  
Land surveying

1. Topographic surveys  
The survey which are carried out to depict the topograph of the terrain such as mountains, rivers, and other details such as roads, railways, etc.
2. Engineering Surveys  
The surveys which are carried out for determination of quantities to afford sufficient data for designing engineering works such as roads, reservoirs, etc.



3. Cadastral surveys

The survey which are generally plotted to a larger scale than topographical surveys under taken in account produce plane maps for legal purpose.

4. Geographical Information System (GIS)

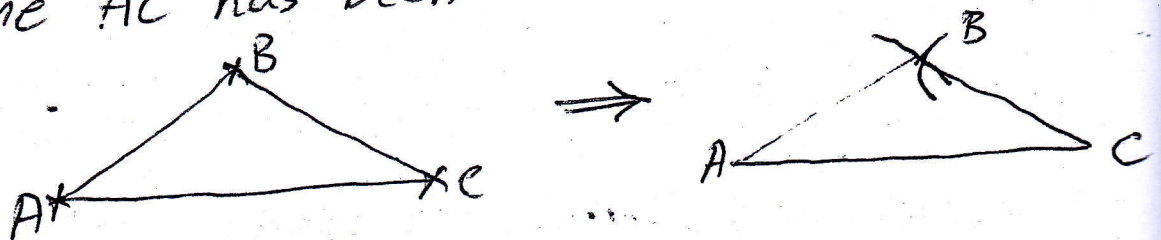
A GIS is information management process for organizing spatially related data so that it can be analyzed and displayed. The data are stored in different "layers" which can be overlaid to access their interrelationships. One of the layer will be a digital map.

Principle of surveying

The fundamental principles upon which different methods of surveying are based as under:

1. Trilateration

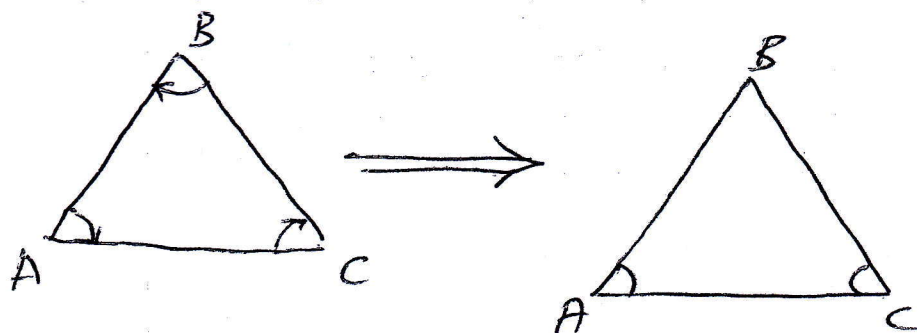
By measuring the distance AB and BC and the location of B may be plotted by drawing the arcs to the same scale to which line AC has been drawn as a base line.



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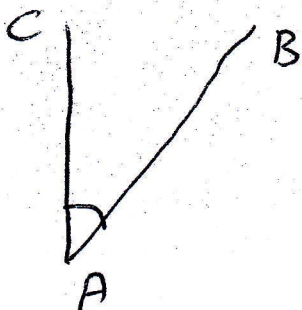
## 2. Triangulation

By measuring the interior angles of the triangle ABC the lengths of the sides AB and BC are calculated by solving the triangle ABC and the coordinate of B are calculated



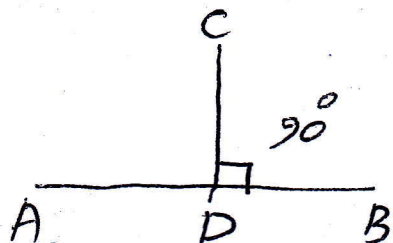
## 3. Traversing

By measuring the distance AB and the angle CAB and used triangle relationship to locate the third point.



## 4. offset

which means line at right angle to base line.





In plane surveying there are primarily two kinds of measurement :-

1. linear measurement

in linear measurement the metric system has been adopted. The units of measurement distances have been recommended as meter and centimeter for the execution surveys.

2. Angular measurement

The popular systems of angular measurement are

a. Sexagesimal system (Degree System)

in this system the circumference of a circle is divided into 360 equal parts each part known as one degree.  $\frac{1}{60^{th}}$  part of degree is called a minute and  $\frac{1}{60^{th}}$  part of minute is called a second.

1 circumference = 360 degrees

1 degree = 60 minutes

1 minute = 60 seconds

ex  $\theta = 87^{\circ} 42' 36''$  (with labels: degree, minute, second)

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## b. Centesimal system (Grad System)

In this system the circumference of a circle is divided into 400 equal parts each part known as one grad. Hundredth part of a grad is known as centigrad and one hundredth part of a centigrad is known as centi-centigrad.

$$1 \text{ circumference} = 400 \text{ grad}$$

$$1 \text{ grad} = 100 \text{ centigrad}$$

$$1 \text{ centigrad} = 100 \text{ centi-centigrad.}$$

## Measurements between two points (Linear measurements)

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### 1. Direct measurements

In this method the distances are actually measured on the surface of the earth by means of tapes, chains, --- etc.

### 2. Computative measurement

In this method distances are determined by calculation as tacheometry --- etc.

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# Equipment for measuring distances

1. Tapes
- cloth tape (width 12-16mm, 10, 15, 20, and 30)
  - Metallic tape
  - Steel tape (10, 15, 20, and 30)
  - Invar tape (width 6mm, 50m)

## 2. Chains

## 3. Ranging rods

There are poles of circular section 2m, 2.5m, 3m long, painted with red and white bands which are usually 0.5m long and tipped with a pointed steel shoe to be driven into the ground.

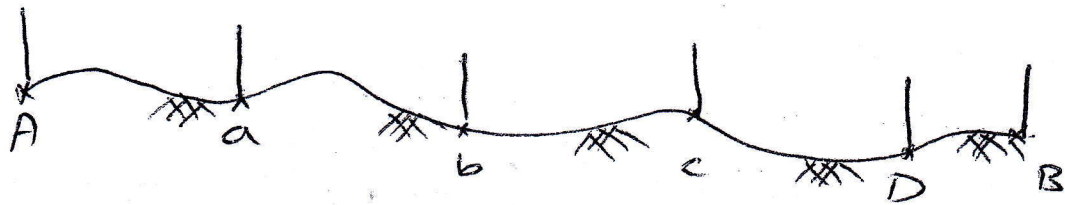
## 4. Pegs and Arrows

They are used to mark the positions of the survey stations.

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## Ranging a line (Ranging way)

This way is used when the distance between two points which are far or the end station is not visible due to undulating ground. The process of this way is by marking a number of intermediate points on a survey line joining two stations in the field so that the length between them may be measured correctly.



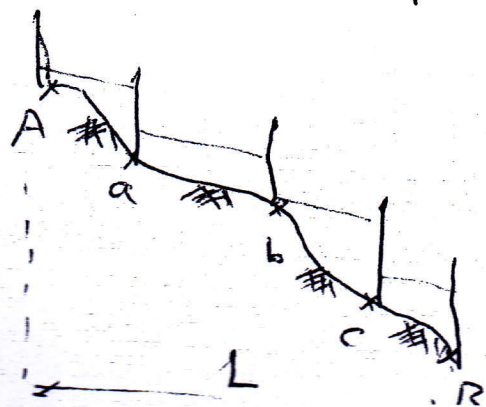
## Measuring line on sloping ground

There are two methods for getting the horizontal distance between two stations on the sloping ground.

### 1. Direct method

In direct method horizontal distance is measured on the ground in short horizontal lengths. Full length of chain or tape is not generally used depending upon the steepness of the slope.

$$L = Aa + ab + bc + cB$$



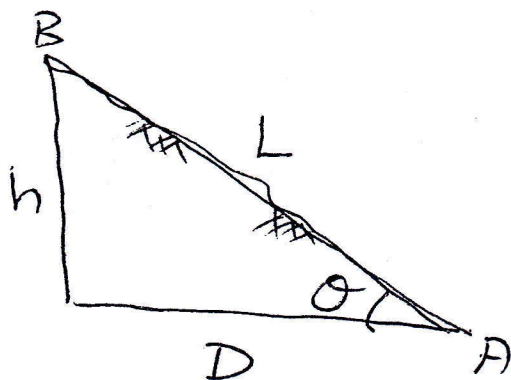


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## 2. Indirect method

By measuring a long the slope and also the angle of slope of the ground.

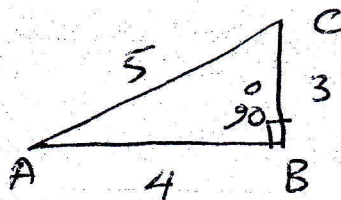
$$D = L \cos \theta$$



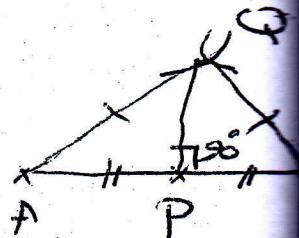
Obstacles during the measurement  
Basic principles of surveying

### 1. Pythagora's theorem (3, 4, 5 rule)

- \* Zero tape at A and measured AB=4m read 4m on B read 7m on C and read 12m on A with the zero. Pull the both part



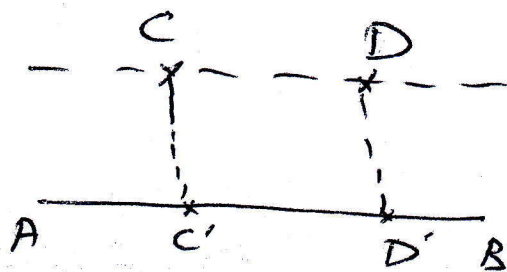
- \* Take A and B on the base line (band) so that PA=PB strike arcs from A and B with equal radii to intersect Q then APQ





2. Let  $AB$  base line and  $C$  the point which is desired to layout a line parallel to given base line.

\* layout perpendicular  $CC'$  from given point  $C$  and measured length  $CC'$  on the line  $AB$  chose point  $D'$  and erect a perpendicular  $D'D$  to  $AB$  equal in length  $CC'$ . The points  $C$  and  $D$  will be a straight line parallel to  $AB$ .



\* measured the distance  $CD$  having obtained the length  $CD$  mark point  $F$ ,  $CF = FD$  now measured  $EF$  and prolong the line  $EF$  to  $G$   $EF = FG$ . Then line  $CG$  parallel to  $AB$ .

