



SSC JE & State AE Exams

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18 Oct

Surveying

- surveying is a process of establishing the relative positions of various points on, above or below the surface of Earth.
- The points can be located by Direct or Indirect measurement. and wot point, the distance, Direction and elevation can also be Reported.

Note: Earth is an oblate spheroid which is obtained by Rotating the ellipse about its axis.

2. The Equatorial Diameter (D_E) is 42.95 km more than Polar Diameter.

$$D_E = 42.95 \text{ km} + D_P$$

Radius of Equator = $R_e = 6378.13 \text{ km}$

Radius of Polar axis = $R_p = 6356.75 \text{ km}$

- on the basis of the Curvature of the Earth surveying is classified as:-

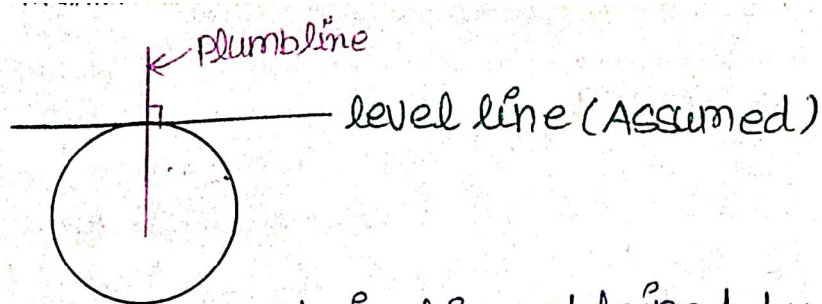
(a) Plane surveying (b) Geodetic surveying

(a) Plane surveying:- In this type of survey, the curvature of Earth is not considered and the Average surface is Assumed planar.

- This type of surveying is generally suitable where the area of work is considerably less.

Generally for area $< 250 \text{ km}^2$ this surveying is preferred.

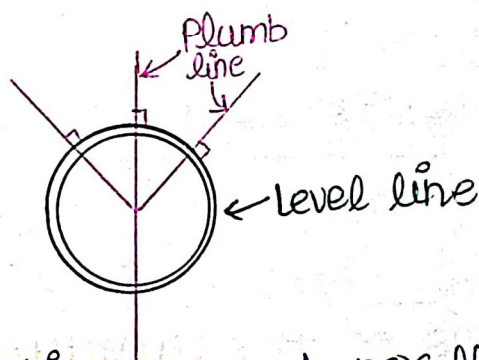
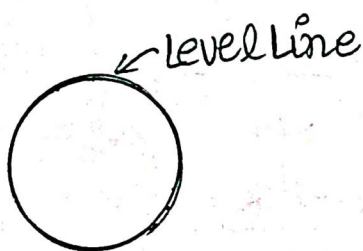
- In this surveying all the lines are considered as plane lines. and triangles are considered as plane Triangles.
- In case of plane surveying, the level lines are considered straight and Plumb lines are parallel to each other.



Plumb line:- It is obtained by freely suspension of plumb bob which marks direction of gravity and passes through centre.

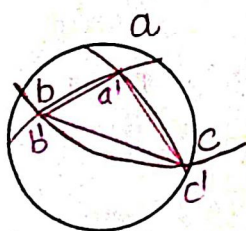
Level line:- It is perpendicular to plumb line and follows the curvature of earth.

In actual if curvature of earth is considered.



It can be seen that Plumb lines are not parallel to each other.

abc is spherical Triangle
 $a'b'c'$ is plane Triangle.



(b) Geodetic surveying:-

- In this type of surveying, the curvature of earth and Actual shape of earth is taken in to consideration.

- All the lines are curved lines and all the Triangles are spherical triangle.

* It is generally adopted for large areas ($\geq 250 \text{ km}^2$) where measurement requires high degree of precision.

- This surveying is done by survey of India department

- by establishing various control points. (Reference points used to mark other points)

Note:- ① Considering any Triangle with area 195 km^2 (approximately), the sum of interior angles is 1 sec ($1''$) more in Geodetic Surveying.

② Considering line of length 12 km , the measurement when done by Geodetic Survey will yield the value 1 cm extra.

★ Types of Surveying:-

① Based on Nature of Surveying:- It is further classified as:-

① Land Surveying:- This indicates features of Land. This includes:-

(i) City Survey:- These surveys are done to carry out various establishment in cities, like Roads, streets, pipe line, Laying of sewers, optical fibres.

(ii) Topographical Survey:- It determines various locations of points by carrying out measurements (Linear, Angular) and determining the topographical features like River, lakes, ponds, Forest, Hills etc.

(iii) Cadastral Survey:-

This survey is carried out to fix the Boundary line of property.

This helps to calculate the total Area before Handing over the property.

② Marine Surveying:-

It deals with Features of water body.

- It is required to carry out various operation like

Navigation, sewage or solid waste Disposal etc.

In this surveying we mark Mean sea level (MSL), calculate discharge, frequency of tides and maximum Reservoir Level.

(C) Astronomical Survey:- It helps to fix the points on the surface of Earth by using celestial body/ Heavenly Bodies/ spatial Bodies.
eg. stars, sun, etc.

(II) Based upon objective of surveying

(a) Mine Surveying:- It is carried out for exploration of new mines.

(b) Geological Surveying:- If objective is to study about formation of Earth, then Geological surveying is carried out.

(c) Engineering Surveying:- This survey is used to collect data regarding various Engineering works and their design. eg Foundation work, Aligning of sewer, Aligning of canal, Capacity of Reservoir etc.

(d) Archaeological Survey:- This survey deals with studying the existence of past civilisation.

(e) Military Survey:- It helps to locate the points which are of strategic importance.

Lec-2
19 Oct 2023

III On the basis of Instrument used

(i) Chain Surveying:- It is the method in which linear measurements are being taken.

The measurement is taken with the help of chain or Tape

- No Angular measurements are being taken and chain surveying is simplest form of surveying.

(ii) Compass Surveying It is the type of survey in which the linear measurement are done by chain/tap and along with it Angular measurements are also taking using Magnetic compass.

- By comparing it with chain surveying, compass surveying is more accurate.

{ However for precise Angular measurement, compass surveying is not preferred }

(iii) Levelling:- In this type of survey the Relative elevations of various points are established by using leveling Instruments.

- The measurements are done in Vertical Plane.

(iv) Plane table Surveying:- In this the observation done on ground or field is plotted simultaneously on plan / map.

(v) Theodolite Surveying:-

- In this type of surveying, Horizontal and Vertical angle are measured with the help of Theodolite.

- Its accuracy is more than compass surveying.

- It is Broadly classified as:-

(a) Traverse Surveying:- Various points are joined to form a Polygon.

(b) Triangulation Surveying:- Various points are joined which forms a system of Well Connected Triangles.

(vi) Tacheometric Surveying:- It is a special type of Theodolite which measures Horizontal Angle, Horizontal Distance, Vertical angle and Vertical distance.

- The Theodolite is fitted with cross hairs.
- Its accuracy is far more than compass surveying but for plane areas it is not very suitable, but it gives better Result in Rough terrain.

(vii) Photogrammetric surveying:- The measurements are taken with the help of photographs.

- It is generally preferred in those areas which are highly inaccessible.
- It also represents the topographical features of large area.
- Photographs can be taken on ground or through air (aerial photography).

(viii) EDM {Electronic Distance Measurement}:-

- In this the linear measurements are taken by using EDM.
- The Distance is calculated by measuring the time of travel of a sound wave.
- The control points established over here forms a triangle.

⊛ Principle of surveying

The principle of surveying are as follows:-

(a) Working from whole to Part:-

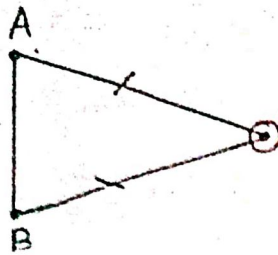
In this principle, the surveying is done by establishing the major control points by using High degree of Accuracy {By using High precise method like geodetic surveying}.

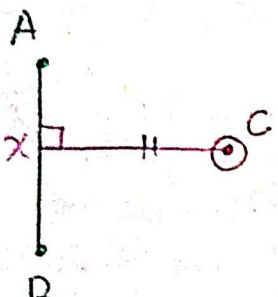
- The minor control points are established by using less precise method. {plane surveying}.
- By doing so, Accumulation of error is avoided.

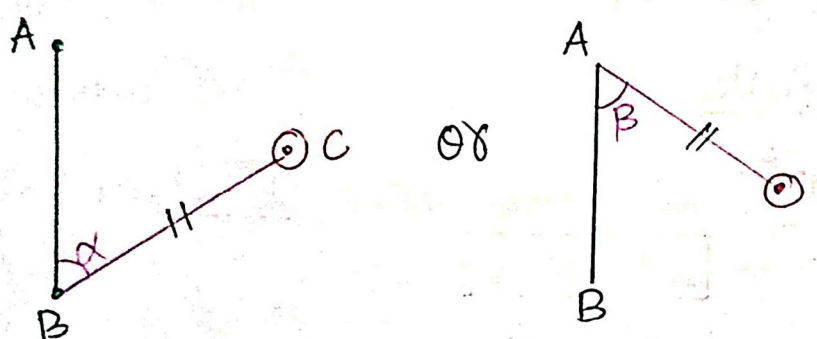
(b) Location of point by measurement from two points

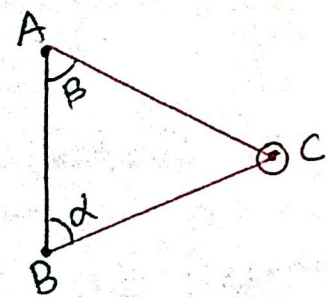
- The Relative position of the point is established by using at least two given Reference points.

- Various method of establishing a point:-

(i)  $\Rightarrow$ To establish point "C" from A and B, AC and BC can be measured by chain/Tape.

(ii)  By measuring CX, which is @ Right angles to AB. (Offset method)

(iii)  or By measuring BC or AC along with α or β respectively.

(iv)  By measuring both angle α and β .

* Plan and Map

- A plan or a map is a graphical Representation to Some Scale which Represents the features lying on, above, or below the surface of earth.

- The above graphical Representation will be termed as map when the scale of choice is small. { small scale gives High Number of observations }

-The Representation will be termed as Plan when scale of choice is large. { large scale will give more detailing }.

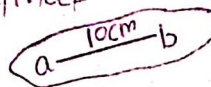
-In case of Map, Vertical and Horizontal distance can also be measured with the help of contours.

Elevation:- Linear Measurement done in Vertical plane.

Distance:- Linear Measurement done in Horizontal plane.

* Scale:-

Plan/Map



$\frac{10\text{cm}}{10\text{km}}$



ground

-Scale is a Ratio which shows a certain Quantity {Distance/Area ---} in plan or map corresponding to same Quantity in ground.

Representation of Scale

(a) Engineer's Scale:- In this scale 1cm on plan or Map represent some x metres on ground. where "x" is a whole number.

eg. $1\text{cm} : 20\text{m}$ or $\frac{1\text{cm}}{20\text{m}}$

(b) Representative fraction:- In this scale, 1 unit on plan represents same unit of Quantity on ground.

eg. $\frac{1\text{cm}}{10,000\text{cm}} = \frac{1}{10,000}$

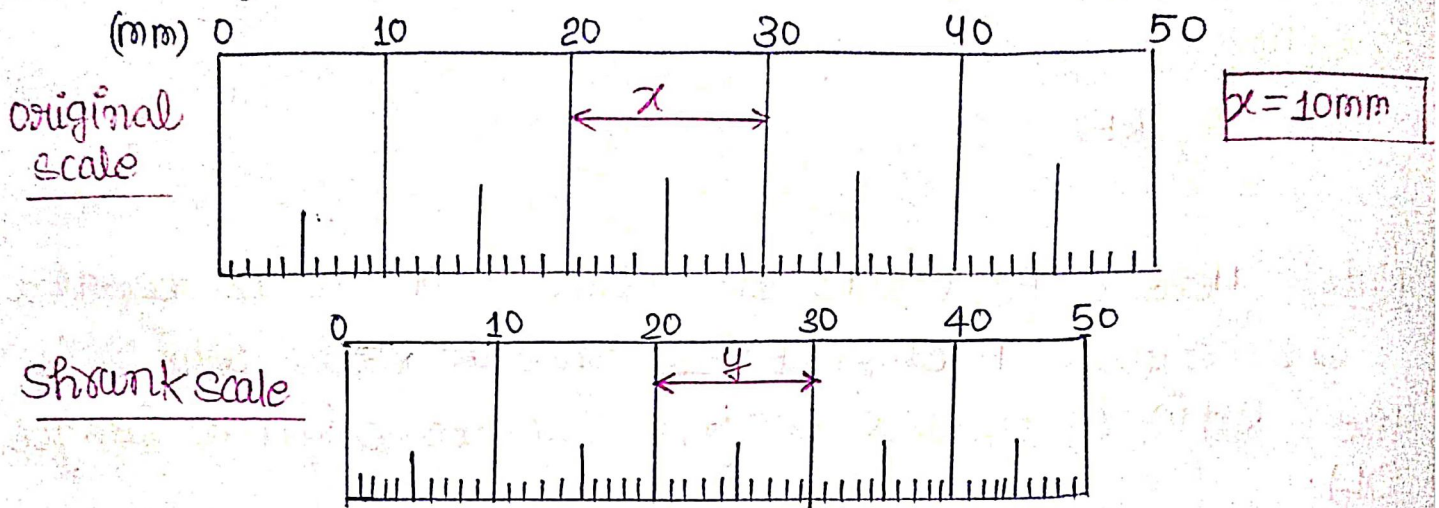
Lec-3
20 Oct 2023

Note:- Engineer's Scale and Representative fraction are termed as Numerical scale.

(c) Graphical Scale:- The paper over which the plan or Map is drawn has got tendency to shrink or expand.

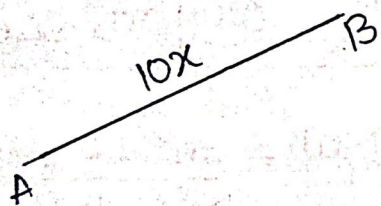
when it is used after many years & Timber is Hygroscopic in Nature?

- Due to this, the actual measurement on ground will have some error if being measured using Numerical scale.
- In such cases, graphical scale is preferred which is drawn over the plan/Map which shrinks or expands in the same proportion.
- Hence, the correct distance on ground can be measured Accurately.



original scale = $x \text{ mm} = 20 \text{ m}$ $x = 10 \text{ mm}$

$10 \text{ mm} = 20 \text{ m}$

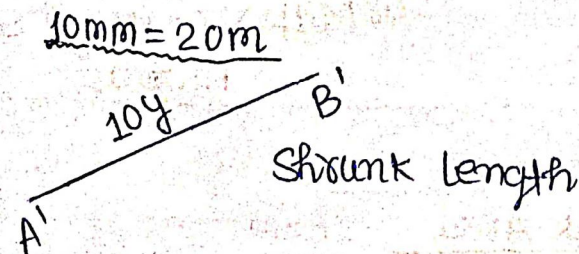


on plan, $AB = 10x = 10 \times 10 = 100 \text{ mm}$

$10 \text{ mm} \rightarrow 20 \text{ m}$

$\therefore 100 \text{ mm on plan} \rightarrow \boxed{\frac{100 \times 20}{10}} = \boxed{200 \text{ m}}$

$\therefore$ correct distance on ground = 200m



$10 \text{ mm} = 20 \text{ m}$

$y = 8 \text{ mm}$

on plan, $10y = 80 \text{ mm}$

$10 \text{ mm} \rightarrow 20 \text{ m}$

$80 \text{ mm} \rightarrow \frac{80 \times 20}{10} = 160 \text{ m}$

$\boxed{\text{on ground} = 160 \text{ m}}$