IES MASTER

Civil Engineering

Toppers Handwritten Notes

SURVEYING

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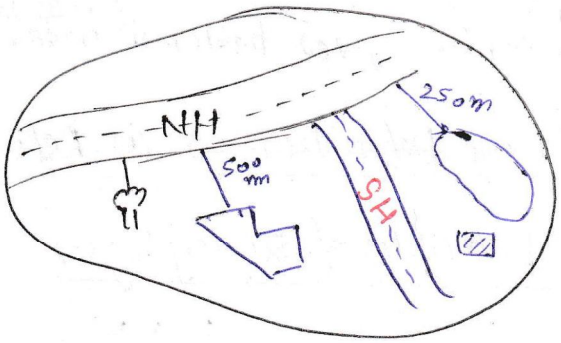
- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

(1) Fundamental of Surveying

Surveying :⇒

(1) Geoinformation : ~~Any thing~~ which is on above or below the earth surface is called geoinformation) → identification



1 cm = 100 m

(2) measurement & record of geoinformation

(3) conversion of geoinformation to a suitable scale to represent actual site condition on plan or map.

Definition :⇒ • It is the art of determining relative position of points on above or below the earth surface & presenting it graphically or numericalley by measurement of distance, dirn & elevation.

Geometics :⇒ • Measurement & management of geoinformation.

management → storage, retrival and presentation also ~~protie~~ priotie of geoinformation

Objective of Surveying :⇒ (1) To determine the relative position of points.

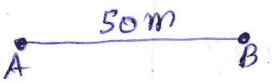
(2) To layout or mark out proposed structure on ground.

(3) To determine relative quantities like ~~data~~ area and volume.

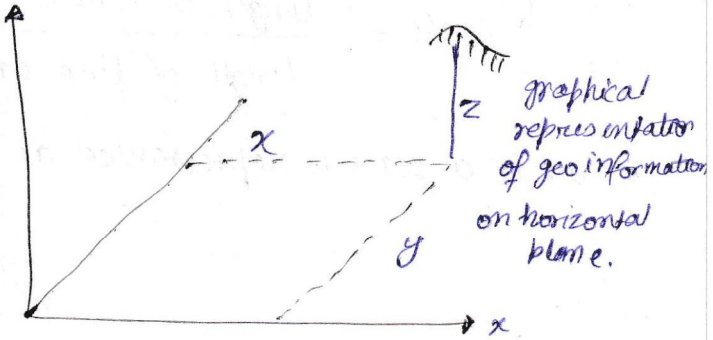
Method of Representation of measurement :⇒ (1) Numerically

AB = 50 m

(2) graphically



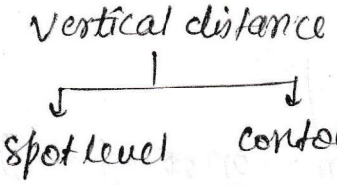
plan map



graphical representation of geoinformation on horizontal plane.

Spot Level :→ • It is the height of individual points.

Contour :→ • it is the imaginary line joining the points of equal elevation on earth surface.



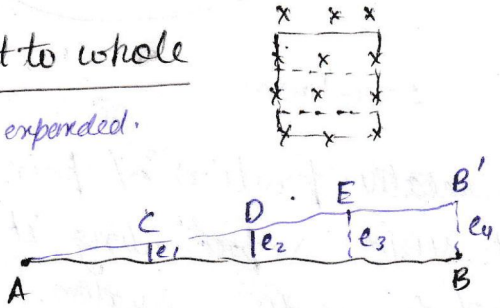
• contour gives better visualisation of area.

~~**Basic Definition :⇒**~~ ~~(i) Reference system for geoinformation~~

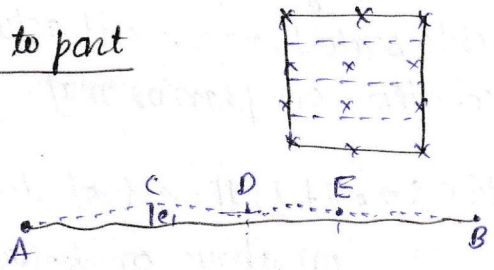
Principles of Surveying :⇒ (1) working from whole to part.

Part to whole

↓ error expended.



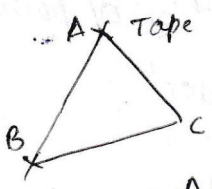
whole to part



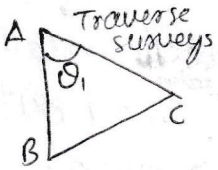
(iii) compensate error in a way or

⇒ advantage of whole to part :⇒ (i) Localise the error.
(ii) prevents the accumulation of errors

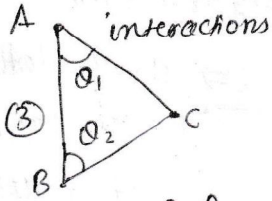
(2) Locate a point by at least two measurement.



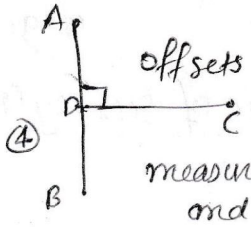
① known AB
measure AC, BC



② measure AC, θ,



measure θ1, θ2



measure AD & BD and DC
draw perpendicular line at half of AB.

Scale / Scale of a map

$$\text{Scale} = \frac{\text{Length of line on Plan/map}}{\text{Length of line on ground}}$$

• when a scale is represented as a fraction, called as Representation fraction.

$$\text{Scale} = \frac{\text{map}}{\text{ground}}$$

Scale

Numerical

(i) → Engineering scale (1cm = 100m)

(ii) → RF (Representation Factor)

↓ Fractional form of engg. scale

$$R.F = \frac{1\,cm}{100m} = \frac{1\,cm}{100 \times 100\,cm} = \frac{1}{10^4}$$

Graphical

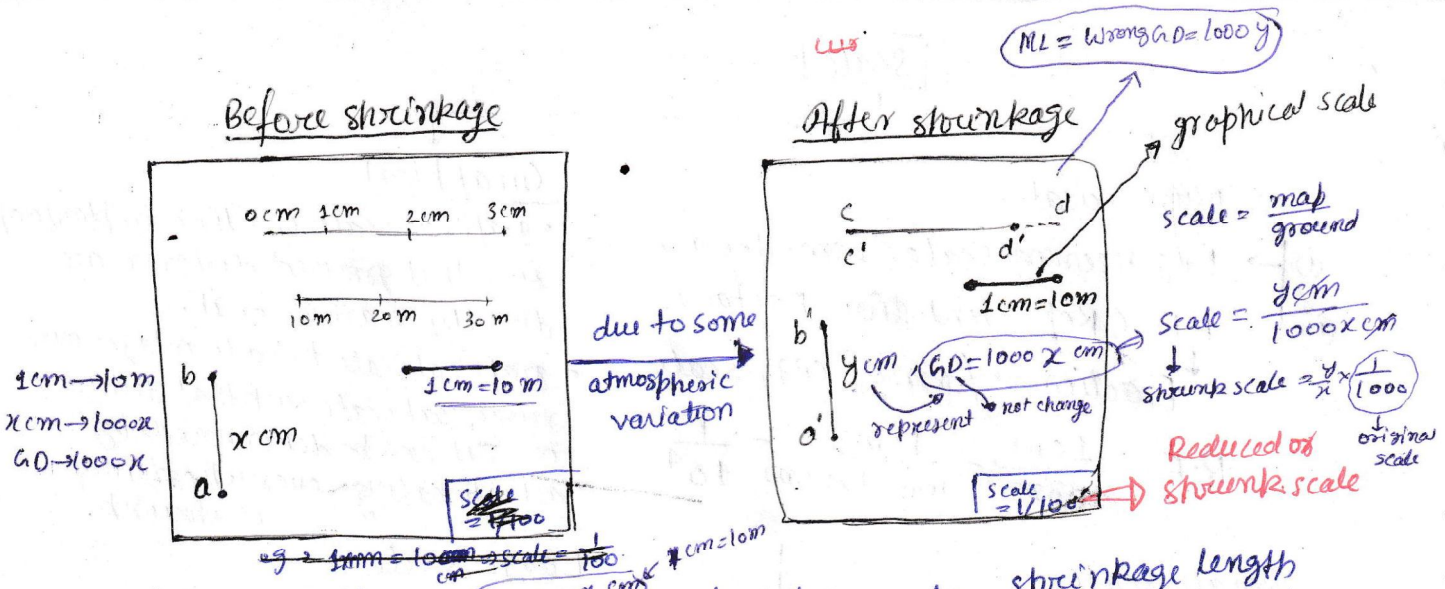
- graphical scale is a line on plan/map such that ground distance are directly marked on it.
- graphical scale has advantages over numerical scale such that distance on map can be determined by actual scaling even when map is shrunk.

Small Scale	Large Scale
• Small scale • R.F small • area covered will be Large. • $R.F = \frac{1}{1000}$ cm 1cm = 1000 cm 1cm = 10m • Less detailing	• Large scale • RF large • area covered will be small. • $R.F = \frac{1}{100}$ 1cm = 100cm 1cm = 1m • more detailing.

Note:⇒ $\frac{1}{1000}$ scale is larger scale than $\frac{1}{10000}$ scale.

** • The scale having larger RF is the largest scale, larger the denominator of RF, smaller is the scale and vice versa.

• जैसे google map में zoom करने object बड़ा दिखायी देता है अतएव scale बड़ा होगा अतएव कम area cover करेगा। और detailing ज्यादा होगा।



original length = x
shrinkage length = y
GD = 1000x cm
original scale = 1/1000
(1 cm on map = 1000 cm on ground, x cm = 1000x)

shrinkage scale = shrinkage length / ground length
= y cm / (x × 1000 cm) → original scale
= y/x / 1000

① (S·R) shrinkage ratio = y/x (y → shrunk length, x → original length) (S·R)

② shrunk scale = original scale × shrunk factor

③ shrunk scale = shrunk length / original length × original scale

④ shrinkage factor (SF) = y/x = shrunk length / original length = RF of shrunk scale / RF of original scale = shrunk scale / original scale
or shrunk ratio (SR)

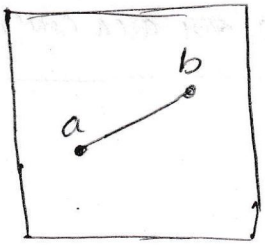
⑤ • S·F < 1, RF of shrunk scale (small) < RF of original scale (large)

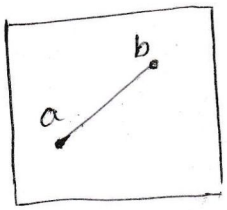
Error due to wrong scale :⇒

ground distance b/w two point (ab) = measured length.

wrong scale = ab / measured length

ab = wrong scale × measured length.





correct scale

correct scale = ab / correct length

correct length (C·L) = ab / R·F of correct scale

C·L = R·F of wrong scale / R·F of correct scale × measured length.

CL × correct R·F = WL × wrong RF

Ques:⇒ plan of an area has shrunk such that a line originally 10 cm long now measure as 9.5 cm only. If original scale of the plan was 1 cm = 10 m (1:1000) then determine

(a) shrinkage factor (b) shrunk scale (c) correct distance corresponding to measured distance of 100 m.

(d) correct area corresponding to measured area of 100 m^2.

Sol:⇒ (a) original length = x = 10 cm

shrunk length = y = 9.5 cm

S.F = $\frac{\text{shrunk scale}}{\text{original scale}}$

S.F original scale = $\frac{9.5}{10}$ = 0.95 Ans

(b) shrunk scale = $0.95 \times \left(\frac{1}{1000}\right)_{\text{original scale}} = \frac{1}{1000/0.95} = \frac{1}{1052.63}$ Ans

(c) S.F = $\frac{y}{x} \times \frac{1000}{1000} = \frac{\text{Measured Length (ML)}}{\text{corrected Length (CL)}}$ ← ground

$$C.L = \frac{M.L}{S.F} = \frac{100}{0.95} = 105.26 \text{ cm Ans.}$$

(d) $C.L = \frac{M.L}{SF}$, Corrected W = $\frac{M.W}{S.F}$

$$CL \times CW = \frac{ML \times MW}{(S.F)^2}$$

correct area (A) = $\frac{MA}{(S.F)^2} = \frac{100\ m^2}{(105.26)^2} \times 10^{-4}\ m^2 = 110.80\ m^2$ Ans

2 Method (c) CL × correct R.F = WL × wrong RF

R.F (shrunk scale) × 100 = C.RF (correct) × CD

$\frac{1}{950} \times 100 = \frac{1}{1000} \times CD$

CD = 105.26

wrong = 0.95 × 1000 = 950 on ground

R.F of wrong = $\frac{1}{950}$

(d) CA × CRF = WA × WRF

$CA \times \left(\frac{1}{1000}\right)^2 = 50 \times \left(\frac{1}{950}\right)^2$

$$S.F = \frac{SL}{GL} = \frac{y}{x} \times \frac{1000}{1000} = \frac{1000y}{1000x} = \frac{ML}{CL}$$

① $S.F = \frac{M.L}{C.L}$

② $C.L = \frac{ML}{S.F}$

③ $C.A = \frac{MA}{(S.F)^2} = \frac{ML}{S.F} \times \frac{M.W}{S.F}$ (measured width)

map से ground पे जाना होतो scale में जो denominator में होगा इससे multiply करेंगे

और अगर ground से map में जाना हो तो divide करेंगे

ES-11

Ques:⇒ R.F ? measured distan. = 40 km

A = 16 km^2 A rectangular plot of 16 km^2 in area is shown on a map by a similar rectangular area of 1 cm^2.

1 cm = 10 m [on map]

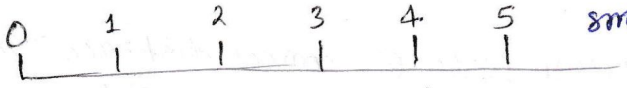
Scale = $\frac{1}{1000}$

1 cm → 1000 C.D

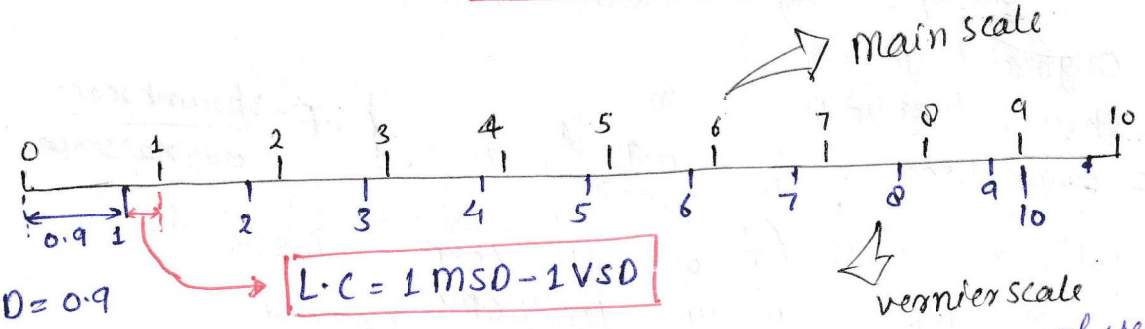
x cm on map → 1000x

Vernier Scale

- It is a device which is used to measure fractional part of smallest devision of main scale.



10 VSD = 9 MSD ⇒ **1 VSD = 0.9 MSD**



VSD = 0.9

L.C = 1 MSD − 1 VSD

- The vernier scale has an index mark (arrow) → represents zero of vernier scale
- The division of the vernier are made either slightly shorter or slightly longer than that of the main scale.

MSD → mainscale division VSD → Vernier scale division

Q⇒ Design a direct vernier for a theodolite circle having main scale graduation upto 20 min (20′) if the L.C required 20″ (second).

Sol^n⇒ MSD = 20′, LC = 20″

direct vernier n VSD = $(n-1)$ MSD

60 VSD = (60−1) MSD

60 VSD = 59 MSD

$LC = \frac{MSD}{n}$ → 20′ (↓ 20″)

$n = \frac{(20\times 60)''}{20''}$

$n = 60$

Q⇒ In a vernier calipers 'n' division of its main scale match $(n+5)$ division of its vernier scale. Each division the MS is of x unit. The L.C of vernier scale.

Sol^n⇒ n MSD = $(n+5)$ VSD → ~~mean retrograde~~ eg → $n = 10$

10 MSD = (10+5) VSD

MSD = $\frac{15}{10}$ VSD

= 1.5 VSD

MSD > VSD

$1\,VSD = \frac{n \cdot MSD}{(n+5)}$

L.C = MSD − VSD [VSD − MSD]

$L.C = MSD - n\cdot\frac{MSD}{(n+5)}$

$= MSD\left[1 - \frac{n}{n+5}\right]$

$= \frac{5\,MSD}{n+5}$

MSD = x

$$L.C = \frac{5x}{n+5}$$

For understanding for geographic co-ordinate system

(1) shape of Earth

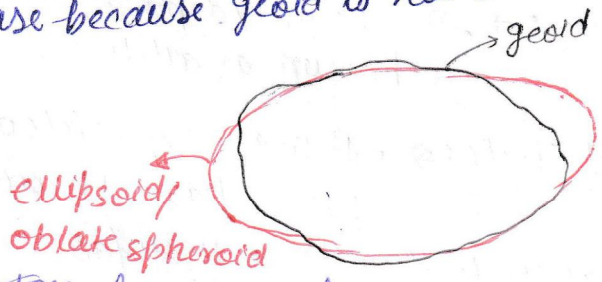
(2) co-ordinate (Latitude, longitude, altitude)

Basic Definition:⇒ (1) Reference system for geoinformation

- It is a method which uses latitude, longitude & altitude for identifying the location of an object over the earth surface.

Geoid:⇒ • The equipotential surface of earth's gravity field.

• This geoid is used for geodesy, geoscience & astronomy like multiple discipline to solve problems but for co-ordinate system this geoid does not provide a base because geoid is not a smooth representation of earth.



Ellipsoid:⇒ • A smooth representation of earth surface.

• Slightly axis is 43.5 km smaller than equatorial axis.

- SH is slightly larger than NH (northern hemisphere)

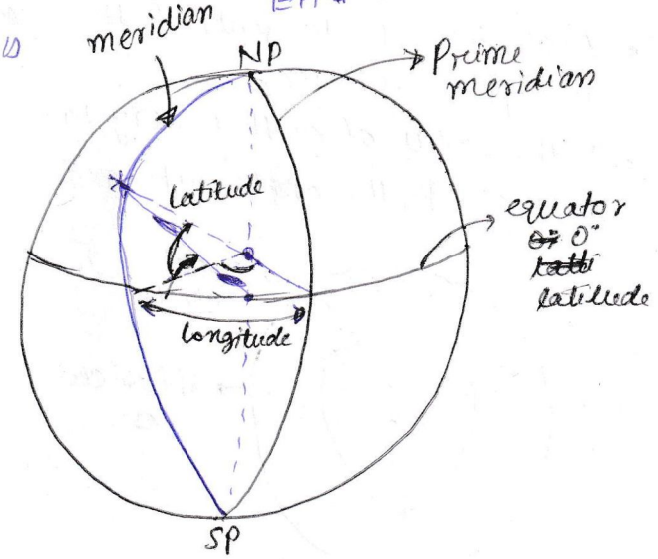
So we before explaining co-ordinate we have to know

Equator:⇒ a line which divide our earth horizontally in two parts NH & SH.

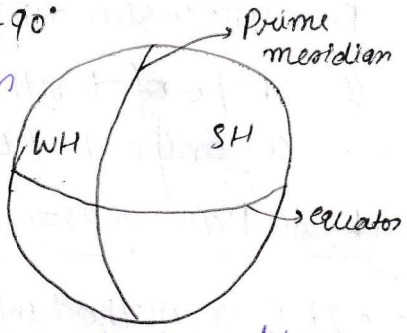
Prime meridian:⇒ a line which divide our earth vertically in two part EH & WH.

Latitude:⇒ Latitude of a point on earth's surface is the angle b/w equitorial plane and straight line that passes through that point and through centre of earth.

Longitude:⇒ • It is point is the angle east or west of reference meridian to another meridian that passes through that point.



Note:⇒ • The point on equator – Latitude – 0°
The point on north or south pole – Latitude – 90°

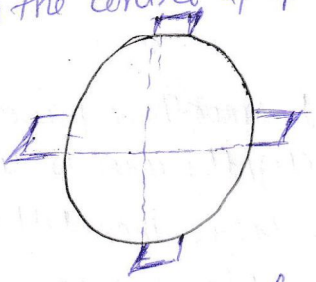


• There two points represents two dimensional position on earth map.
• For all measurement purpose irregularity of earth surface are coin considered to be absent and it is assumed as sphere.

Mean Sea Level:⇒ • It is measurement of average height of sea b/w high tide and low tide over a long period of 19 Yrs.
G-15 • MSL acts as baseline to calculate heights and elevations [vertical control]
• MSL adopted by survey of India for reference is located at Bombay high.

Altitude:⇒ • The height/depth of an object or point MSL or ground is known as altitude.

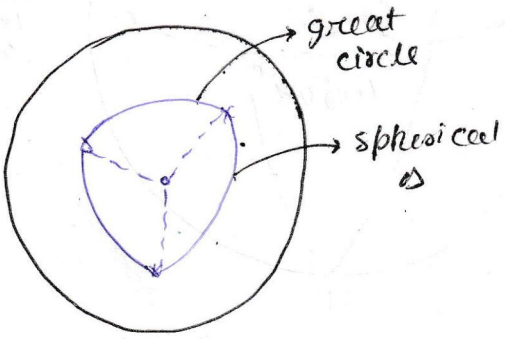
(2) Great Circle:⇒ • A imaginary circle on the surface of a sphere, whose plane passes through the centre of sphere.

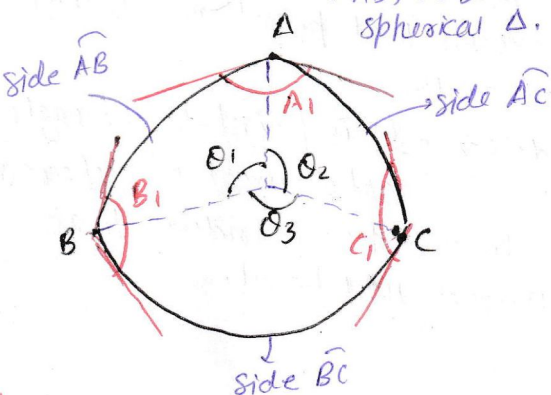


• A great circle divides earth surface in two equal parts.
Ex → equator, longitudes

(3) Spherical Triangle:⇒ • It is triangle formed on surface of sphere by intersecting of three arc of great circle

• Angle b/w the tangents of the great circles at the intersection point is the spherical angle.
• As the radius of earth is very large so we denote the length of side of spherical triangle by the angle substended by that arc on the centre of earth.
• AB, BC & CA are sides of spherical Δ.





- $\overset{\frown}{AB} = R\theta_1 = \theta_1$
- $\overset{\frown}{BC} = R\theta_2 = \theta_2$
- $\overset{\frown}{AC} = R\theta_3 = \theta_3$

} angle formed by that arch on the centre of earth.

∠A, ∠B, ∠C → spherical angle (angle b/w tangent at the intersection point).