SURVEYING

3-4 marks GATE

Prelims → 7-8 Marks ESE

Mains → 30-45 Marks ESE

→ Equal importance to all Subjects. (Never judge any subject as major or minor)

1. Fundamentals of Surveying
2. Linear measurement
3. Compass Surveying
4. Theodolite (I don't study)
5. Traversing
6. Levelling
7. Tacheometry
8. Trignometric levelling
9. Photogrametry
10. Theory of error.
11. Curve
12. Field Astronomy (I don't study)
13. Measurement of Area-Volume
14. Contour
15. Plane Table
16. Minor Instrument (I don't study)

1. Fundamentals of Surveying

→ Surveying is a art of determining relative position of points on, below and above the earth surface, presenting it graphically and numerically.

Objectives of Surveying :-

i) To determine relative position of points
ii) To Layout (or) Markout proposed structure on the ground
iii) To measure relative quantities like Area & Volume

Methods of Presenting measurements :-

i) Numerically : AB = 260 Km (example)
ii) Graphically : A 260Km B

→ Generally Graphical representation is done in the form of

→ Plan $\xrightarrow{\text{on}}$ Large scale
Map $\xrightarrow{\text{on}}$ Small scale

Note :-

→ Vertical distances on the Plan (or) Map can be shown with the help of Contours and Spot levels.
→ Contours are imaginary line joining points of equal elevation on the earth surface.
→ Spot levels are reduced level (or) height of individual points.
→ Contour gives better visualisation of the area.

Basic definitions :-

1. Shape of earth :-

i) Oblate Speriod → Slightly flattend at poles, Polar axis is 43.5 km Smaller than Equitorial axis
ii) Ellipsoid → Equitorial section is slightly elliptical in nature
iii) Ovalloid → Southern Hemisphere is slightly larger than Northern Hemisphere.

→ We can observe that no geometrical shape perfectly defines shape of earth.

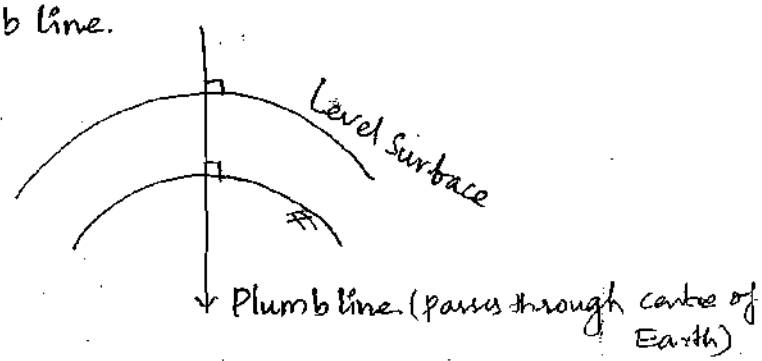
→ Therefore a new name has been given, i.e, "GEOID".

Note :-

→ For the ease in calculation the shape of earth is assumed to be "Spherical".

Level Surface :-

→ Level Surface is a Curved Surface Parallel to Earth surface and every point on it is equidistant from the centre of the Earth, every element on the level Surface is perpendicular to Plumb line.



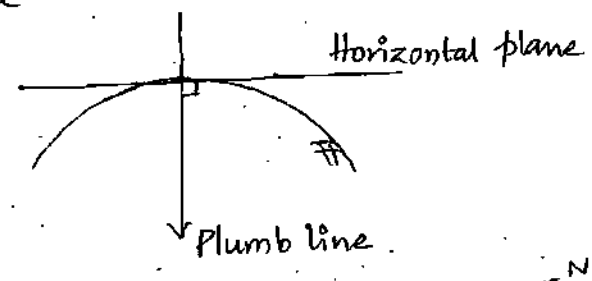
3. Level line :-

→ It is a line in the level surface

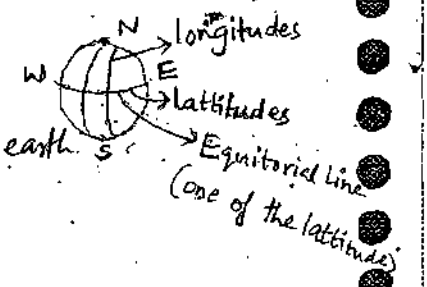
4. Horizontal Plane :-

→ It is a plane tangential to earth surface at any point.

→ It is also ⊥ar to Plumb line



5. Great circle :-



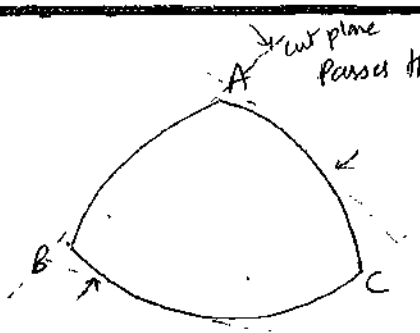
→ It is a imaginary circle passing through centre of the earth.

→ A great circle divides earth into two equal parts

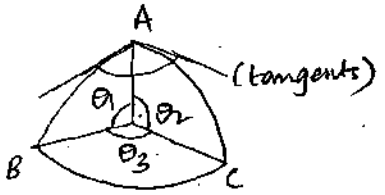
Ex:- Equator and longitude.

Spherical triangle :-

→ A spherical triangle is that triangle which is formed on the surface of a sphere by intersection of three arcs of Great circle.



→ The Arcs enclosing the spherical triangle are called as its sides, and the angles in which these Arcs are intersects are called as "Spherical Angle".



→ Spherical Angle is defined as the angle between tangents to the great circles drawn at the point of intersection. i.e, Angle A_1AA_2

$$\overline{AB} = R\theta_1 \quad (R \rightarrow \text{neglected})$$
$$\overline{AC} = R\theta_2$$
$$\overline{BC} = R\theta_3$$

→ length of a side of a spherical triangle is defined as angle subtended by that side at the centre of the earth

→ <u>Properties of Spherical Triangle</u> :-

→ length of a side of a spherical triangle should be less than equal to 180°.

→ Each angle of a Spherical triangle should be less than 180°.

→ Sum of three spherical sides should be in between 0° to 360°

→ Sum of Spherical angles should be in the range of <u>180° to 540°</u>

<u>Note</u> :-

→ Amount by which sum of the angles of a spherical triangle exceed by 180° is called as "Spherical excess".

→ Surface Area of a Spherical triangle should be less than $2\pi r^2$, where r → radius of the Earth

Half of $\frac{4\pi r^2}{2}$

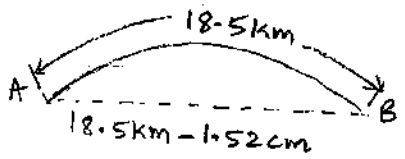
→ Greater spherical angle will be opposite to greater side.

⇒ Classification of Surveying :-

→ Surveying can be classified into many types on the basis of instrument used, place of Survey, Purpose of Survey etc

→ But mainly Surveying is classified as ;

1. Plane Surveying
2. Geodetic Surveying.



Plane Surveying

→ In Plane Surveying we neglect the effect of Curvature and Plotted measurements are projected on Horizontal plane

→ Area < 195.5 km²

→ It is done for Local Surveys

→ Plane trigonometry

Geodetic Surveying

→ Geodetic Survey is done for large Area in which effect of Curvature of the Earth Surface is considered.

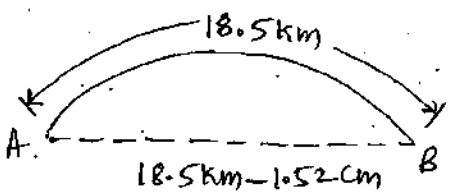
→ Area ≥ 195.5 km²

→ It is done by Survey of India to establish control points which serves the purpose of reference point for local Surveys.

→ Spherical Trigonometry.

Note :-

→ for Area upto 195.5 km² Spherical Excess is 1 sec.



→→ standard (Specific value)

Classification Based on Purpose :-

1. Topographical Survey :-

→ These surveys are used to obtain Maps which show details of natural and man made features on the Earth surface including elevation

Scale :- 1 : 25000 to 1 : 10,00,000 (No need to remember)

Ex: Mountains, water bodies, woods, valley, rivers etc

2. Engineering Survey :-

→ These are surveys used for Engineering works like Railway, Highway, Canal, Bridge etc

Building :- 1 : 50 to 1 : 200

Bridge & other civil engineering works :- 1 : 500 to 1 : 2500

Highway :- 1 : 1250 to 1 : 50,000

3. Cadastral Survey :-

→ It is done to establish Property boundaries (ఆస్తి సరిహద్దులు)

Scale :- 1 : 1000 to 1 : 5000

4. Hydrographic Survey :-

→ These are the surveys done on (or) near the water body

Ex:- River, lake etc

5. Astronomical Survey :-

→ With the help of this survey we can determine Latitude, longitude and Local mean time at any place on the earth surface.

6. Geological Survey :-

→ It is done to determine information about various strata of earth surface

Classification based on Instrument :-

1. Chain Surveying :-

→ It is simplest type of Surveying in which only linear measurements are done with the help of chain and tape and no angular measurements are done.

2. Compass Surveying :-

→ It is the branch of Surveying in which horizontal angles and directions of lines are measured with Compass and length of line are measured with chain and tape.

3. Theodolite Survey :-

→ In this Surveying Horizontal and vertical angles are measured with theodolite and distances are measured with Chain or Tape.

4. Levelling :-

→ In this type of survey, elevations of various points are measured with a levelling instrument and a vertical staff.

5. Plane table Surveying :-

→ In plane table Surveying, plan or Map is produced by determing directions of various points and taking linear measurements with Chain or Tape.

6. Tacheometric Surveying :-

→ In this surveying horizontal & vertical distances are measured with a instrument called "Tacheometer".

7. Photogrametric Survey :-

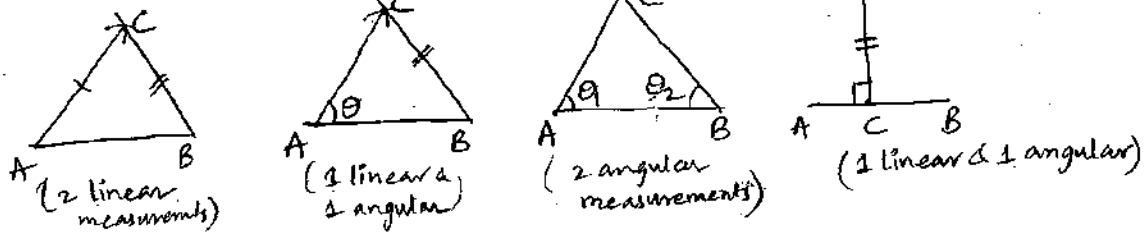
→ In this survey photographs are taken for an area which are inaccessible or time available is less and area to be survey is large.

→ Principles of Surveying :-

i) → Working from Whole to Part.

→ main objective of working from whole to Part is to localise the error where as if we work from part to whole error gets maximise

ii) Locating a point atleast by 2 measurements.

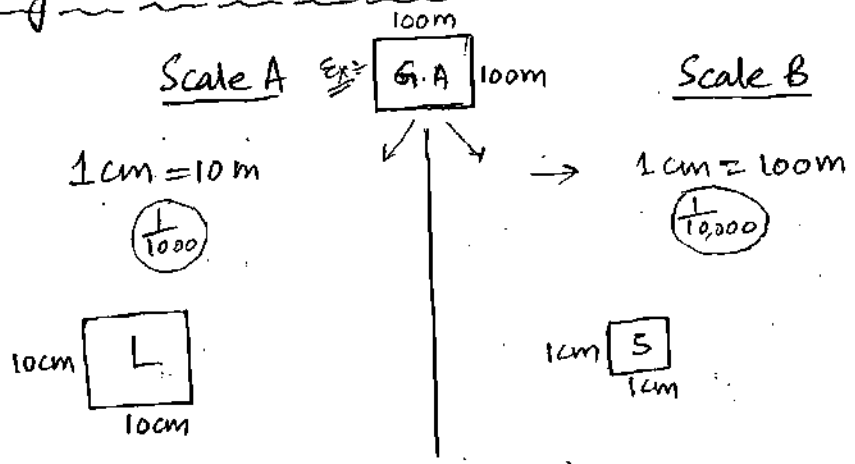


→ Scale :-

$$\text{Scale} = \frac{\text{length of a line on Plan or map}}{\text{length of same line on the ground}}$$

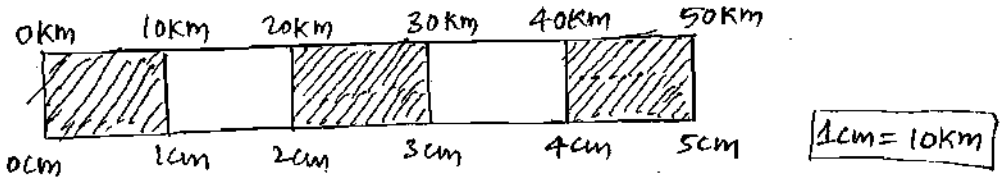
- Scale
  - Numerical Scale
    - Engineer Scale
      - 1cm = ground distance
      - Ex: 1cm = 10km.
    - Representative fraction. (R.F.)
      - It is fractional form of the scale
      - Ex: 1cm = 10km → $\frac{1\text{ cm}}{10^6\text{ cm}}$ (1 : 10^6).
  - Graphical Scale

⇒ Large Scale & Small Scale :-



- Larger is the Denominator of RF Smaller is the Scale.

- **Graphical Scale :-**



- Graphical Scale is a line drawn on the plan (or) Map on which ~~ground~~ distance is directly marked.

Graphical scale has advantage over Numerical scale such that distance on the plan (or) Map can be determined by actual Scaling, Even though Plan (or) Map has shrunk.

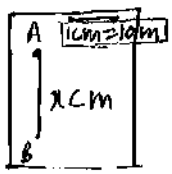
- In case of shrinkage of map, Graphical scale also changes with the Map and therefore ratio is unaffected.

Before shrinkage :-

- Let distance between two points on the Plan (or) Map is equal to x cm.

Let scale is 1cm = 10m (RF = 1:1000)

- Therefore, x cm on the Plan represents ground distance of 1000x cm.



$RF = \frac{1}{1000}$