UNIT - I

Surveying :—

Surveying is the science and art of determining the relative positions of various points above, on (or) below the surface of the Earth.

The Relative positions are determined by measuring Horizantal distances, vertical distances (elevations), Horizantal Angles and vertical angles accurately using various surveying Instruments.

Objectives of surveying :—

1. To take measurments to determine the relative positions of the existing features on or near the ground.
2. To layout or to mark the positions of the proposed structure on the ground.
3. To determine areas, volumes and other related quantities.

History of surveying :—

* The Babylonians practised some type of surveying as early as 2500 BC.
* Surveying in some form was used in India & Egypt to divide the land for Taxation purposes even 1400 B.C.
* Surveying methods were used to control points in the Nile valley civilization.

Surveying is thus primarily divided into two types :

1. plane Surveying
2. Geodetic surveying.

Plane Surveying :—

It is the type of surveying in which the curvature of the earth is neglected and it is assumed to be flat surface. All distance and Horizantal Angles are assumed to be projected onto a Horizantal plane.

Plane surveying can safely be used when one is concerned with a small portions of the Earths surface and the areas involved are less than 250 Sq. Km. In plane surveying, the angles of polygons and Triangles are considered as plane angles.

Geodatic surveying :—

In this type of surveying in which the curvature of Earth is taken into consideration. and a very high standard of accuracy is maintained. the main objective of geodatic surveying is to determine the precise location of a system of widely spaced points on the surface of the Earth.

The Geodatic surveying are used to calculate the Spherical Δ^{le} using Spherical Trignometry.

Main differences between plane surveying & Geodatic surveying:

Plane Surveying	Geodatic Surveying
→ It is useful for relatively small areas	→ It is useful for only large areas
→ A curved line on the earth surface is considered as a straight line	→ The surface of the Earth is considered as curved.

Classification of Survey :—

Based on Purpose :—

1. Engineering survey
2. Geological survey
3. Defence survey
4. Geographical survey
5. Mine survey
6. Route survey
7. Archeological survey.

Based on Place :—

1. Land survey
2. Topographical survey
3. Cadastral survey
4. City survey
5. Hydrological survey
6. Areal survey.

Engineering survey :—

In this survey, generally we are collecting dimensions, area and is it surface site is suitable for our Engineering work.

Geological survey :—

→ In this survey we determine soil strata and formation of Earth layers i.e Fault zone, Fold zone, unconfirm ties.

→ In this we also determine the Economical minerals & oils

Defence survey :—

It is very important and critical Application. They provide strategic information that conducting in the situation of war and they provide area and Topographical areas of enemy area indicating important routes & also survey provides missile stations & Airport location.

Geographical survey :—

This is conducted to provide a graphical information to prepare maps. The map is may be used to picturise land use efficiency sources and Intensity of Irrigation and surface drianage etc....

Mine survey :—

In this survey both surface and underground investigations are required.

Consists of Topographic survey of mine property and location of particular mine.

Route survey :—

These are undertaken to locate and setout adopted line on ground for a Highway (or) railway to obtain all necessary Features

A sequence of surveys followed

a) Reconnaisance survey
b) Priliminary survey
c) Control survey
d) Locational survey.

Archeological survey :

These are done on earth the relicts of antiquity, civilization kingdoms, towns, villages etc which are collapsed due to earth quakes & other natural calamities.

Land survey :-

In this survey we are identifying old boundary lines of land (or) area (or) city etc..

In this survey we need to determine present Boundary lines & to determine size & shape of land.

Topographical survey :

In this survey we need to determine the earth features like naturally available materials forest areas, river location, coastal region and other required data which is related that survey land

Cadastoal survey :

In this we are generally mark the city and town boundaries and we need to extend the area into villages which are near by town or city.

City survey :-

In this survey generally consists of localitions of various landmarks and clearly marked of road networking system and to establish the relative position to city centres.

Hydrological survey :-

In this survey we determine the water bodies of area which are nothing but surface and subsurface water bodies.

we also determine the depth of water table which also Indicated in map and also determining the location & area of extension also be determined.

Areal survey :-

This is also known as photographical survey

Generally in this survey we are Identifying the location, property and civilization and effective use of land is to be determined.

Plane Surveying	Geodatic Surveying
→ Standard of Accuracy is low as compared to Geodatic	→ Standard of Accuracy is high
→ The directions of plumb lines at various points are assumed to be parallel to one another.	→ The directions of plumb lines at various points are different. Mean sea level is 1er to the direction of gravity.

Classification Based on Instruments Used :—

1. Chain surveying :—

In this surveying the chain is used as a Instrument. Only linear measurments are taken with chain (or) Tape. It is the simplest Way. In this we can't get highly accurate values. Angular measurments are not taken.

2. Compass surveying :—

In compass surveying, the Horizantal Angles are also made in addition to linear measurments with the help of compass. ~~Compass~~ ~~is~~ and measurments with chain (or) Tape. As magnetic compass is not precise angle measuring instrument, this compass survey is not very Accurate. It is better when compared to chain surveying.

3. Levelling :—

Levelling Instrument is used for determination of relative elevations of various points in vertical plane. In this, the vertical line means the direction of gravity Indicated by a plumb bob. The Horizantal direction is direction perpendicular to the gravity.

Levelling is used for finding out the difference in elevations and for finding out the elevations w.r.t some reference plane. It is used for Topographical maps & for the control of elevations during construction.

4. Plane Table Survey :—

In plane table surveys a map is prepared in the field while viewing the terrain after determining the directions of various lines & taking the linear measurments with a chain (or) a Tape.

The accuracy of plane table is low. Its main advantage is that the measurments & plottings are done simultaneously in the field.

5. Theodolite Survey :—

Theodolite is a very precise Instrument for measuring Horizontal & Vertical angles. It can be broadly classified into 2 types : (i) Traverse (ii) Triangulation

* In Traverse various stations form a polygon. The Horizontal angles are measured with a theodolite and linear measurments with Tape.

* In Triangulation, line forms a triangles. The base line is measured accurately & all other lines of lengths are from measured angles. It is used for extensive areas.

* theodolite surveys are quite Accurate.

6. Tacheometric Survey :—

Tacheometer is a special type of theodolite which is Fitted with a Stadia diaphragm having two Horizontal cross hairs in addition to central Horizontal Hair.

In this surveying Horizantal angles, Horizantal distances & Elevations are measured with a Tacheometer. It is not very accurate.

7. Photogrammetric Surveying :—

photogrammetry is the science of taking measurments with the help of photographs. Generally used for Topographic mapping of vast areas. These are extremely useful for obtaining topographical details of areas which are difficult to reach. Its taken from Aeroplane and taken from Ground Based Cameras.

8. EDM Surveys :—

Trilateration is a type of Triangulation in which all the three sides of Each triangle are measured accurately with EDM instruments. The angles are computed indirectly from the knowledge of Triangles. EDM instrumnents are modern and they gradually replacing the later for control Surveys.

Principles of surveying :—

Always work from the whole to part :—

The First principle of surveying is to work from the whole to the part. The Surveyor should first establish accurately a large main framework consisting of widely spaced control points. Between the large main Frame work subsidiary small frameworks can be Established by relatively less accurate. The Errors in small Frame works are thus localised and are not magnified and the accumulation of errors is controlled.

Always choose the method of survey that is most suitable for the purpose :—

The cost of surveying increases rapidly if we want highly accurature values because high accuracy requires very costly precise Instruments.

Always choose the method of survey so that the desired accuracy is acheived at a minimum cost.

Always make provisions of Adequate checks :—

There is always a possibility of making Errors while taking the measurment, Recording the observations, computing and plotting the results. The survey should be conducted so that the Errors don't pass undetected. There should be a suitable provision of checks. It can be done by suitable Method. checks may be of 2 types. :

1 We must check in field itself

2. We check the data which collected the field from Formulae & Techniques.

Always Record Field data carefully :—

All the measurments taken in a proper field book. The Field book must be in proper way with tables & diagrams. The record must be in standard form & clearly written. Always use 3H (or) 4H pencil so that a permanent impression is left on the paper. The Field record should be accurate, legible, clear, True & properly arranged

Errors in Surveying :—

There are mainly 2 types of Errors due to :

1. Shrinkage of a map
2. Measuring of a Scale

Shrinkage of a map :—

The drawing paper generally shrinks due to variation in the atmospheric temperature, Humidity etc... consequently; all the lines marked on the map shrink to some Extent. Thus the lengths measured from the map after shrinkage of map are not the correct distances.

If the map has shrunk, the actual distance would be more than the corresponding measured distance from the map.

The ratio of the shrunk length to the actual length is known as shrinkage ratio (or) shrinkage Factor.

It is always less than unity

Some Formulae :

$$\text{Shrunk scale} = \text{Original scale} * \text{Shrinkage Factor}$$

$$\text{Shrunk R.F} = \text{Original R.F} * \text{Shrinkage R.F}$$

$$\text{Corrected Distance} = \frac{\text{Measured Distance}}{\text{Shrinkage Factor}}$$

$$\text{Corrected Area} = \frac{\text{Measured Area}}{(\text{Shrinkage Factor})^2}$$

Related Example Problems :—

1. The plan of an Area has shrunk that the line originally 10 cm now measures 9.5 cm. If the original scale of plan was 1cm = 10m. (R.F = 1 : 1000) (i) Shrinkage Factor

(ii) Shrunk scale (iii) Correct distance corresponding to a measured distance of 98 m (iv) correct area corresponding to a measured area of $10,000\ m^2$.

Shrinkage factor $= \frac{9.5}{10} = 0.95$

Shrunk R.F $= \frac{1}{1000} \times 0.95 = \frac{1}{1053}$

Given shrunk scale, 1 cm = 10.53 m

Correct Distance $= \frac{98}{0.95} = 103.16m$

Correct Area $= \frac{10000}{(0.95)^2}$

$= 11080.33\ m^2$

2. A Rectangular plot in plan is 10cm x 30cm, draw to a scale of 1cm = 100m. If the same plot is redrawn on a toposheet to a scale of 1cm = 1Km, what would be its area on the toposheet? Determine also R.F in each case?

R.F. of Original plan $= \frac{1}{10,000} = \frac{1}{10^4}$

Actual Area in the Field $= (10 \times 30)(10^4)^2$

$= 3 \times 10^{10}\ cm^2$

R.F of the Toposheet map $= \frac{1}{100,000} = \frac{1}{10^5}$

Area of the Toposheet map $= \frac{3 \times 10^{10}}{(10^5)^2}$

$= 3\ cm^2$ $\left(\because \text{Area} = \frac{\text{Actual Area}}{(R.F)^2}\right)$

Errors due to Wrong Measuring Scale :—

If a wrong measuring scale is used to measure the length of a line already drawn on the plan, the measured length will not be correct.

$$\text{Corrected length} = \frac{\text{R.F of wrong scale}}{\text{R.F of corrected scale}} \times \text{Measured length}$$

As Area is product of two distances,

$$\text{Corrected Area} = \left[\frac{\text{R.F of wrong scale}}{\text{R.F of correct scale}}\right]^2 \times \text{measured area}$$

1. (a) A Surveyor measured the distance between two points marked on the plan ~~from~~ drawn to a scale of 1 cm = 1 m (R.F = 1 : 100) and found it to be 50 m. Later he detected that he used a wrong scale of 1 cm = 50 cm. (R.F = 1 : 50) for measurment. Determine correct length.

(b) what would be the correct area if the measured area is 60 m^2

Al-

$$\text{Correct length} = \frac{\text{R.F of wrong scale}}{\text{R.F of correct scale}} \times \text{measured length}$$

$$= \frac{\left(\frac{1}{50}\right)}{\left(\frac{1}{100}\right)} \times 50$$

$$= 100 \text{ m}$$

$$\text{Correct Area} = \left[\frac{\text{R.F of wrong scale}}{\text{R.F of correct scale}}\right]^2 \times \text{measured Area}$$

$$= \left[\frac{\frac{1}{50}}{\frac{1}{100}}\right]^2 \times 60$$

$$= 240 \text{ m}^2$$

Errors classified on source :

1. Instrumental Error
2. Personal Error
3. Natural Error

Instrumental Error :—

Generally these Errors are occured due to defect in Instrument which are controlled by clear observations & Necesary checks.

Personal Error :—

Which are done by carelessness of surveyor (or) Improper to take measurments.

Natural Error :—

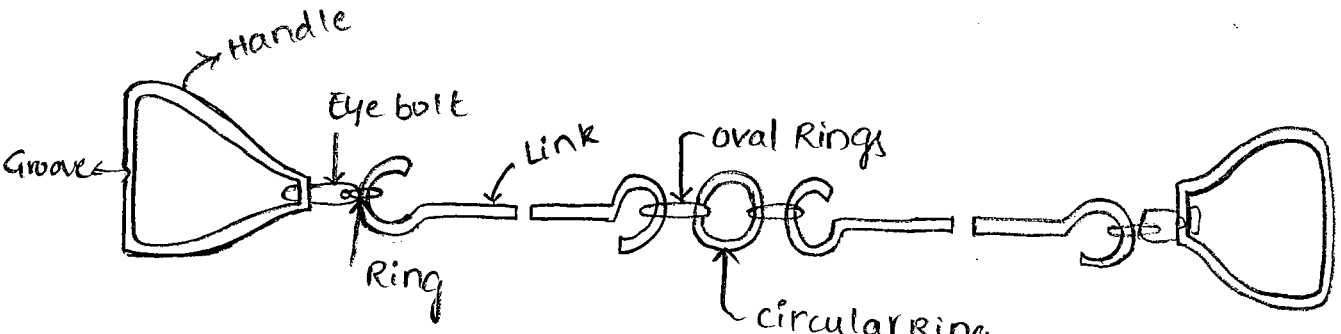
Due to the climatic conditions these Errors are occured.

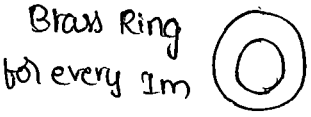
* the terms large scale & small scale are not well defined. The difference between plan & map are rather arbitary.

* When a plan becomes a map the large scale representation of small areas in engineering surveys are called plans Where as small scale represents a large areas are called Map

Overview of chain surveying :—

* Chain surveying is a branch of surveying used to measure the linear distances with a chain (or) Tape.
* This surveying is not very accurate.
* The links in a chain are prepared by Galvanised mild steel wire of 4mm diameter.
* These links consists of three rings there are two oval shape & central ring is circular.





There are 2 types of chains :

1. Metric chain
2. Non Metric chain

Metric chain :—

* Generally metric chain is available in 20 m & 30 m
* 20 m chain has 100 links, Each link having a length of 20 cm
* 30 m chain has 150 links, each link having a length of 20 cm
* Chain provided with Talleys
* In 20 m chain the talley appears at Every 2 m
* In 30 m chain the talley appears at every 5 m
* A Brass ring also provided for every 1 m

Non Metric chain :—

* Generally Gunter chain, Engineers chains, Revenue chains comes under this
* The length measured in this type of chain is in Feets
* Gunters chains having a length of 66 feet and it consists of 100 links, each link having 0.66 Feet length
* Engineers chain consists of 100 links and each link in 1 feet
* Length of Engineers chain is 100 feet* It is also known as Surveyors chain.

Overview of plane Table Surveying :—

Generally, Size of the board is 0.75m x 0.6m

Thickness of the board is 20 mm

~~Depending upon~~

→ we use this plane table method to determine the area (or) plotting in field itself. & It is the main Feature

Depending upon the methods of Fixing the boards, levelling of table & rotating in Horizantal plane.

1. Simple plane Table
2. Johnson plane Table
3. Coast Survey plane Table

* Generally we use simple plane Table

Alidade :—

It is a Straight Edge ruler having some sighting device.

It is of two types :

Plain Alidade → 450 mm long

Telescopic Alidade → 380 mm x 65 mm

Principle of plane Table surveying :—

→ The plane table is levelled and centred over the ground station o.

→ the point 'o' representing the station occupied by the plane is marked on the drawing sheet with the help of plumbing fork.

→ The Alidade is kept on the drawing sheet with zero mark of Fiducial edge set on point 'o'.

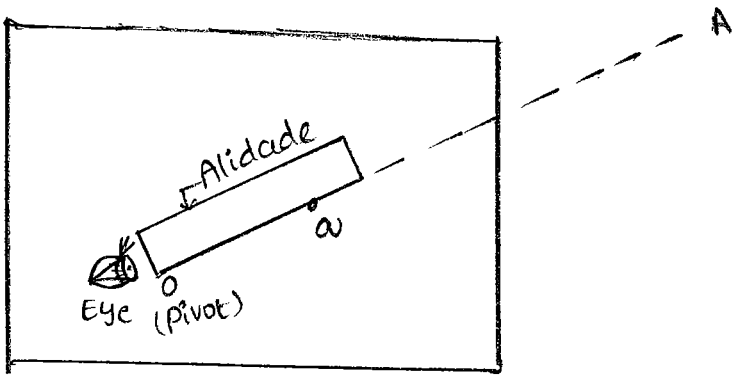
→ The point 'o' is called pivotin of Alidade.

→ With the Alidade pivoted on point 'o'. the Alidade is rotated so that straight line of sight passes through Object 'A'.

→ The line is drawn along on the paper along Fudicial Edge of Alidade.

→ The line represents the direction of station 'o' to 'A'. The distance measured in plane with Tape (or) chain from 'o' to 'A'

→ the measured distance is plotted to scale as 'o' along the line already drawn on the paper



FO Basic Defination → Refer class Notes →

Advantages of plane Table survey :—

* plane table survey is quite suitable for plotting small scale maps directly in the Field
* Errors in measurments and plotting can be easily detected in the field by taking suitable check lines.
* The plane table can be used even in magnetically disturbed area where the compass survey is not possible.
* It is less costly than most other types
* As instruments are simple, not much skill is required.

Disadvantages of plane Table Survey :—

* It is not possible in Wet climates
* It is not accurate
* As no field data are taken it becomes difficult to plot
* The time spent in the field is much more as compared to other types
* It can be used in relatively open country where the stations can be easily sighted.

Centring :—

This is the process of setting of the plane table such that plotted point 'o' corresponding to ground station Zero is exactly over the station. The plumbing Fork is used for checking the centring The centring is completed when the pointed of the Fork is at the plotted point 'o' & plumb bob is just above ground station.

Orientation :—

This is the process of aligning the plane table by rotating it in the Horizantal plane such that all plotted lines are parallel to corresponding lines on the ground. This is done by using a compass.

Back sight :—

It is a sight taken from a plane table station to another station whose position has already been plotted on a drawing pad. For taking a back sight to station when the plane table is centred over a station 'A', the alidate is placed along the plotted line $\overline{AB}$. The plane table is rotated until the station is bisecting.

Fore sight :—

It is a sight take from a plane table station to another station whose position hadn't already been plotted on a drawing pad. It is taken to locate the position of Forward station.

Radiation :—

This is a method of locating the point by drawing a Radial line from the plane table station to the point. For locating a point by radiation to plane table is set up & Oriented

then a ray is drawn in the direction of that point using the Alidate as Explain in Theory. A length equal to distance of that point to a suitable scale is correct to locate the point.

Intersection :—

This is a method of locating a point by the intersection of 2 rays drawn from 2 different stations. The method of Intersection is suitable when it is difficult to measure the radial distance of the unknown point due to some obstruction & the radiation method cannot be used.

Resection :—

This is a method of locating the station occupied by the plane table when the position of that station hadn't been previously plotted from other stations.

It is done by sighting to any 2 points whose positions had been previously plotted in a 2 point problem. It is also done by sighting on any 3 points whose positions had been previously plotted in 3 point problem.