GEOGRAPHICAL SURVEY

The following technical terms are generally used in surveying:

1. **Plan.** A plan is the graphical representation of the features on the earth surface or below the earth surface as projected on a horizontal plane. This may not necessarily show its geographical position on the globe. On a plan, horizontal distances and directions are generally shown.

2. **Map.** The representation of the earth surface on a small scale, is called a *map*. The map must show its geographical position on the globe. On a map the topography of the terrain, is illustrated generally by contours, hachures and spot levels.

3. **Topographical map.** The maps which are on sufficiently large scale to enable the individual features shown on the map to be identified on the ground by their shapes and positions, are called *topographical maps.*

4. **Geographical maps.** The maps which are on such a small scale that the features shown on the map are suitably generalized and the map gives a picture of the country as a whole and not a strict representation of its individual features, are called *Geographical maps.*

PRINCIPLE OF SURVEYING

The fundamental principles upon which different methods of surveying are based, are very simple. These are stated as under:

1. **Working from the whole to the part.** The main principle of surveying whether plane or geodetic is to work from the whole to the part. To achieve this in actual practice, a sufficient number of primary control points, are established with higher precision in and around the area to be detail-surveyed. Minor control points in between the primary control points, are then established with less precise method. Further details are surveyed with the help of these minor control points by adopting any one of the survey methods. The main idea of working from the whole to the part is to prevent accumulation of errors and to localize minor errors within the frame work of the control points. On the other hand, if survey is carried out from the part to the whole, the errors would expand to greater magnitudes and the scale of the survey will be distorted beyond control. In general practice the area is divided into a number of large triangles and the positions of their vertices are surveyed with greater accuracy, using advanced instruments. These triangles are further divided into smaller triangles and their vertices are surveyed with lesser accuracy.

2. Location of a point by measurement from two control points.

The control points are selected in the area and the distance between them, is measured accurately. The line is then plotted to a convenient scale on a drawing sheet. In case, the control points are coordinated, their locations may be plotted with the system of coordinates, *i.e.*, Cartesian or spherical. The location of the required point may then be plotted by making two measurements from the given control points as explained below.

Let *P* and *Q* be two given control points. Any other point, say, *R* can be located with reference to these points, by any one of the following methods (Fig.1.2).

(*a*) *By measuring the distances PR and QR.* The distances *PR* and *QR* may be measured and the location of *R* may be plotted by drawing arcs to the same scale to which line *PQ* has been drawn [Fig.1.2 (*a*)].

(*b*) *By Dropping a perpendicular from R on PQ.* A perpendicular *RT* may be dropped on the line *PQ*. Distances *PT*, *TQ* and *RT* are measured and the location of *R* may be plotted by drawing the perpendicular *RT* to the same scale to which line *PQ* has been drawn [Fig. 1.2 (*b*)]. Principles (*a*) and (*b*) are generally used in the method of 'Chain surveying

(*c*) *By measuring the distance QR and the angle PQR.* The distance *QR* and the angle *PQR* equal to ⟨ are measured and the location of *R* may be plotted either by means of a protractor or trigonometrically [Fig.1.2 (*c*)]. This principle is used in the method of '*Theodolite Traversing'.*

(*d*) *By measuring the interior angles of the triangle PQR*. The interior angles *P*, *Q* and *R* of the triangle *PQR* are measured with an angle measuring instrument such as theodolites. The lengths of the sides *PR* and *QR* are calculated by solving the triangle *PQR* and the coordinates of *R* are calculated in the same terms as those of *P* and *Q*. Even without calculating the coordinates, or sides the location of *R* can be obtained by plotting the angles *PQR* and *QPR* [Fig. 1.2 (*d*)]. This principle is used in the method of 'Triangulation'.

(*e*) *By measuring the sides of the triangle PQR.* The interior angles *P*, *Q* and *R* are calculated from the measured sides of the triangle *PQR* by applying cosine rule. This principle is used in the method of Trilateration.

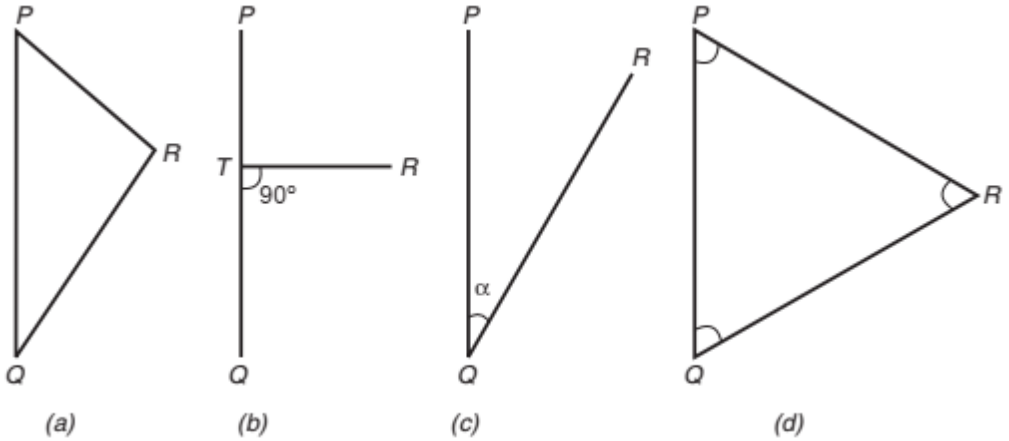


Fig.1.2. Location of a point.

UNITS OF MEASUREMENTS

There are two kinds of measurements used in plane surveying;
1. Linear measure, *i.e.*, horizontal or vertical **distances.**
2. Angular measure, *i.e.*, horizontal or vertical **angles.**

1. Linear Measures.

The units of measurement of distances, have been recommended as meter and centimeter for the execution of surveys.

(a) Basic units of length in metric system:

10 millimeters= 1 centimeter
10 centimeters = 1 decimeter
10 decimeters = 1 meter
10 meters = 1 decameter
10 decameters = 1 hectometer
10 hectometers = 1 kilometer

(b) Basic units of area in metric system:

100 sq. meters = 1 are
2500 sq. meters = 1 *don*
10000 sq. meters = 1 hecta
4 don=1 hecta

(c) Basic units of volume in metric system:

1000 cub. millimeters = 1 cub. centimeter
1000 cub. centimeters = 1 cub. decimeter
1000 cub. decimeters = 1 cub. meter.

Before 1956, F.P.S. (Foot, pound, second) system was used for the measurement of lenghts, areas and volumes. These units which are known as British units, are:

(a) Basic units of length in F.P.S. System:

12 inches = 1 foot 3 feet = 1 *yard*

(*b*) *Basic units of area in F.P.S. System:*

144 sq. inch = 1sq. foot

Conversion Factors for Lengths

(Metres, yards, feet and inches)

Metres	*Yards*	*Feet*	*Inches*
1	1.0936	3.2808	39.37
0.9144	1	3	36
0.3048	0.3333	1	12
0.0254	0.0278	0.0833	1

Conversion Factors for Areas

(Sq. metres, sq. yards, sq. feet and sq. inches)

Sq. metres	*Sq. yards*	*Sq. feet*	*Sq. inches*
1	1.196	10.7639	1550
0.8361	1	9	1296
0.0929	0.1111	1	144
0.00065	0.00077	0.0069	1

Conversion Factors for Areas

(Ares, acres and sq. yards)

Ares	*Acres*	*Sq. metres*	*Sq. yards*
1	0.0247	100	119.6
40.469	1	4046.9	4840
0.01	0.000247	1	1.196
0.0084	0.00021	0.8361	1

Conversion Factors for Volumes

(Cub. metres, cub. yards, gallons)

Cub. metres	*Cub. yards*	*Gallons (Imps)*
1	1.308	219.969
0.7645	1	168.178
0.00455	0.00595	1

2. **Angular Measures.** An angle may be defined as the difference in directions of two intersecting lines, or it is the inclination of two straight lines. The unit of a plan angle is ‘radian’. Radian is defined as the measure of the angle between two radius of a circle which contain an arc equal to the radius of the circle [Fig. 1.3].

The popular systems of angular measurements, are:

(*i*) *Sexagesimal System of Angular Measurements* In this system the circumference of a circle,

is divided into 360 equal parts, each part is known as *one degree.* 1/60th part of a degree is called *a minute* and 1/60th part of a minute, is called a *second. i.e.*
1circumference = 360 degrees of arc

1° = 60 minutes of arc

1 minute = 60 seconds of arc

(*ii*) *Centesimal System of Angular Measurements* In this system, the circumference of a circle,

is divided into 400 equal parts, each part is known as *one grad.* One hundredth part of a grad is known *as centigrad* and one hundredth part of a centigrad is known as *centi-centigrad i.e.*,

1 circumference = 400 grads

1 gard = 100 centigrads

1 centigrad = 100 centi−centigrads.

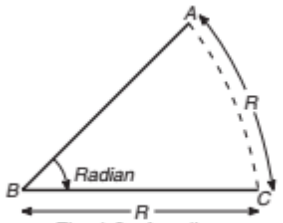


Fig. 1.3. A radian.

1- Unit of length

1km = 1000 m
1m = 10 dec
1dec = 10 cm

1yard = 3ft
1ft = 12 inch
1inch = 2.54 cm

1mile = 5280 ft
1mile = 1.6093 km
1ft = 0.3048 m

2- Unit of area

1 KM^2 = 100 hectar

100 hectar = 400 dounm

1dounm = 2500 m^2

1olk = 100 m^2

3- Unit of volume

$1\ cm^3 = 1000\ mm^3$

$1\ cm^3 = 1000\ dec^3$

$1\ dec^3 = 1000\ cm^3$

1 letter = $1000\ cm^3$

$1\ yard^3 = 0.7645\ m^3$

$1\ ft^3 = 0.02831\ m^3$

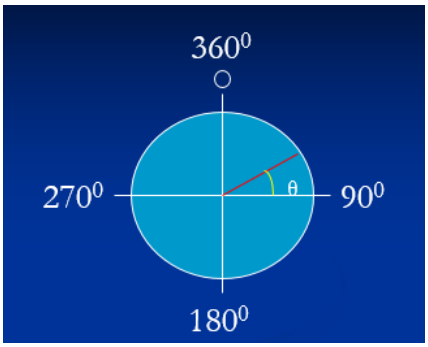
4- Unit of the angle

A) Degree system: -

circle perimeter = 360^0 degree

1^0 degree =$60'$ minutes

1^0 minutes = $60''$ seconds

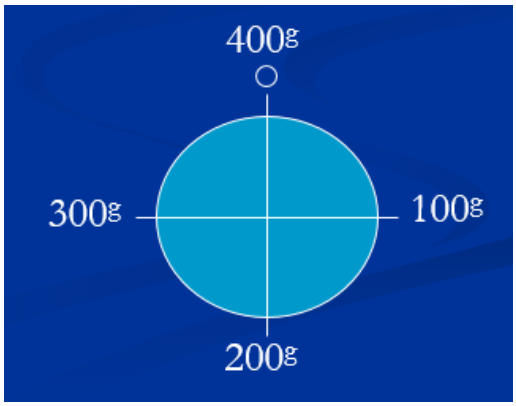


B) Grade system

circle perimeter =400^g

1^g grade =100^c centigrade

100^ccentigrade =100^{cc} cent centigrade



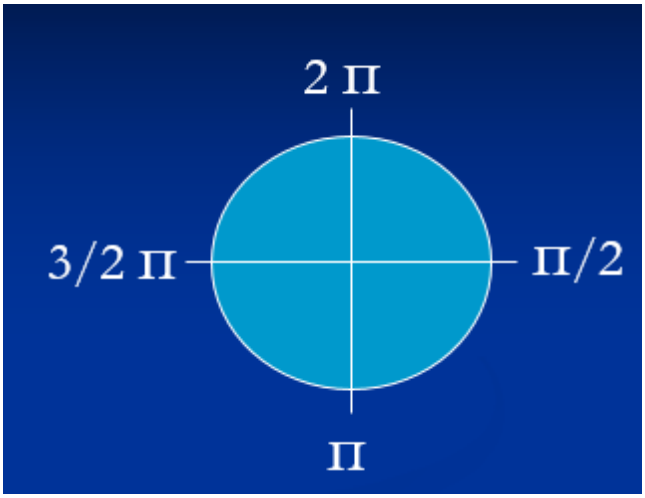
C- Radian system: -

It’s the central angle which is the arch length to the radian

Θ = L/R= Radian

R.A(right angle) = π/2

π = 3.14



Example (1): -

Convert the angles $42^{\circ}\ 26'\ 30'$, $72^{g}\ 62^{c}\ 35^{cc}$ to the radian system.

Ans:-

$42^{\circ}\ 26\ '30'' = (42^{\circ} + 26/60 + 30/60*60) * \pi/1800 = 0.74$

$72^{g}\ 62^{c}\ 35^{cc} = \{(72 + 62/100 + 35/100*100) * 3600/400\} *\pi/1800=1.14R$

H.W

Convert the angle $142^{\circ}\ 22'\ 14.5''$ to the grade system.