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 survey

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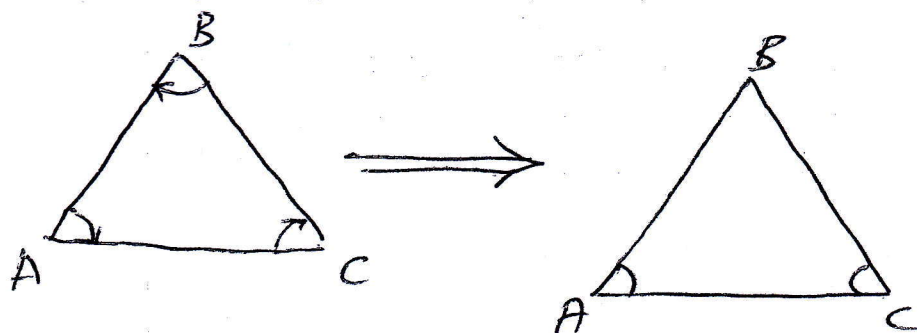
1. Trilateration
By measuring the distance AB and BC and the location of B may be plotted by drawing the arcs to the same scale to which line AC has been drawn as a base line.
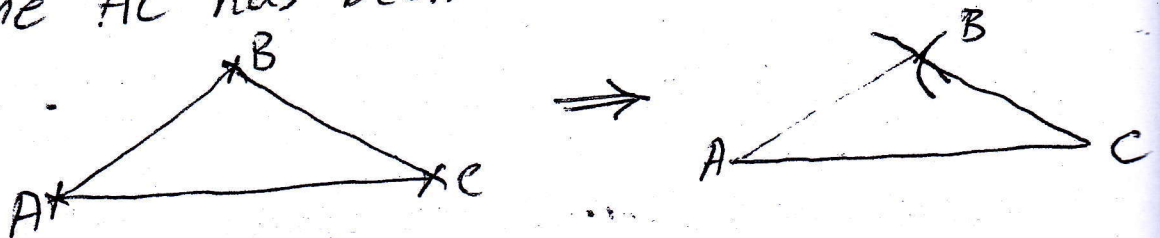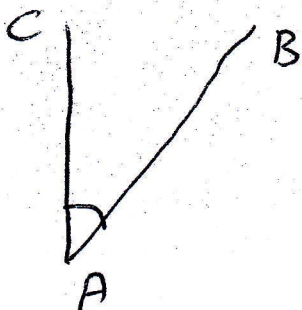
2. Triangulation

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
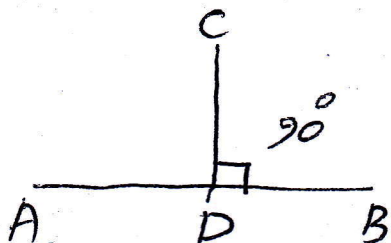
3. Traversing

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 kind of measurement :-

1. linear measurement

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

2. Angular measurement

The popular systems of angular measure are

a. Sexagesimal System (Degree System)

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

1 circumference = 360 degrees
1 degree = 60 minutes
1 minute = 60 second

ex $\theta = 87\overset{degree}{^\circ} \; 42\overset{minute}{'} \; 36\overset{second}{''}$

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 hunderdth 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 measurments)

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.

Equipment for measuring distances

1. Tapes → cloth tape (width 12-16mm
   10, 15, 20, and 30

   → Metallic tape

   → Steel tape (10, 15, 20, an
   len

   → Invar tape (width 6∅ mm
   50m . le

2. Chains

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

4. Pegs and Arrows
   There are used to mark the positions of th
   survey stations.

Ranging a line (Ranging way)

This way is used when the distance between two points which Far or the end station is not visible due undulating ground. The process of this way 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.
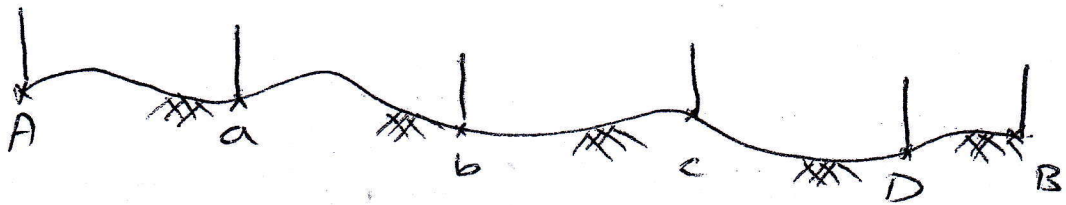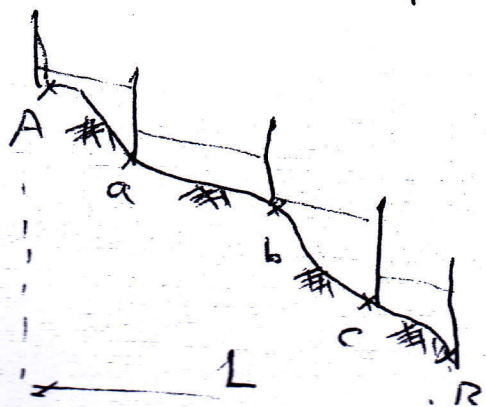

Measuring Line on sloping ground

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

1. Direct method

In direct method horizontal distance are measured on the ground in short horizontal length Full length of chain or tape is not generally used depending upon the steepness of the slope.
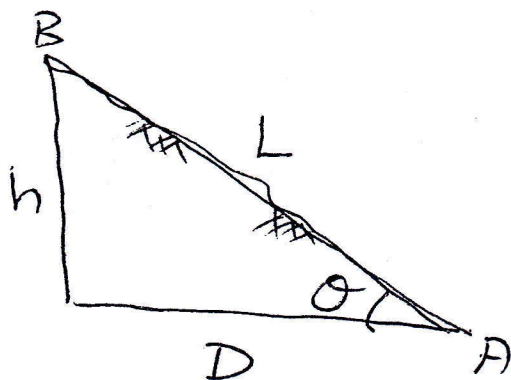
$$L = Aa + ab + bc + cB$$

2. Indirect method

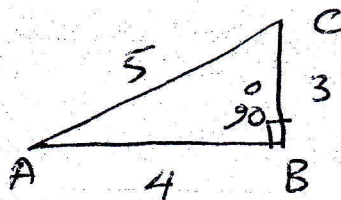By measuring a long the slope and also the angle of slope of the ground.

$$D = L \cos \theta$$

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 bothpart
the tape to C. Then ABC = 90°

* Take A and B on the base line (band) so the
PA=PB stricke arcs from A and B w
equal radii to interesect Q then APQ
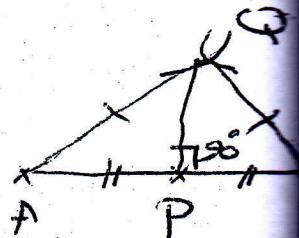
2. Let AB base line and C the point which is
desired to layout a line parallel to given base
line.

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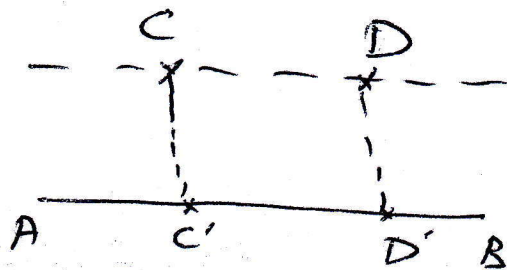
* measured the distance CD having obtained
the length CD mark point F , CF=FD
now measured EF and prolong the line EF
to G   EF=FG. Then line CG parallel to
AB.