UNIT - 1

SURVEYING (20 to 22 M)

NRC - National Remote Sensing centre (Hyd), Banglore

Map:-

Map is a representation of features on earth surface drawn to a scale.

$$\text{scale} = \frac{\text{Map units}}{\text{Ground units}}.$$

Object of surveying:-

It is the preparation of plan and Map

plan:-

Large scale representation of small areas is called plan.

Ex:- plan of a building

Scale : 1 : 50, 1 : 100

Map:-

small scale representation of large areas is Map

Ex:- Road Map of India.

Scale : 1 : 2000, 1 : 1,25000

This maps are sub divided into two types

1. Large scale maps
2. Small scale maps

Large scale map:-

It representation of small areas

Ex:- 1 : 2000, 1 : 1000

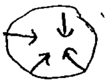
Small scale map:-

It representation of large areas

Ex:- 1 : 250000, 1 : 125000

Principles of surveying :-

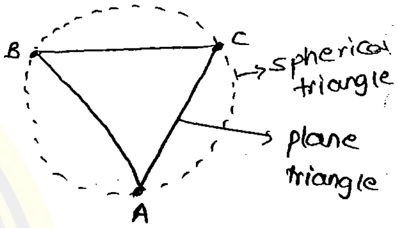
1. To work from "whole to the part"



2. If the curvature of earth is considered then it is called Geodetic surveying. If the curvature of earth is not considered then it is called plaine surveying.

3. The difference between the length a arch of a circle and subtended chord on the surface of earth is 0.1m for 18.2 km, 0.3m ⟶ 54.3 km, 0.5 m ⟶ 91 km

4. The sum of the angles on a spherical triangle on the earth surface and corresponding plane triangle is 1 sec per every 195.5 sq.km area



5. plane triangle is measured in terms of radians, The spherical triangle is measured in terms of steradians.

Different types of scale :-

plane scale :-

It is possible to measure two succesive dimensions

Ex:- m, deci meters

Diagonal scale:-

It is possible to measure three succesive dimensions

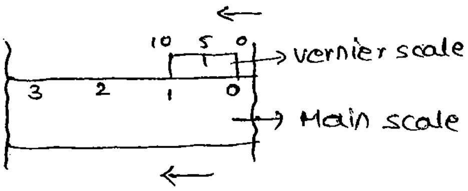
Ex:- m, deci m, cm

Vernier scale:-

It is a small scale which slides along the main scale. The divisons on the vernier scale are little smaller or larger than the divisons of main scale.

Types of vernier scale:-

1. Direct vernier:-



1. The divison on the vernier slightly shorter than Main scale.
2. The divisons on the vernier increases same direction as th of main scale.
3. 9 divisons of main scale = 10 divisons of vernier scale.

$$nv = (n-1)s$$

'n' is no. of divisons on the vernier scale

'v' is the value of one divison on the vernier scale

's' is one divison of main scale.

$$v = \frac{(n-1)}{n} \times s$$

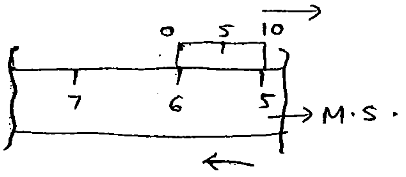
Then Least count of vernier, L.C = difference of one divis on the main scale and vernier scale.

$$L.C = s - v$$
$$= s - \left(\frac{n-1}{n}\right)s$$
$$= s\left[\frac{n-n+1}{n}\right]$$
$$\boxed{L.C = \frac{s}{n}}$$

L.C. is represented as the value of one divison on the main scale divided by No. of divisons on the vernier.

Indirect vernier:-

It is also known as Retrograde vernier. The divisons on vernier indicates in opposite direction as that of main scale the smallest divison of vernier is little larger than the smalle divison on main scale.



'N' divisons of vernier is equal to (n+1) divisons of main scale.

$$nv = (n+1)s$$

$$V = \left(\frac{n+1}{n}\right)s$$

$$L\cdot C = V - S$$

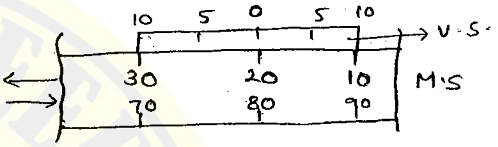
$$= \left(\frac{n+1}{n}\right)s - s$$

$$= \left(\frac{n+1-n}{n}\right)s$$

$$\boxed{L\cdot C = \frac{s}{n}}$$

3. Double vernier :-

The divisons on vernier represented in both the directions the zero is marked at the centre. It is a combination of both direct and Retrograde vernier.



$$nV = (n-1)s$$

$$V = \left(\frac{n-1}{n}\right)s$$

$$L\cdot C = s - V$$

$$= s - \left(\frac{n-1}{n}\right)s$$

$$\boxed{L\cdot C = \frac{s}{n}}$$

4. Extended vernier :-

'n' divisons of vernier scale is equal to (2n-1) divisons of main scale

$$V = \frac{(2n-1)}{n} \times s$$

$$L\cdot C = 2s - V$$

$$= 2s - \left(\frac{2n+1}{n}\right)s.$$

$$\boxed{L\cdot C = \frac{s}{n}}$$

Ex:- A ground area of $112 \cdot 5 \text{ cm}^2$ represented by $4 \cdot 5 \text{ cm}^2$ on the plan. The representative fraction is

A. $4 \cdot 5 \text{ cm}^2 \longrightarrow 112 \cdot 5 \text{ cm}^2$

$1 \text{ cm}^2 \longrightarrow ?$

$$x = \frac{112 \cdot 5}{4 \cdot 5} = 25 \text{ cm}^2$$

$1 \text{ cm}^2 \longrightarrow 25 \text{ cm}^2$

$1 \text{ cm} \longrightarrow 5 \text{ cm}$

Scale = 1 : 5

Ex:-

$4 \cdot 5 \text{ cm}^2 \longrightarrow 112 \cdot 5 \text{ m}^2$

$1 \text{ cm}^2 \longrightarrow ?$

$$x = \frac{112 \cdot 5}{4 \cdot 5} = 25 \text{ m}^2$$

$1 \text{ cm}^2 \longrightarrow 25 \text{ m}^2$

$1 \text{ cm} \longrightarrow 5 \text{ m}$ or 500 cm

∴ 1 : 500

Ex:- A theodolite circle is divided into degress and $\frac{1}{3}^\circ$ If 59 divisons of main scale are equal to 60 divisons of vernier. The L.C. of the instrument.

A. $L \cdot C = \frac{S}{n}$

$1^\circ = 60'$, 1 divi = 3 pa

1 divison = $\frac{60}{3} = 20'$

The L.C. on main scale is equal to $\frac{1^\circ}{3} = \frac{60'}{3} = 20'$

∴ 1 divison on the main scale, $S = 20'$

$n = 60$

$$L \cdot C = \frac{20}{60} = \left(\frac{1}{3}\right)' = \left(\frac{60}{3}\right)''$$

$1' = 60''$

$= 20''$

Ex:- which of the following scales is the smallest.

a) 1 cm = 10 m b) $R \cdot F = \frac{1}{5000}$ c) 1 : 10,000 d) 1 cm = 10 km

A) a) 1 cm = 10 m
= 10×100 cm
1 cm = 1000 cm
⇒ 1 : 1000

b) 1 : 5000

c) 1 : 10,000

d) 1 cm = 10 x 1000 m
= 10000 x 100 cm
1 cm = 1000000 cm
1 : 1000000

The smallest scale is 1 cm = 10 km.

** Error due to use of wrong scale :-

1. If the length of the line existing on a plan or map is calculated by means of wrong scale. The length obtained will be wrong or incorrect.

$$\text{Correct Length} = \frac{\text{RF of wrong scale}}{\text{RF of correct scale}} \times \text{Measured length.}$$

$$\text{Correct Area} = \left(\frac{\text{RF of wrong scale}}{\text{RF of correct scale}}\right)^2 \times \text{Measured area}$$

** Error due to shrinkage:-

1. If the plan is drawn shrinkage due to variation in the atmospheric conditions.

$$\text{Shrinkage Ratio or Factor} = \frac{\text{Length after shrinkage}}{\text{actual length.}}$$

Shrinkage Representative Fraction = shrinkage factor x original R·F
(or)
Shrunk RF

$$\text{correct distance} = \frac{\text{measured distance}}{\text{shrinkage factor}}$$

$$\text{correct area} = \frac{\text{Measured area}}{(\text{Shrinkage factor})^2}$$

Ex:- The plan of an area has shrunk such that a lin originally 10cm now measuring 9·5 cm. If the original scale of the plan 1cm = 10m. The correct distance corresponding to a measured distance of 190m is

A. Shrinkage factor = $\frac{9·5}{10}$ = 0·95

Measured distance = 190 m

$$\text{correct distance} = \frac{\text{Measured distance}}{\text{shrinkage factor}}$$

$$= \frac{190}{0·95}$$

$$= 200 \text{ m}$$

Ex:- A plan of an area drawn with a original scale 1cm 10m has shrunk such that a line originally 15cm measures 14·5 cm. Find shrunk scale in terms of 1cm = ?

A. Shrinkage Ratio = $\frac{14·5}{15}$ = 0·97

shrunk RF = Shrinkage Ratio × original R·F

$= 0·97 \times \frac{10}{\cancel{10}}$ Given original scale 1 cm = 10 m

= ~~0·0~~97 m

∴ 1 cm = ~~0·0~~97 m

Ex:- A surveyor measured an area of 50 m² drawn to a scale of 1cm = 1m. Afterwards he found that he used a wrong scale of 1cm = 2m for the measurement. The the correct area is

A. Given measured area = 50 m²

shrinkage ~~factor~~ = $\frac{\text{Length \cancel{after} shrinkage}}{\text{\cancel{actual} length}}$

Correct scale = 1cm = 1m wrong scale : 1cm = 200cm

1 cm = 100 cm

$$\text{correct Area} = \left(\frac{1/200}{1/100}\right)^2 \times 50$$

$$= 12.5 \text{ cm}^2$$

Ex:- The distance between two points on a plan was 200m when measured with a scale of 1 : 1000. the distance between the same points with a scale of 1:500 will be.

A. $$\text{correct length} = \left(\frac{1/1000}{1/500}\right) \times 200$$

$$= 100 \text{ m}.$$

Ex:- The plan of a map was to reduced size such that a line originally 100 mm measures 90 mm. The original scale of the plan 1 : 1000. The revised scale is

A. $$\text{shrinkage factor} = \frac{\text{Length after shrinkage}}{\text{actual length}}$$

$$= \frac{90}{100} = 0.9$$

Original scale = 1 : 1000

Scale after reduction = S.F X scale before reduction

= 0.9 X 1000

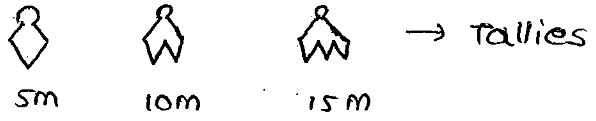
= ~~0.9000~~900

UNIT- 2

CHAIN SURVEYING

Metric chain:-

Available in length 20m and 30m. 20m chain having 100 links and 30m chain having 150 links. small brass rings are provided at 1m interval. Tallies are placed at an interv of 5m



Band chain (or) steel band:-

Available in length 20m and 30m. Brass tallies are placed at 5m interval.

Gunter's chain :-

It is also known as surveyor's chain. the length of the chain is 66 feets. It having 100 links. It is convinient for measuring the distances in Furlongs and miles or area in acres.

1 Furlong = 10 Gunter's chain

1 mile = 8 Furlongs.

1 Acre = (10 Gunter chain)^2

Revenue chain :-

Length 33 feet and 16 links

Engineer's chain :-

Length 100 feet and 100 links

Tapes :-

Cloth and Linen tape :-

It is available in 10m, 20m, 25m and 30m length. It is not accurate.

Glass fibre:-

These tape are not strech or shrink due to changing temperature and moisture content.

It is accurate than cloth tape.

Metallic tape:-

It is available in 1m, 2m, 10m, 15m, 20m, 30m and 50m length. These tapes are more durable than glass fibre tape and cloth tape.

Steel tape:-

It is available in 1m, 2m, 10m, 15m, 20m, 30m, 50m

It is more accurate than metallic tape.

Enval tape:-

It is made up of steel and nickle. It is more accurate than all other tapes.

Arrow:-

It is used to indicate the position of end of the chain on the ground. I

Peg:-

It is used to indicate position of survey stations or end points of the survey line.

Ranging Rod:-

It is used to locate intermediate points such that these points lie on the straight line joining the end stations.

Ranging:-

The process of finding the intermediate points is known as ranging.

Types of Ranging:-

1. Direct Ranging:-

If end stations are inter visible then it is called Direct Ranging.

Line Ranger:-

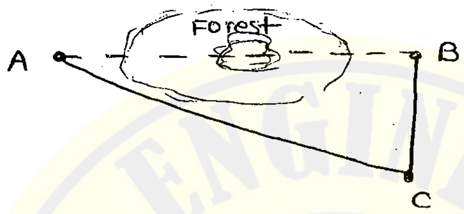
It is a two right angled isosceles triangular prism placed one above the other is used for Direct Ranging.

2. Indirect Ranging:-

when end points are not inter visible indirect rangi is required.

3. Random line method:-

If survey line passes through a thick forest it is not possible establish by intermediate points by direct meth



EX:- As per IS specifications the length of the chain when measured with a tension of 80 N at a standard temperature 20 °c should be within the following tolerance limits.

A. Given 80N, 20°c

20 m → ±5 mm   30m chain → ± 8 mm

Corrections for chain:-

1. Correction for Standardisation:-

1. If the actual length L' is shorter than nominal leng 'L' the distance measured will be more than correct distance.

$$\text{The correct distance} = \frac{\text{actual length of the chain}}{\text{nominal length of the chain}} \times M.D$$

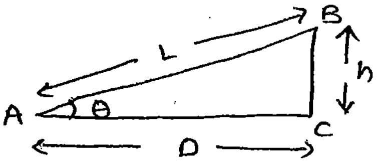
The measured distance is more than actual distance therefore error is positive and correction is negative.

2. If the actual length L' is greater than nominal length, L the measured distance will be shorter than actual distance therefore error is negative and correction is positive.

$$C.D = \frac{L'}{L} \times M.D$$

2. Correction for slope:-

1. Measured distance is always greater than the horizontal distance



$$C_g = -2L\sin^2\left(\frac{\theta}{2}\right)$$

(or)

$$C_g = \frac{-1}{2} h^2/L$$

D = horizontal distance

L = Inclined distance

h = difference between B and C

θ = angle of slope.

2. If the actual length of the chain is not equal to nominal length the correction for standardisation should be apply before applying the correction for slope.

Ex:- The length of a survey line measured with 20m length was found to be 200 m. When chain was compared with a standard chain it was found to be 10 cm too long. The true length of the line in 'm' is.

A. $L' = 20 + 0{\cdot}1 = 20{\cdot}1$ m

Nominal length of the chain, $L = 20$ m.

Measured distance = 200 m.

$$C{\cdot}D = \frac{L'}{L} \times 18\, M{\cdot}D$$

$$= \frac{20{\cdot}1}{20} \times 200$$

$$= 201 \text{ m.}$$

Ex:- A 30m metric chain is found to be 0·1 m shorter than actual length. If the distance measured with 300m the actual distance will be.

A. Nominal length, $L = 30\ m$ — 0.1 m shorter (−)

$$L' = 30 - 0.1 = 29.9\ m$$

$$C.D = \frac{L'}{L} \times M.D$$

$$= \frac{29.9}{30} \times 300$$

$$= 299\ m$$

Ex:- The area of a field was found to be $4000\ m^2$ when measured with a chain of 20m length. If the chain was 0.1 m shorter than nominal length. the correct area in m^2.

A. Correct area $= \left(\frac{L'}{L}\right)^2 \times$ M. Area

$$L' = 20 - 0.1 = 19.9\ m$$

$$L = 20\ m$$

$$C.A = \left(\frac{19.9}{20}\right)^2 \times 4000$$

$$= 0.99 \times 4000$$

$$C.A = 3960.1\ m^2$$

→ Correct volume $= \left(\frac{L'}{L}\right)^3 \times$ Measured volume

L' = actual length of the chain

L = Nominal length of the chain

Ex:- The volume of the earth work was calculated to be $5000\ m^3$. when measured with a 30m chain. If the chain was 0.15 m too long the correct volume in m^3 is.

A. Given measured volume $= 5000\ m^3$

Measured chain or Nominal $= 30\ m$

$$L' = 30 + 0.15 = 30.15\ m$$

$$C.V = \left(\frac{L'}{L}\right)^3 \times M.V$$

$$= \left(\frac{30.15}{30}\right)^3 \times 5000 = 5075.37\ m^3$$

Corrections for tape :-

The first two corrections i.e., correction for standardisation and slope correction are same as chain corrections.

1. Slope correction for pull :-

$$C_p = \frac{P - P_o}{AE} \times L$$

P = pull applied during measurement

P_o = standard pull

A = cross sectional area of tape, cm^2

E = youngs modulus of the tape, N/mm^2

L = Measured Length in m.

2. Temperature correction :-

$$C_t = \alpha (T - T_o) L$$

α = coefficient of linear expansion, °c

T = Temperature during measurement

T_o = standard temperature

L = measured length.

3. correction for sag :-

$$C_s = \frac{L_1 w^2}{24 P^2 n^2}$$

L_1 = distance between the two supports

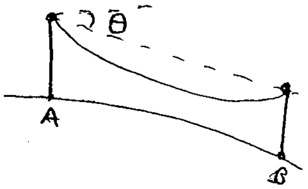
w = total weight of the tape between the two supports

P = pull applied during measurement

n = no. of intervals or no. of base

When end stations are not at same level then sag correction

$$C_s' = C_s \cos^2\theta \left(1 \pm \frac{wL_1}{P} \sin\theta\right)$$



L_1 = distance b/w the two supports

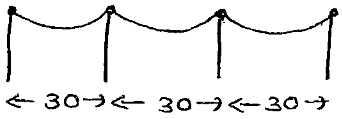
w = weight of the tape per unit length

θ = angle of slope b/w the two supports

Ex :- A steel tape of 30m is supported on four supports with equal spacing by a pull of 80N. The cross sectio area of tape 8 mm². The unit wt. of steel tape is 77 kN/m³. The sag correction in m is.

A. Given $P = 80\ N$, $A = \cancel{77}\ 8\ mm^2$

$L_1 = 30\ m$, $n = 3$



Unit weight = 77 kN/m³

= 77000 N/m³

W = unit wt. x volume

= 77000 x (Area of c/s of tape x Length)

$= 77000 \times \left[\left(\frac{8}{1000} \right)^2 \times 30 \right]$

W = 18.48 N

$$C_s = \frac{L_1 w^2}{24 P^2 n^2}$$

$$= \frac{30 \times (18.48)^2}{24 \times 80^2 \times 3^2}$$

$$= \frac{10245.3}{1382400}$$

= - 0.00741 m (always sag correction in negative)

Ex :- A 30M steel tape is subjected to a pull of 10 kg in 3 equal spans of 10m each. The area of c/s and density of tape are 0.08 cm² and 7.86 g/cm³. The correction for sag in m.

A. $L_1 = 10\ m$ $n = 3$ $A = 0.08\ cm^2$ $P = 10\ kg$

W = unit wt x volume

$= 7.86 \times \left(\frac{0.08}{\cancel{10}} \times \overset{1}{\cancel{3}}000 \right)$

$W = \overset{0.6288}{\cancel{1.88}}\ kg$

$$C_s = \frac{L_1 w^2}{24 P^2 n^2}$$

$$= \frac{10 \times \cancel{1.88^2}\ 0.6288^2}{24 \times 10\cancel{0}^2 \times 3^2}$$

$$= \frac{3.95}{21600}$$

$$C_s = \cancel{0.00018\ \text{'m'}}.$$

$$= -0.00018\ \text{'m'}$$

EX:- A steel tape 20m long standardised 55° F used for measuring a base line. The temperature during measurement 30° F. The coefficient of linear expansion of steel tape 6×10^{-6} °F. Then correction for temperature is.

A. $C_t = \alpha (T - T_0) L$

$= 6 \times 10^{-6} (30 - 55) \times 20$

$= -0.003$ m

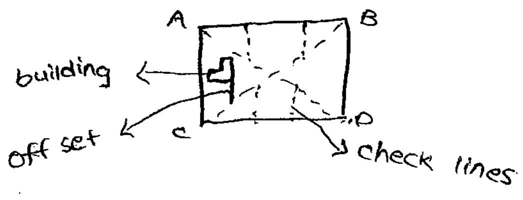
Correction	source of error	sign	
1. Standardisation	Instrument	±	cumulative ~~compen -~~ ~~satory~~ correction.
2. Temperature	Natural conditions	±	
3. pull	personal error	±	
4. sag	Natural / personal	−	Compensative ~~cumulative~~ correction
5. slope	Natural	−	

survey line:-

The line joining the main survey stations

Check line or proof line:-

The lines used for check the accuracy of the frame work of triangles.



Off set :-

Lateral distances measured from main survey lines

1. perpendicular offset :-

The short measurements at right angles to the survey line

2. Oblique offset :-

the short measurements inclined to survey lines

3. Range type offset :-

It is a Oblique offset taken along the line of wall c a building.

Well conditioned :-

1. The best well conditiond triangle is an equilateral triangl

2. The fairly good intersection when plotting the triangles ne angle is less than 30° and more than 120°

3. Cross staff :-

1. Instrument used for setting a perpendicular offset.

Open cross staff:-

It is also used to setout a perpendicular offset.

French cross staff :-

It is in Octagonal in shape. It is used to setout perpendicular offset and oblique offset with an angles 45° and 135°

Adjustable cross staff :-

It is used to setout offsets with an angles of any magnitude.

Optical square :-

It is used to setout perpendicular offset more accurate than a cross staff. It works under the principle of double reflection (optical principle). It consists of two mirrors place at an angle of 45°

Prism square :-

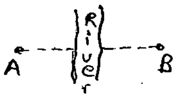
It is used to set out a perpendicular offset more accurate than a optical square.

Obstacles in chaining:-

a. Chaining around the obstacle is possible.

Ex:- pond or lake.

b. chaining around the obstacles is not possible.



Ex:- River

Obstacles in Ranging:-

Ex:- Hills or mountains.

Obstacles in chaining and Ranging:-

Ex:- buildings.

Leader:-

The chain man at the forward end of the chain line is called leader. The chain man at the rear end is called follower

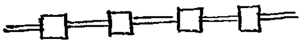
conventional signs used in chain surveying:-

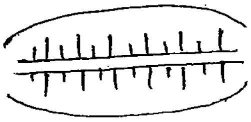
1. Chain line - - - - - -

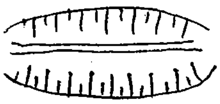
2. Bench Mark 

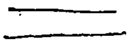
3. Building 

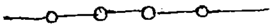
4. Dam 

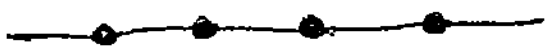
5. Boundary with pillars 

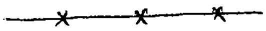
6. Embankment 

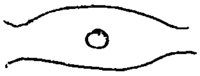
7. Cutting 

8. Metal Road 

9. Telephone line 

10. Electrical line 

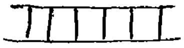
11. Wire fencing 

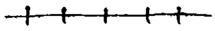
12. River 

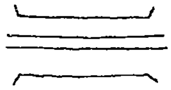
13. Canal 

14. Lake or pond 

15. Well 

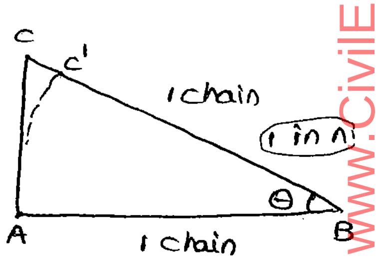
16. Railway double line 

17. Railway single line 

18. Road bridge 

19. Railway bridge 

Hypotensual allowance :-



BC' is one chain length on the slope having an angle 'θ' the arrow is not kept at c'. But the arrow is kept at point c. Therefore the cc' is hypotensual allowance for each chain length.

$$cc' = \frac{\text{hypotensual allowance}}{1 \text{ length of chain}}$$

$cc' = 100 (\sec\theta - 1)$ link — 20 m

$cc' = 150 (\sec\theta - 1)$ link → 30 m

$= 50\,\theta^2$ link → 'θ' radiant

$= \frac{1.5}{100}\,\theta^2$ link → 'θ' degrees

$= \frac{50}{n^2}$ link ⇒ (1 in n)

Double line field book :-

It is used for ordinary works where accuracy required is less.

Single line field book :-

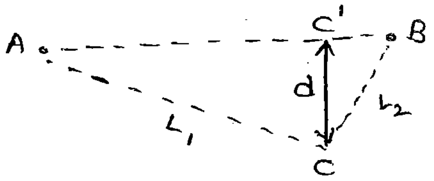
It is used for large scale mapping and most detail dimensional work.

Correction for mis alignment :-

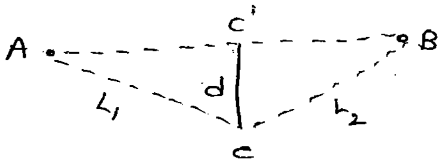
$$= \frac{d^2}{2L_1} + \frac{d^2}{2L_2}$$

error is +ve

correction is −ve



$$= \frac{d^2}{2L_1} + \frac{d^2}{2L_1} \Rightarrow \frac{d^2}{L_1}$$



Ex:- The hypotensual allowance per chain of 30 m length. If the angle of slope is $12° 30'$ is

A. $CC' = 150(\sec\theta - 1)$ link

$= 150(\sec(12° 30') - 1)$ links

$= 3.64$ links

each link = 20 cm

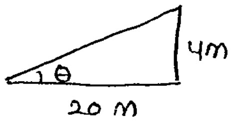
= 0.2 m

$CC' = 3.64 \times 0.2$

$= 0.728$ m

Ex:-) The hypotensual allowance per chain of 20 m length. If the ground raises by 4 m in one chain length.

A. $\tan\theta = \frac{4}{20} = \frac{1}{5}$



1 in 5 ⇒ n = 5

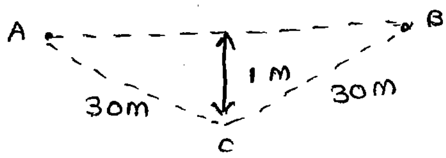
$CC' = \frac{50}{n^2}$ links

$= \frac{50}{5^2}$

$= 2$ links

$= 0.4$ m

Ex:-) A survey line was measured to be 60m. It wa found that there was mis alignment and the line was 1 off the straight line at the middle the corrections for th length in 'm' is.

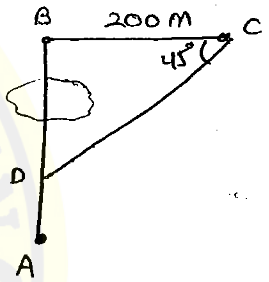


A. $\frac{d^2}{2L_1} + \frac{d^2}{2L_1} = \frac{d^2}{L_1}$

$= \frac{1^2}{30}$

$= -0.033$ m (correction).

Ex:- To continue a survey line AB passes an obstructio a line BC 200m length was setout perpendicular to AB and from 'c'. The ∠BCD was setout 45°. Find the obstructed length BD in 'm'.



A. $\tan 45 = \frac{x}{200}$

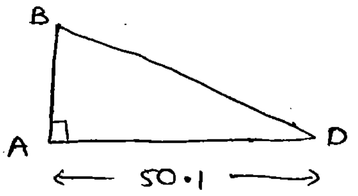
$x = 200 \times \tan 45$

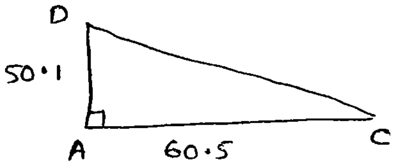
$x = 200$ m

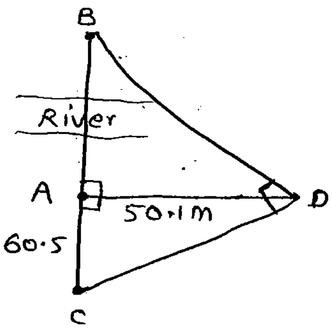
BD = 200m

Ex:- A and B are two points on the opposite banks of a river along a chain line CAB which crosses a river at right angles. The surveyor select a point 'D' which is 50.1 m from A along the bank and set a perpe dicular CD with respect to BD. If the distance CA is 60.5 m the obstructed length AB in 'm'.

A.







$\frac{AB}{AD} = \frac{AD}{AC}$

$\frac{AB}{50.1} = \frac{50.1}{60.5}$

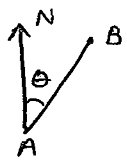
AB = 41.5 m

15-11-2014

UNIT - III

COMPASS SURVEYING

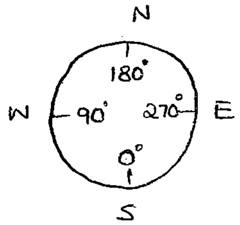
*. It measures the angle between the magnetic meridian and a given line.



compass are classified into two types.

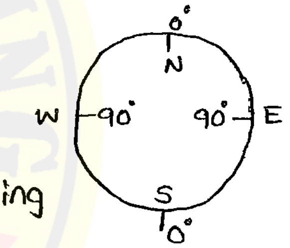
1. prismatic compass
2. surveyors compass

prismatic compass:-



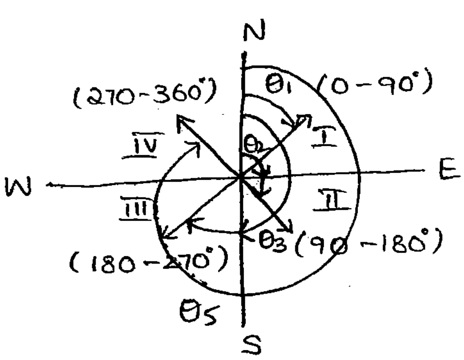
1. The angles are measured from 0° to 360°. This system is called whole circle bearing system (W.C.B)
2. Sighting the object and taking the readings are done simultaneously.

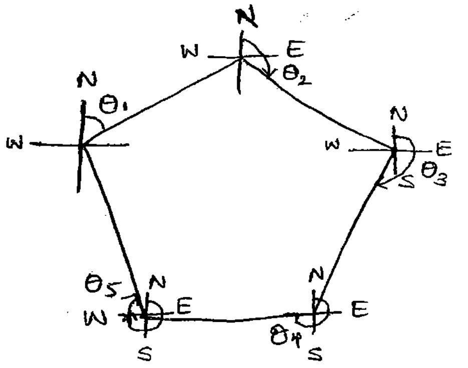
Surveyors compass:-



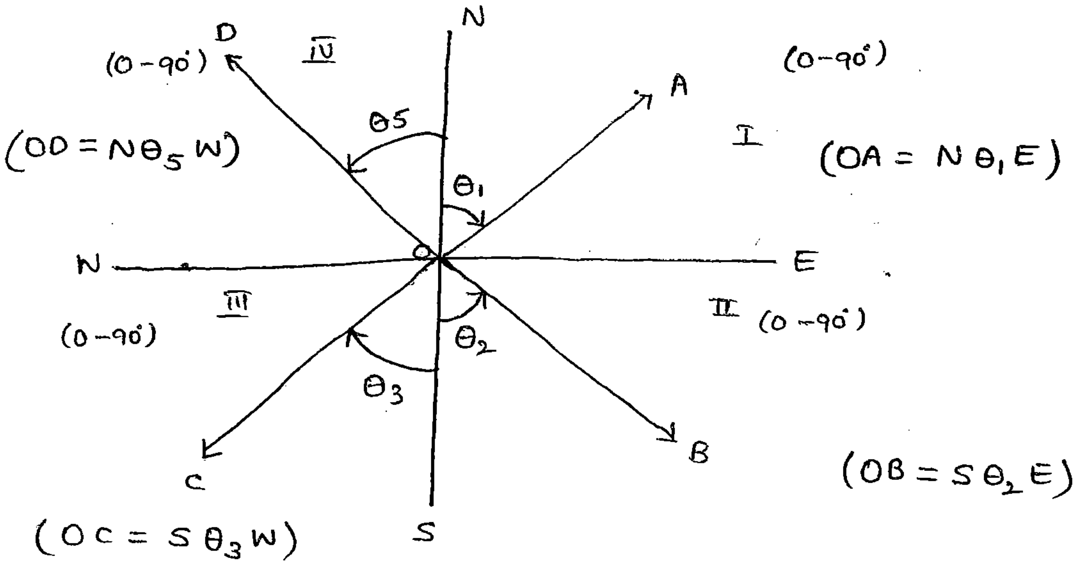
1. Angles are measured ranges from 0° to 90°. This system is called Reduced Bearing system (R.B) (or) Quadrental Bearing system (QB)
2. Sighting the object and taking the readings are not done simultaneously.

** Whole circle Bearing system (W.C.B):-





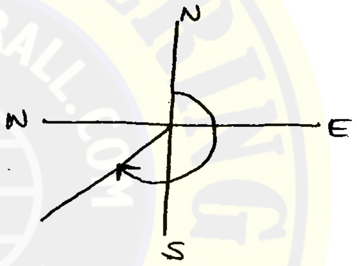
** Quadrental Bearing system:-



EX:- If the quadrantal bearing of a line is S 10° W then the W.C.B of line is?

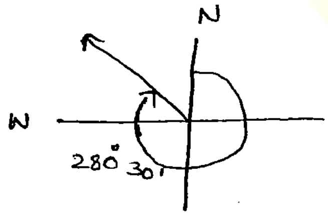
A. W.C.B = 180 + 10°

= 190°



EX:- If the W.C.B of a line is 280° 30' then R.B is

A.



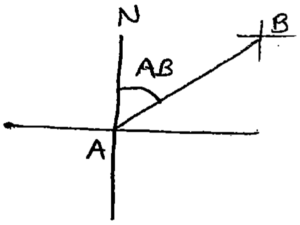
R.B = 360° − 280° 30'

= 79° 30'

= N 79° 30' W

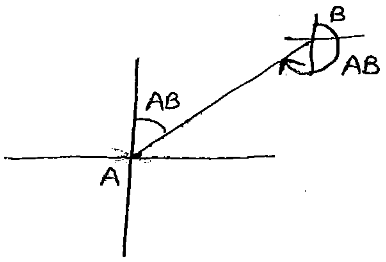
Fore bearing (F_b):-

The bearing of a line in the direction of progress of survey is called Fore bearing or Forward bearing



Back bearing (BB) :-

It is also known as reverse bearing. The bearing of a line in the opposite direction is known as Back bearing



B·B of AB

(or)

F·B of BA

Local attraction:-

The magnetic needle is deflected from its normal position when it is place near to external attractive forces such as steel structure and magnet such a disturbing influence is known as Local attraction.

If the difference between Fore bearing and back bearing is 180° there is no local attraction of both the stations

B·B = F·B ± 180°

+ve, if F·B is less than 180°

-ve, if F·B is greater than 180°

EX:- If F·B of AB is 60°, then B·B of AB ?

B·B of AB = F·B of AB + 180°

= 60° + 180°

= 240°

EX:- If FB of AB is 200°, then BB of AB ?

B·B· of AB = F·B of AB - 180°

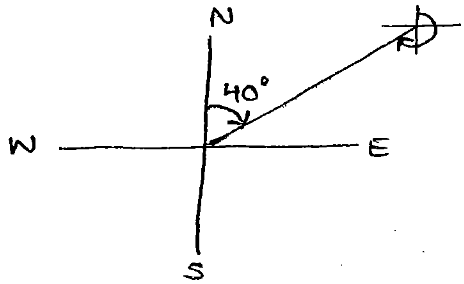
= 200° - 180°

= 20°

Quadrantal Bearing system:-

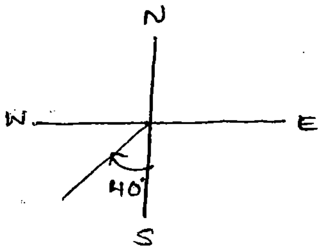
In the Quadrental Bearing system the F.B and B.B are numerically equal but with opposite sign.

Ex:-



F.B of AB = N 40° E

B.B of AB = S 40° W



Types of Meridians:-

There are basically two types of meridians.

1. True meridian
2. Magnetic Meridian

True meridian:-

1. True meridian at a point is passing through that point and geographical North and south poles of earth surfa

2. The horizontal angle between the true meridian and a given line is called the true bearing of a line or Azimuth.

3. The direction of true meridian at a point is invariabl

Magnetic Meridian:-

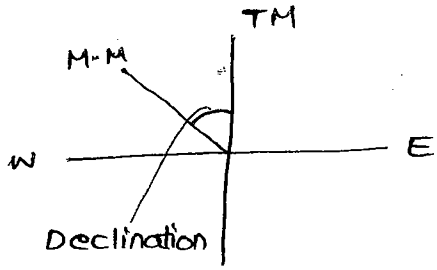
1. The angle between the magnetic meridian and given line is called Magnetic bearing or Bearing of a line.

2. The direction indicated by a freely suspended and properly balanced and magnetic needle unaffected by local attractive forces is called Magnetic meridian or the magnet north and south line.

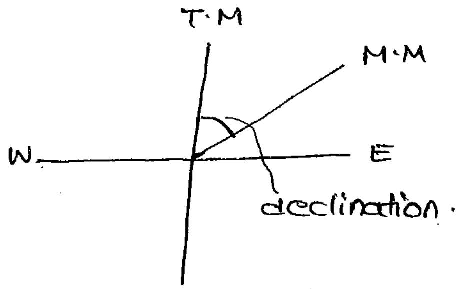
~~Enclinati~~ 3. It will change slowly with respect to time.

Declination:-

1. The Horizontal angle between the magnetic meridian and True Meridian is called Declination or Magnetic Declination.



We
Towards East



Towards East

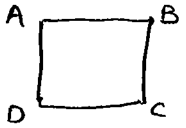
2. The relation between these two is indicated as

T·B = M·B ± Declination.

+ve, if declination is towards East
-ve, if declination is towards west

Ex:-) ABCD is a square, if bearing of AB is 20° then bearing of DC is.

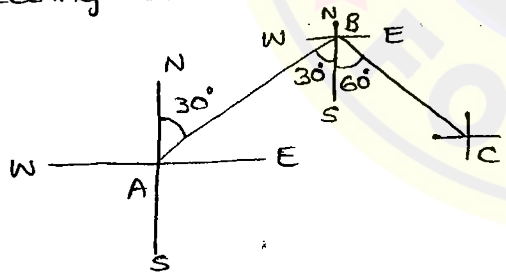
A. In a square bearing of AB = bearing of DC and bearing of BC = bearing of AD.



Bearing of AB = Bearing of DC = 20°

Ex:-) ABCD is a square, if bearing of AB is N 30° E then bearing of BC is.

A.



Bearing of AB = N 30° E
Bearing of BC = S 60° E

Ex:- If a true bearing of a line is 260° then its Azimuth is.

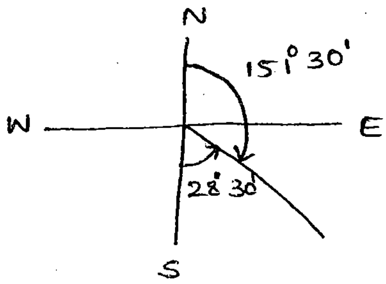
A. Azimuth of a line is 260°.

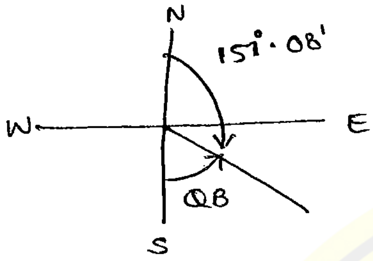
Ex:- The magnetic bearing of a line is 48° 24'. If the magnetic declination is 5° 38' E. Then true bearing of a line is.

A. True bearing = M·B + Declination
= 48° 24' + 5° 38'
= 54° 02'

EX:- The magnetic bearing of a line is S 28° 30' E. If the magnetic declination is 5° 38' E. Then the true bea of the line is?

A.





A.B of line = S 28° 30' E

W.C.B of AB line = 180° − 28° 30'

= 151° 30'

declination = + 5° 38' (Eas

T.B = M.B + declination

= 151° 30' + 5° 38'

T.B = 157° 8'.

= N 157° 08' E

Quadrantal bearing = 180° − 157° 08

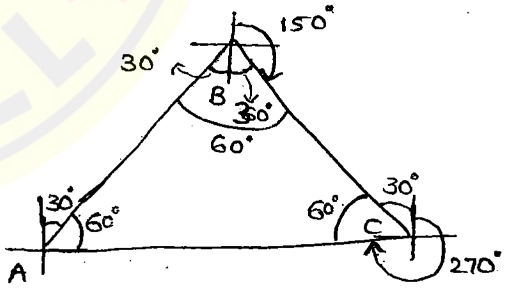
= S 22° 52' E

EX:- In a triangle ABC the bearings of AB, BC and CA are 30°, 150°, 270° respectively. Then it is

A) Equitateral triangle B) Isosceles triangle

c) Right angle triangle D) None of the above.

A. Equilateral triangle



Types of declinations:-

The declination at a place does not remains consta but it changes from time to time. There are four types of variations.

Secular variation:-

1. Secular variation of declination occurs over a long perio of time like 100 years or 150 years

2. The annual rate of change of secular variation is generally vary between 5' to 10'

8. Annual variation:-

1. The variation of declination in one year is called Annual variation.
2. the annual variation is independent of secular variation and it varies from place to place and from year to year.
3. these value ranges from 1' to 2'

Diurnal variation:-

1. The variation of declination in one day is called Diurnal variation.
2. It depends upon locality, season and time
3. It ranges from 3' to 12'

Irregular variation:-

1. The variation of declination occur due to natural phenomena like Earthquakes, volcanic erruptions.

Ex:-) The following bearings were observed while traversing with a compass. Which stations were affected by Local attraction

Line	F B	B.B
AB	124° 30'	304° 30'
BC	68° 15'	246° 0'
CD	310° 30'	135° 15'
DA	200° 15'	17° 45'

A) A & B

B) B & C

c) C & D

D) None.

A. B.B = F.B ± 180°

AB line → B.B − F.B = 180

304° 30' − 124° 30'

180 = 180

∴ No local attraction at A & B.

∴ Local ~~Loc~~attraction is only at 'c'.

CD line → $135^\circ 15' - 310^\circ 30' = \pm 180^\circ$

$-175^\circ 15' \neq \pm 180^\circ$

∴ Local attraction at C & D stations.

Isogonic line:-

1. An imaginary line passing through equal declination on the surface of earth at a given time.

Agonic line:-

1. An imaginary line passing through 0° zero declination poin is known as Agonic lines.
2. On the Agonic line the true meridian and the magnetic meridian coincide each other.

Dip of needle:-

1. The inclination of needle with the horizontal is know as dip of needle.
2. It is 0° at the equator and 90° at the poles

~~3. Isoclini~~

Isoclinic line:-

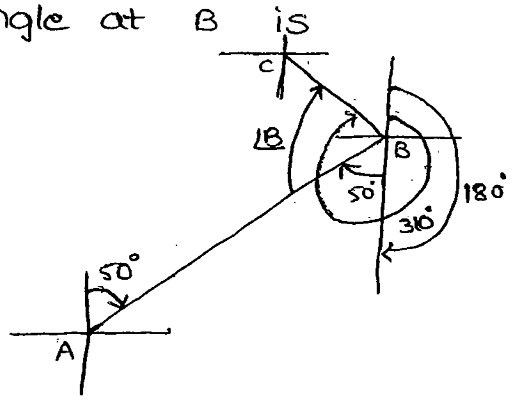
1. An imaginary line passing through equal amount of dip of needle on the earth surface.

Aclinic line:-

1. An imaginary line passing through zero dip of the need

Ex:- If bearing of AB 50°, bearing of BC 310° then the angle at B is

A·



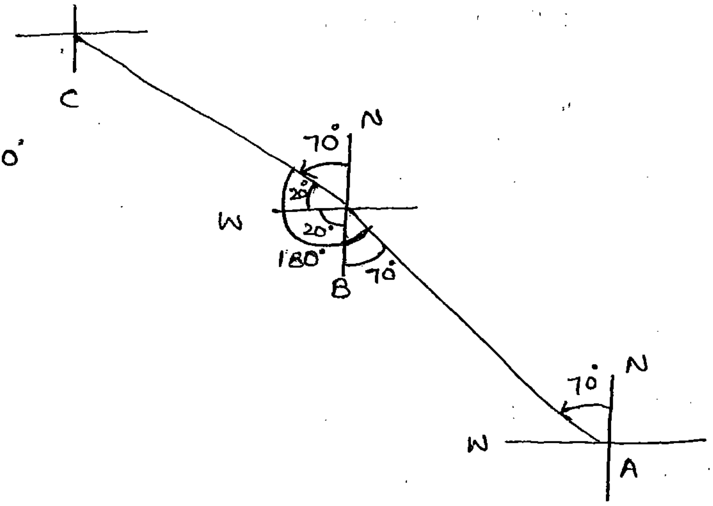
$\angle B = 310^\circ - (180^\circ + 50^\circ)$

$= 80^\circ$

Ex:- The bearing of AB N 70° W and bearing of BC N 70° W

Then $\angle B = ?$

A·

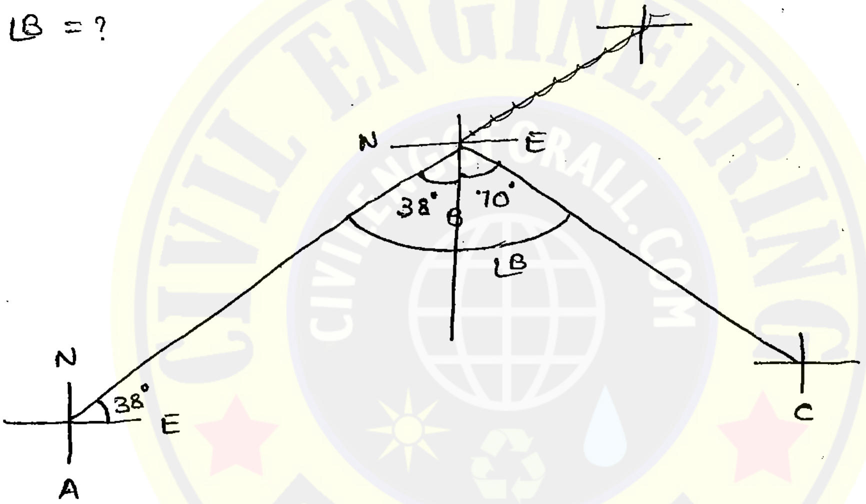


$\angle B = 70° + 20° + 20° + 70°$

$= 180°$

Ex:- The bearing of AB N 38° E and bearing of BC S 70° E

Then $\angle B = ?$



$\angle B = 38° + 70° = 108°$

Sources of errors in compass:-

Instrumental error:-

It is related to needle and graduated circle

Errors of manupulation and sighting:-

Centering, levelling and reading

Errors due to external influences :-

These is related to local attraction and declination.

UNIT – 11

PLANE TABLE SURVEYING

It is graphical method of surveying where the field wor and plotting are done simultaneously.

1. It is adopted for small scale mapping and medium scale mapping where great accuracy is not required.
2. There is no possiblity of ommiting the measurements as the map is plotted in the field.
3. It is particularly advantages in magnetic areas where compa survey is not reliable.
4. The instrument used in the plane table surveying is "Alida
5. The working edge of the Alidate is called Fudicial edge. This is also called bevelled edge.

6. Principle of plane table surveying:-

Orientation:-

1. The preparation of keeping the plane table at each stati parallel to the position occupied at the previous station i known as Orientation.

Methods of plane table:-

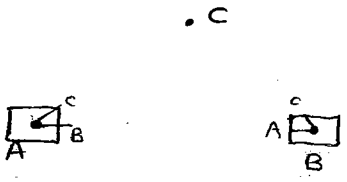
1. Radiation:-

These method is suitable for survey of small areas which can be done for a single station.

2. Intersection:-

In these method a point is fixed on the drawing sheet by drawing the lines from two plane table stations to that point and find the point of intersection of two lines.

It is employed when inaccesible points to be surveyed



3. Resection:-

Resection is the process of finding the location of plane table station with the help of known locations. The principle of Resection is opposite to intersection method.

Resection is done by following methods.

a. compass method.
b. Back ray method
c. Three point method
d. Two point method.

The several methods for the solution of Three point method are:

1. Trial and error method or Lehmans method.
2. Bessels method Mechanical method (or) Tracing paper method
3. Graphical method (or) Bessels method.
4. Analytical method
5. Geometrical construction method.

The two point problem is more leborious to three point problem.

Lehman's method:-

It is more accurate and quick

Telescopic Alidade:-

The instrument used in plane table surveying for finding the horizontal distances without actual measurement is called Telescopic Alidade.

4. Traversing:-

It is used to plot the areas.

Orientation:-

Orientation by back sighting is more accurate than magnetic needle method.

UNIT- 6

LEVELLING

Level surface:-

Level surface is a surface that is perpendicular to the direction of gravity at every point.

EX:- Surface of still water in a lake.

Surface of sea water which is not affected by tides

Geoid :-

The mean sea level at a particular location on earth surface extended in all directions creating and undulating spheroi is known as Geoid. It is also called equi potential gravity surface.

Elevation:-

It is the verticle distance of the point above or belo the datum surface.

Altitude:-

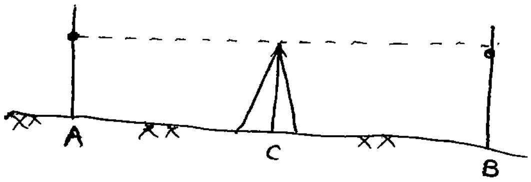
It is the verticle distance of the point above or below the mean sea level.

Methods of levelling:-

1. Direct method (spirit levelling):-

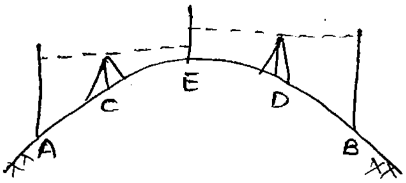
a. simple levelling:-

Find the difference of elevations of two points which are visible from a single position of instrument.



b. compound levelling:-

It is also known as differential levelling. Find the difference of elevations of two points requires more than one instrument stations.

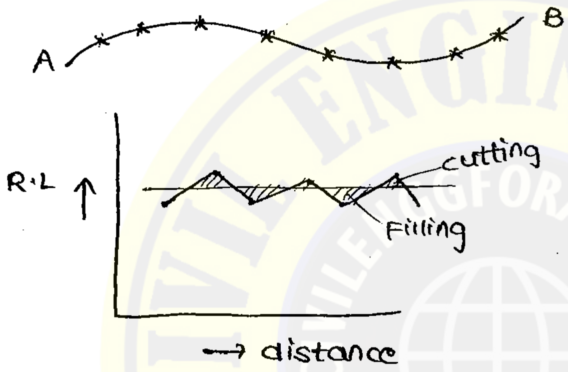


c. Fly Levelling:-

It is used for Reconnaisance of the area for approximate checking of the levels.

d. profile Levelling:-

It is used for plotting Longitudinal section for fixing the gradient and finding the earthwork quantities.



e. Reciprocal Levelling:-

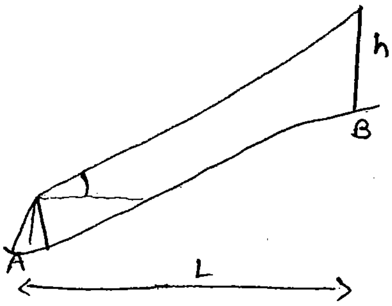
It is used for finding the elevation of difference of two points which are having certain distance and it is not possible to setup the instrument in between the two points.

Ex:- River

2. Indirect Me Levelling:-~~(Trig~~

1. Trigonometrical Levelling:-

Difference of elevations is finding indirectly from the horizontal distance verticle angle and trigonometrical relations.



2. Barometric Levelling :-

Difference of elevations is finding indirectly from the changes in the atmospheric pressure.

3. Hypsometric Levelling :-

The elevation difference is finding with respect to the temperature, where the water starts boiling.

3. Barometric Levelling :-

a. Levelling staff :-

Each 1 m is divided into 200 divisons. The least count is 5 mm.

b. Level :-

Telescope is used for level.

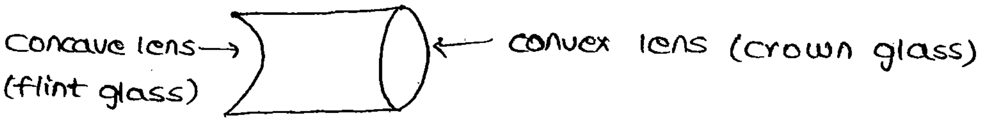
Optical defects of lens :-

1. The telescope of a level consists of two convex lenses
2. It is assumed that lenses having neglijible thickness an diameter.
3. But in actual telescope the thickness and diameter of lenses are not neglijible.
4. These results the optical defects of lens.
5. They are two types of optical defects of lenses.

a. Chromatic abberation :-

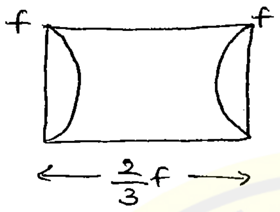
1. It occurs in a telescope because of dispersion of light.

2. It is remedial by using two lenses to form object glass consists of a convex lens and a concave lens

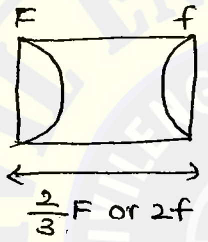


b. spherical abberation:-

It occurs due to the spherical surfaces of the lens. Because of spherical abberation the rays incident on the edges of the lens are refracted more than the rays incident on the centre of the length. It is remedial by using Ramsden's eye piece. It is made up of with two identical plano convex lenses with curved surfaces faced towards each other and place at a distance of 2/3rd of focal length.



If different focal lengths are used



The relation between F and f is $\frac{2}{3}F = 2f$

$$\boxed{f = \frac{F}{3}}$$

Power of the lens:-

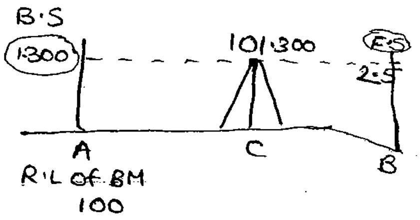
1. It is the reciprocal of the focal length of the lens.
2. The unit of power is "Diopter".
3. If focal length of the length is 0.1 m then power of the length is 10 diopters.

Station:-

It is the point where the levelling staff is held.

Height of Instrument (HI):-

It is elevation of Line of sight with respective reference point



H·I = R·L of BM + Reading at A

= 100 + 1.3

= 101.300

Back sight (or) plus sight:-

The reading taken on Levelling staff held at known elevation.

Fore sight (or) Minus sight:-

Reading taken on the levelling staff kept at another point whose elevation is required.

R.L of B = 101.3 − 2.500

= 98.800

There are two methods to find the elevation difference from the observed staff reading.

1. H.I method:-

R.L. of B.M at A = 100

B.S at A = 1.300

H.I = R.L of BM at A + B.S at A

= 100 + 1.300

= 101.300

F.S at B = 2.500

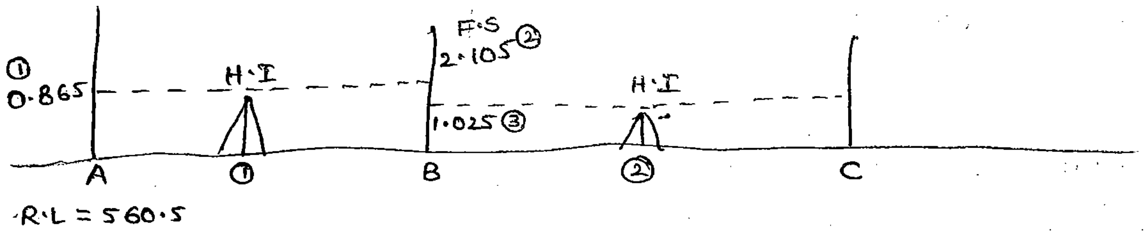
R.L of B = H.I − F.S

= 101.300 − 2.500

= 98.800

Station	BS	IS	FS	HI	RL	Remarks
A	0.865			561.365	560.500	BM
B	1.025		2.105	560.285	559.260	CP
C		1.580			558.705	
D	2.230		1.865	560.650	558.420	CP
E	2.355		2.835	560.170	557.815	CP
F			1.760		558.410	

ΣB.S = 6.475 ΣF.S = 8.565



Arithmatic check :-

Σ BS = 6.475

Σ FS = 8.565

Σ BS − Σ FS = R.L of last point − R.L of first point

6.475 − 8.565 = 558.410 − 560.500

2.090 = 2.090

Hence O.K

Rise and Fall method :-

Station	BS	IS	FS	RISE	FALL	R.L	Remark
A	0.865					560.50	BM
B	1.025		2.105		1.240	559.260	CP₁
C		1.580			0.555	558.705	
D	2.230		1.865		0.285	558.420	CP₂
E	2.355		2.835		0.605	557.815	CP₃
F			1.760	0.595		558.410	
	ΣBS = 6.475		ΣFS = 8.565		ΣF = 2.685		

Arithmatic check:-

Σ BS − Σ F.S = Σ Rise − Σ Fall = Last R.L − First R.L

6.475 − 8.565 = 0.595 − 2.685 = 558.410 − 560.50

− 2.09 = −2.09 = − 2.09

∴ Hence OK.

P·g NO:- 44·

29· R·L of B·M = 100, B·S = 2·30 m, F·S = 2·45 m R·L of A = ?

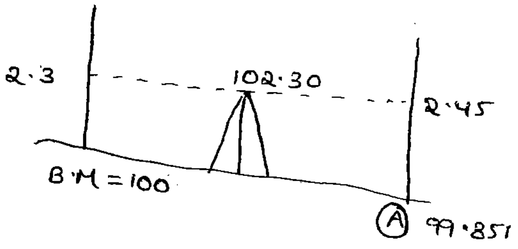
H·I = R·L of BM + BS

= 100 + 2·30

= 102·30 m

R·L of A = H·I − F·S

= 102·30 − 2·45 = 99·85 m



30· H·I = R·L of B·M + B·S (inverted staff reading −ve)

= 200 − 1·500

= 185·5 m

R·L of A = H·I − F·S (same kept on the ground)

= 198·5 − 2·5 = 196·00 m

33· Arithmatic check

ΣBS − ΣF·S = R·L of Last point − R·L of first point·

12·63 − 13·03 = 194·43 − x

x = 194·830 m

35· ΣBS − ΣFS = ΣRise − ΣFall

2·670 − (7·670x) = 1·10 − 7·705

x = 1·605 m

P·g NO:- 47·

4· H·I = R·L of A + B·S

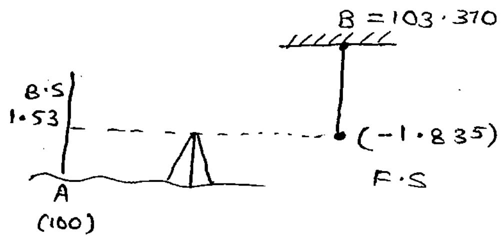
= 100 + 1·53 = 101·53 m

R·L of B = HI − F·S

= 101·53 − (−1·835) ⇒ 101·53 + 1·835 = 103·370 → Inverted staff reading

= 103·370 − 100

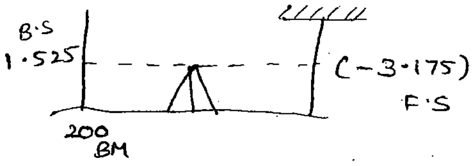
= 3·370



6. $H \cdot I = R \cdot L$ of $BM + BS$

$= 200 + 1 \cdot 525$

$= 201 \cdot 525 m$



R·L of forward station $= H \cdot I - F \cdot S$

$= 201 \cdot 525 - (-3 \cdot 175)$

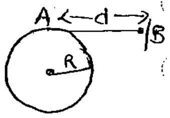
$= 204 \cdot 700 m$

Curvature and Refracture correction:-

1. Curvature correction:-

The effective curvature of earth surface is cause the object sighted appear lower than the actual position.

Therefore the error is positive and correction is negative



$C_c = -0 \cdot 0785 d^2$

d = distance between two points in 'km'

2. Refraction correction:-

The effect of Refraction is to make the object is sighted appear higher than actual position. Therefore error is negative and correction is positive.

$C_R = +0 \cdot 0112 d^2$

3. Combined correction for curvature and Refraction:-

$C = C_c + C_r$

$= -0 \cdot 0785 d^2 + 0 \cdot 0112 d^2$

$C = -0 \cdot 0673 d^2$

Note:-

$C_r = \frac{1}{7}$ of correction for curvature. This is relation between C_c and C_r.

P.g. No:- 45

39. $d = 1$ km, $C_r = 0 \cdot 0112 d^2$

$= 0 \cdot 0112 (1)^2$

$= 0 \cdot 0112 m$

40. $d = 3000 m = 3$ km

$C = -0 \cdot 0673 d^2$

$= -0 \cdot 0673 (3)^2$

$= -0 \cdot 606 m$

P.g NO:- 47

14. Given $d = 1400\, m = 1.4\, km$

$c = -0.063 d^2$

$= -0.063 (1.4)^2$

$= -0.132\, m$

Reciprocal Levelling:-

Reciprocal Levelling is used to find the difference of elevation of two points and it is not possible to setup the instrument in between the two points.

Level difference between A and B $= \frac{1}{2}[(a-b)+(a_1-b_1)]$

Note:-

This method eliminates error due to curvature and Refraction and the collimation error [i.e., the line of collimation not exactly parallel to the bubble line].

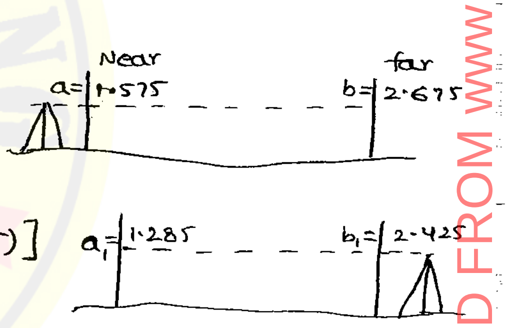
P.g NO:- 45.

44.

$\frac{1}{2}[(a-b)+(a_1-b_1)]$

$= 0.5[(1.575 - 2.675) + (1.285 - 2.425)]$

$= 1.12\, m$

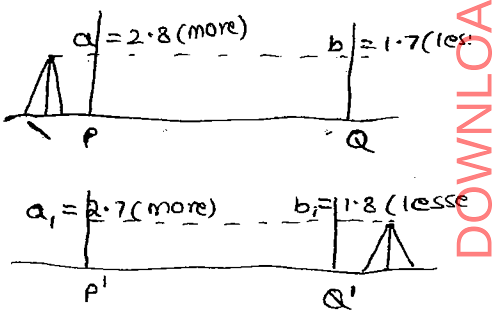


P.g No:- 47

13. R.L of P = 100

Level difference b/w P & Q = 1m

The reading at Q are lesser than the reading at the P.



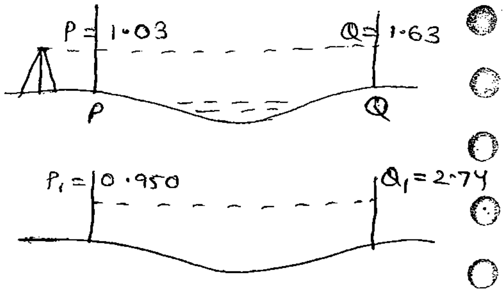
∴ The point "Q" is higher elevation with respect to P.

R.L of Q = R.L of P + 1

= 100 + 1

= 101 m

P.g NO:- 49.



27. $\frac{1}{2}\left[(1.03 - 1.63) + (0.950 - 2.74)\right]$

$= 1.195 m$

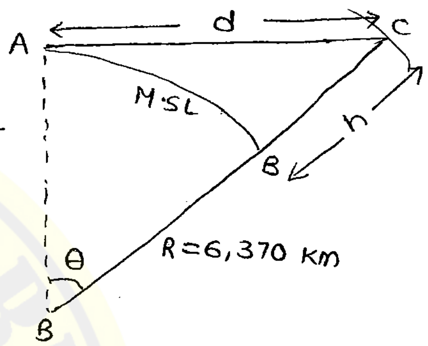
R.L of Q = 450 − 1.195 = 448.8 m

Note:-

The readings at the 'Q' are more than the reading at 'P'.

∴ The 'Q' point is lower than 'P' point.

Distance of visible horizon:-



'C' is a point at an elevation 'h' above the M.S.L point A on the horizon has observed from the point C can be indicated by using following formulae.

$$d = \sqrt{\frac{h}{0.0673}}$$

$$= 3.853\sqrt{h}$$

Dip of horizon (θ) = Ratio between d and Radius of earth surface (R)

$$\theta = \frac{d}{R} = \frac{d}{6.370}$$

where, R = radius of earth surface.

P.g No:- 45.

41. $d = \sqrt{\frac{h}{0.0673}} = \sqrt{\frac{200}{0.0673}} = 54.49$ km

P.g NO. 48

20. $h = 9+25 = 34m$

$d = \sqrt{\frac{h}{0.0673}} = \sqrt{\frac{34}{0.0673}} = 22.47$ km

24. d = 60 km, $h = 0.0673 d^2$

$= 0.0673(60)^2$

$= 242.28 m$

Sensitivity of bubble tube :-

The sensitivity is defined as the angular value of 1 divison of bubble tube. (or) It also defined as its capacity to indicate small divison from horizontal position when it is disturb

Factors effecting the sensitivity :-

1. Larger the radius of tube, greater the sensitivity.
2. Larger the length of the divison, the greater the sensitivity.
3. The larger diameter of tube, the greater the sensitivity.
4. Larger the length of the Q, the greater the sensitivity.
5. lesser the viscosity and surface tension of the liquid in the tube greater the sensitivity.

S = D/f b/w two staff readings.

D = Distance between instrument station to staff station

α = angle between the line of sight and horizontal express in Radians.

R = Radius of curvature of bubble tube.

l = Length of 1 divison on the bubble tube [2mm]

n = no. of divisons the centre of bubble is moved.

The relation between two parameters

$$\alpha = \frac{S}{D} = \frac{nl}{R}$$

$$\alpha = \frac{l}{R} = \frac{S}{Dn}$$

$$\alpha = \frac{nl}{R} \times 206265$$

$$\alpha = \frac{S}{Dn} \times 206265$$

P.9 NO:-46.

49. $n=5$, $D = 80\,m$

$S = 1.6 - 1.52 = 0.08\ m$

$\alpha = \frac{S}{Dn} \times 206265$

$= \frac{0.08}{80 \times 5} \times 206265$

$= 41.25$ sec

50. $D = 100$ m

$n = 5$, $l = 2$mm $= 0.002$ m, $S = 0.050$ m $R = ?$

$$\frac{l}{R} = \frac{S}{Dn}$$

$$R = \frac{l \times Dn}{S}$$

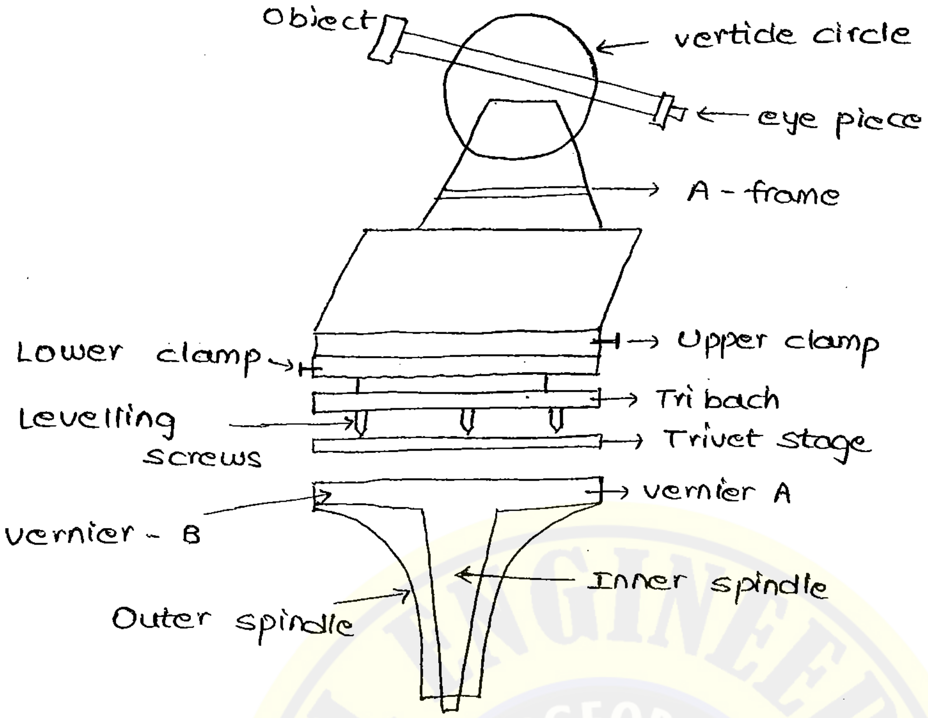
$$= \frac{0.002 \times 100 \times 5}{0.050}$$

$$R = 20\text{m}$$

30-11-2017

UNIT - 4

THEODOLITE SURVEY



1. Theodolite is used for measuring both horizontal and verticle angles.

2. Based on least count, theodolites are two types
   a. Vernier theodolite (L.C = 20")
   b. precise theodolite (L.C = 1")

Horizontal angle:-

1. Horizontal angle measured with Horizontal scale.
2. It consists of Upper plate and Lower plate. It also consists of Main scale (°, ') and vernier scale (' min and '' seconds). vernier A &
3. Horizontal angle measures 0° to 360°. Each degree is divide into 3 parts (20') and 1' is divided into 3 parts (20")

Verticle angle:-

1. Verticle angle ranges from 0° to 90°.
2. It consists of Main scale (each part is 20') and vernier scale (each part is 20"). It consists of vernier C and vernier

Functions of Upper clamp screw and Lower clamp screw:-

1. When upper clamp screw is tightened but lower clamp screw is loose. so vernier scale readings is do not change.

2. When lower clamp screw is tightened but upper clamp screw is loose. so the vernier readings is change.

Line of collimation:-

1. It is the imaginary line passing through the intersection of cross hairs of diaphram and optical centre of objective and its continuation.

Face left condition:-

If the verticle circle is left side on the observer then the theodolite is in Face left condition.

Face right condition:-

If the verticle circle is on the right side of the observor then the theodolite is in Face right condition.

Swinging of the telescope:-

It is the process of turning the telescope in horizontal plate. Rotation of telescope in clock wise direction then it is called Right swing. Rotating the telescope in anticlock wise direction then it is called left swing.

Plunging the telescope:-

It is the process of rotating the telescope in verticle plane it is called plunging. It is also known as Transiting or Reversing.

Double sighting:-

The process of measurement of Horizontal angle and verticle angle in both the conditions.

Temporary adjustments:-

It is also known as station adjustments. Sequence of Station adjustments are:

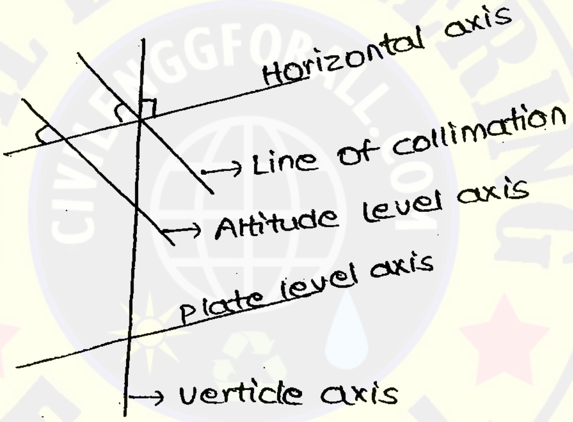
1. setup the instrument
2. centering
3. Levelling
4. Focussing the eye piece
5. Focussing the objective.

Horizontal axis:-

It is also known as Trunion axis (or) Elevation axis(o Transverse axis. The line passing through bearings at the top o standards

Verticle axis:-

The line passing through centres of inner spindle, Outer spindle and upper parallel plate. verticle axis also call Azimuth axis.

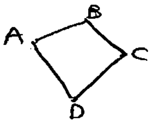


Methods of Theodolite:-

The following methods are used for measuring angl theodolite traversing.

1. Loose needle method (or) Free needle method.
2. Fast needle method – More accurate than first method.
3. Method of included angles.

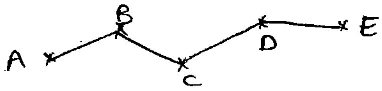
It is more accurated than second method.



This three methods are close Traverse

4. Method of direct angles
5. Method of deflection angles.

} Used for open traverse.



Permanent adjustments of theodolite:-

1. Adjustment of plate level.
2. Adjustment of Line of sight.
3. Adjustment of Horizontal axis.
4. Adjustment of Altitude bubble and verticle index frame.

Errors in theodolite surveying:-

1. Instrumental errors
2. Personal errors
   a. Errors in manupulation
   b. Errors in sighting and reading.
3. Errors due to natural causes.
   a. Due to temperature effect.
   b. Wind effect
   c. Refraction effect

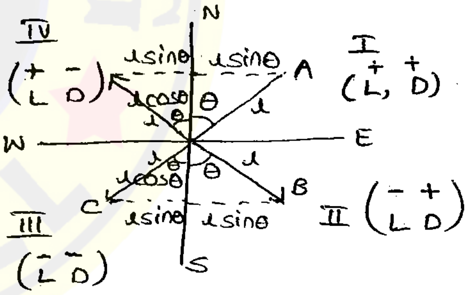
Lattidude and Departure:-

The projection of a line parallel to the meridian is called Lattitude.

$L = l \cos\theta$

l = Length of the line

θ = reduced Bearing



The projection of a line perpendicular to the meridian is called Departure.

$D = l \sin\theta$

North Lattitude:-

It is also known as Northing, denoted with '+ve'.

South Lattitude:-

It is also known as southing, denoted with '-ve'.

East Departure:-

It is also known as Easting, denoted with '+ve'.

West Departure:-

It is also known as westing, denoted with '-ve'.

The Latitude and Departure of any point with respe to previous point are known as consecutive coordinates of the point.

The coordinates of any point represented with respect t common origin are known as Independent coordinates of the poi

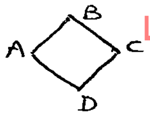
Length of the line $= \sqrt{L^2+D^2}$

$$\tan\theta = \frac{\text{Departure}}{\text{Latitude}}$$

Checks in a closed Traverse:-

1. Loop traverse:-

The end station is closing at starting station that i called Loop traverse.



The following two conditions should be satisfied.

1. The algebraic sum of all the lattitudes should be equal to ze

$$\Sigma L = L_1 + L_2 + L_3 + \cdots\cdots = 0$$

In other words the arithmatic sum of Northings shoul be equal to the Arithmatic sum of southings.

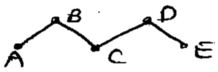
2. The algebraic sum of all the departures should be equal t zero.

$$\Sigma D = D_1 + D_2 + D_3 + \cdots\cdots = 0$$

In other words the arthmatic sum of Eastings should be equal to arthmatic sum of westings.

2. Link traverse:-

The end station ending at known elevation then the traverse is known as Link traverse. The following two condi-tions should be satisfied in Link traverse.



1. The algebraic sum of all the lattitudes should be equa to the difference in Latitude of last point and first point

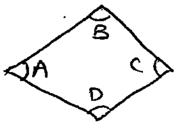
$\Sigma L = L_1 + L_2 + L_3 + \cdots\cdots$ = 'L' of Last point − 'L' of firs point

2. The algebraic sum of all the departures should be equal t the difference in departure of Last point and First point.

$\Sigma D = D_1 + D_2 + D_3 + \cdots\cdots$ = 'D' of Last point − 'D' of first point

Angle misclouser:-

1. It is necessary to find the angle of misclouser in closed Traverse. It is equal to the difference between the actual sum of the measured angles and theoritical sum.



$$\angle A + \angle B + \angle C + \angle D = \bigcirc \text{ (theoritical sum)}$$

$$= (2n-4)90.$$

2. The theoritical sum of included angle $= (2n-4)90$

n = no. of sides of a traverse

If $n = 4$

$\Rightarrow (2\times4-4)90$

$\Rightarrow 360^\circ$

3. The permissible angle misclosure will depend upon the purpose of the traverse and accuracy required.

$$E = K\sqrt{n}$$

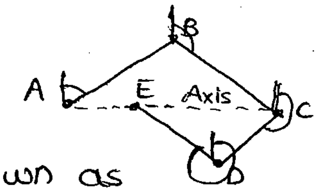
n = no. of sides of a traverse

K = L.C. of the theodolite.

$$E = 20''\sqrt{4}$$
$$= 40''$$

Linear Misclouser:-

It is also known as Error of closure. The end point of a closed traverse is not coincide with starting point the distance 'AE' is called "Linear Misclouser".



$$AE = \sqrt{ED^2 + EL^2}$$

Relative error of closure it is also known as

Relative accuracy or degree of accuracy $= \dfrac{\text{Error of closure}}{\text{perimeter of the traverse}}$

$$AE = \frac{E}{P}$$

The following methods used for adjustments of error of closure.

1. Arbritary method:-

The linear misclouser is distributed randomly based o field conditions.

2. Compass Rule:-

It is also known as Bowditch rule. It is generall used for adjusting the traverse where the angles and distanc are measured with the same accuracy.

$$\frac{\text{Error in Latitude or Departure of a traverse line}}{\text{Total error in lattitude or Departure}} = \frac{\text{Length of that line}}{\text{perimeter o the travers}}$$

When the traverse is adjusted by this rule both length of the lines and bearing of the lines are changed slightly.

3. Transit Rule:-

It is used in theodolite traverse where the angular measurement are more precise than linear measurements.

$$\frac{\text{Error in lattitude or departure of any line}}{\text{Total error in lattitude or departure}} = \frac{\text{The value of lattitude or Departure of that l}}{\text{Arthmatic sum of all t lattitudes or Departure}}$$

In the transit rule the angles are changed less but length of the line changed more.

4. Axis method:-

This method is applied to only length of the travers lines. The direction of the lines are unaffected the general shape of the traverse does not change.

$$\text{Correction to any line} = \frac{\frac{1}{2}\text{ of the closing error}}{\text{Length of the axis}} \times \text{Length of that li}$$

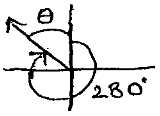
Ex:- The latitude of a line AB of length 204m and bearin 87° 30' is.

A. $L = l \cos\theta$

$= 204 \times \cos 87° 30'$

$= 8.89\,m$

Ex:- Departure of a line XY, of length 187m and bearing 280°.



A. $l = 187$ m

Bearing $= 280°$

$\theta = 360° - 280° \Rightarrow 80°$

$D = l \sin\theta$

$= 187 \sin 80°$

$D = 184 \cdot 16$ m

Ex:- Latitude and Departure of a line $-87 \cdot 86$m, $-0 \cdot 72$m respectively. Then find length and Bearing of that line.

A. Given $L = -87 \cdot 86$ m

$D = -0 \cdot 72$ m

$l = \sqrt{L^2 + D^2}$

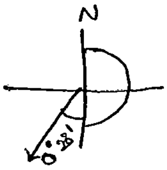
$= \sqrt{(-87 \cdot 86)^2 + (-0 \cdot 72)^2}$

$l = 87 \cdot 86$ m

$\tan\theta = \dfrac{\text{Departure}}{\text{Lattitude}} = \dfrac{-0 \cdot 72}{-87 \cdot 86} = 0 \cdot 0081$

$\theta = 0° 28'$ (Reduced Bearing).

'L' and 'D' both are negative the given line comes under third quadrant.

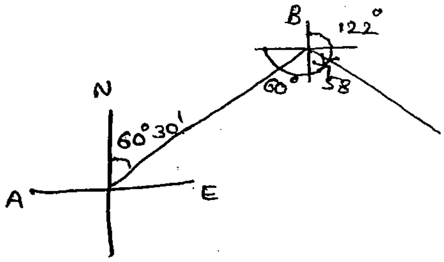


Bearing of line $= 180° + 0° 28'$

$= 180° 28'$.

Ex:- Latitude and Departure of a line is equal when the reduced Bearing of a line is equal to 45°

P.g NO:- 36



1. $180 - 122$

$= 58°$

$\angle B = 60° \cdot 30' + 58°$

$= 118° 30'$

2) L = +40 m   +20 m

D = −20 m   +30 m

$$L = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$$

$$= \sqrt{(40-20)^2+(30-(-20))^2}$$

= 53·85 m

6. e → +2

$\Rightarrow \frac{Ne}{N}$

⇒ The correction for third line is $\frac{3e}{N}$

N = No. of sides of traverse

$$= \frac{3e}{5}$$

$$= \frac{3 \times 2}{5}$$

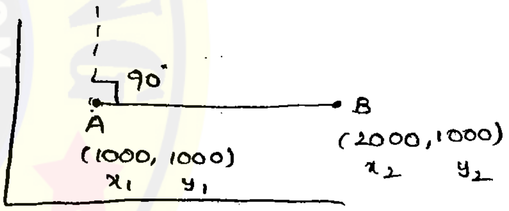
$$= 1^\circ \ 12'$$

P.9 NO:- 37

1. $\tan\theta = \frac{P}{L}$

$$= \frac{2000-1000}{1000-1000}$$

$\theta = 90^\circ$



3. ΣL = +5·080

ΣD = −5·406

$$l = \sqrt{(5\cdot080)^2+(-5\cdot406)^2}$$

= 7·42 m

Degree of accuracy $= \frac{l}{P}$

$$= \frac{7.42}{2052.5}$$

$$= \frac{1}{277}$$

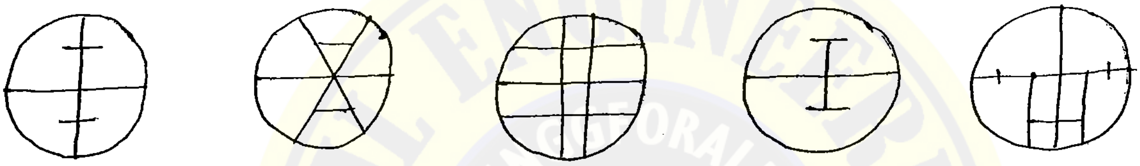
1 in 277.

UNIT - 8

TACHEOMETRY

Tacheometer is a theodolite arranged with a stadia diaphram having three horizontal lines. The two stadia lines i.e., upper and lower are equidistance from the central horizontal line.

1. Tacheometric surveying is also known as the optical distance measuring method because an optical instrument i.e., a tacheometer is used in the surveying
2. Various patterns of stadia diaphram are Upper stadia diaphragam and Lower stadia diaphragam.

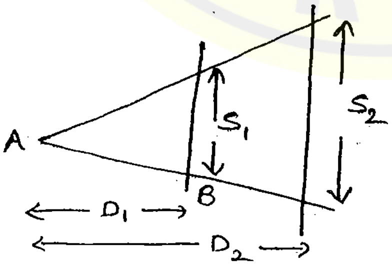


Methods of Tacheometric surveying:-

1. Stadia method :-

a. Fixed hair method:-

In this method the verticle spacing between upper and lower stadia hairs i.e., Stadia interval (i) is fixed and Staff intersect (s) is changing



Staff intersect (S) :-

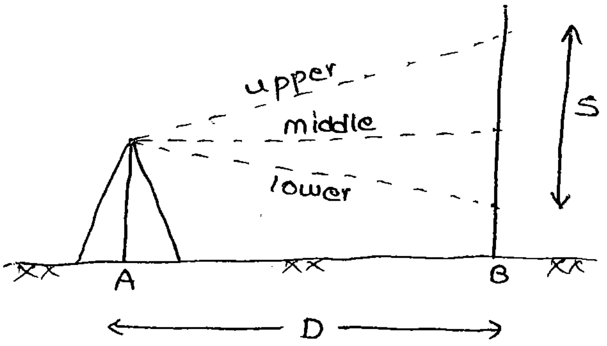
'S' is the difference in the reading with respect to upper and lower stadia hairs on the verticle staff.

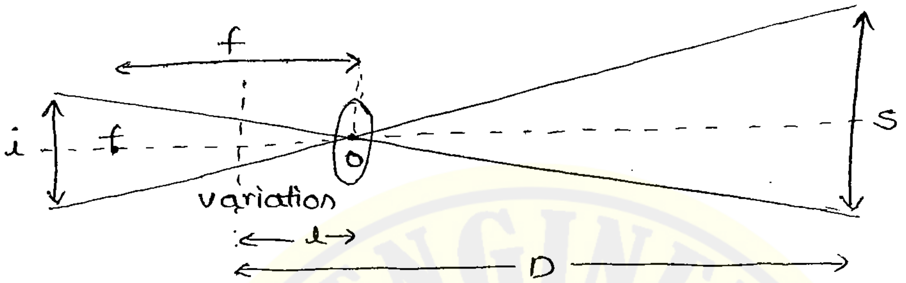
b. Movable Hair method:-

In this method the verticle spacing between the stadia hairs will be changes and staff intersect will be fixed.

Various methods of fixed hair method:-

i. Horizontal Line of sight :-





i = stadia interval

s = staff intersect

f = focus point

o = optical centre of objective length

The horizontal distance between instrument station and staf station

$$D = KS + C$$

where

K = a multiplying constant or stadia interval factor. Generally this value is 100.

$$K = \frac{f}{i} = \frac{\text{focal length}}{\text{Stadia interval}}$$

C = additive constant = (f+d)

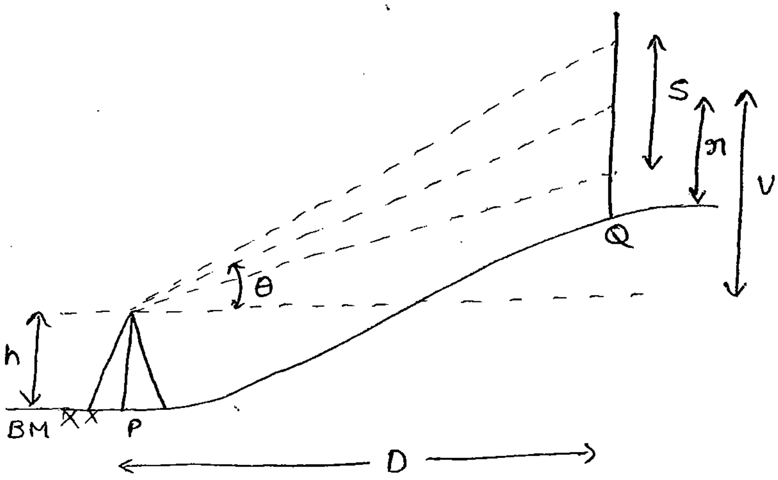
d = The distance between verticle axis of the instrument and optical centre of the objective.

C = 0.32 to 0.6 m for external focussing types of telescope.

C = 0.08 to 0.2m for internal focussing type of telesc

ii. Inclined sight with verticle staff :-

a. Angle of elevation :-



θ = verticle angle

r = central hair reading on the verticle staff

V = verticle intercept.

S = staff intersect.

$D = KS\cos^2\theta + C\cos\theta$

$V = \frac{KS\sin 2\theta}{2} + C\sin\theta$

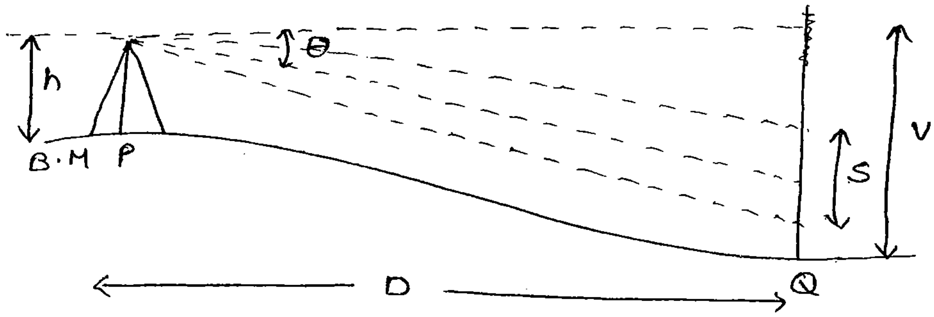
If analytical lens is used the additive constant, c = 0

$D = KS\cos^2\theta$

$V = \frac{KS\sin 2\theta}{2}$

R.L of Q = R.L of BM + h + (V − r)

b. Angle of depression :-

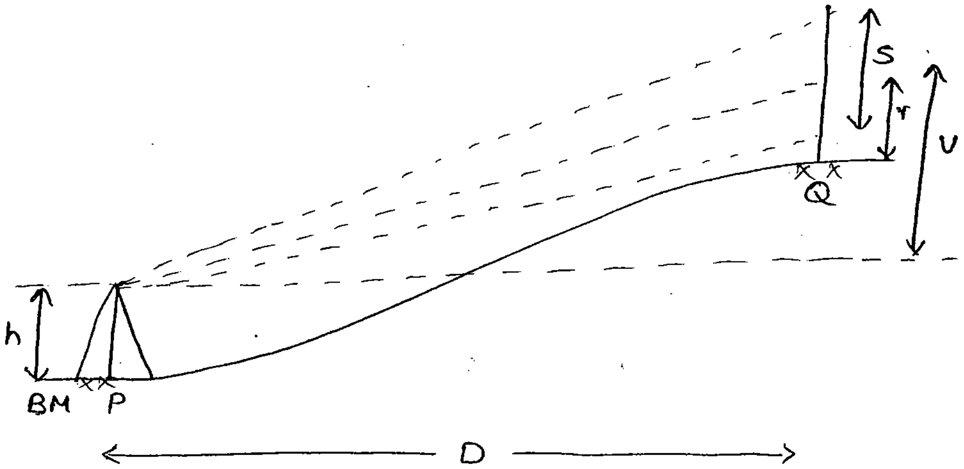


$D = KS\cos^2\theta + C\cos\theta$

$V = \frac{KS\sin 2\theta}{2} + C\sin\theta$

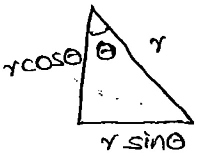
R·L of Q = R·L of BM − V − R· + h

iii) Inclined sight with staff normal to the Line of sight:-



$D = (KS + C)\cos\theta + r\sin\theta$

$V = (KS + C)\sin\theta$



If analytical lens is used, $C = 0$

$D = KS\cos\theta + r\sin\theta$

$V = KS\sin\theta$.

R·L of Q = RL of BM + h + V − rcosθ

Ex:-) The following readings were taken with a tacheometer with line of sight horizontal and a staff held verticle. Find the horizontal distance from the instrument station to the staff station $K = 100$, $C = 0{\cdot}15$ m and three staff readings are 0·950, 1·285, 1·620 m

A. Given staff readings 0·950, 1·285, 1·620

$S = 1{\cdot}620 - 0{\cdot}950$

$= 0{\cdot}670$

$D = KS + C$

$= 100(0{\cdot}670) + 0{\cdot}15$

= 67~~0~~·15.

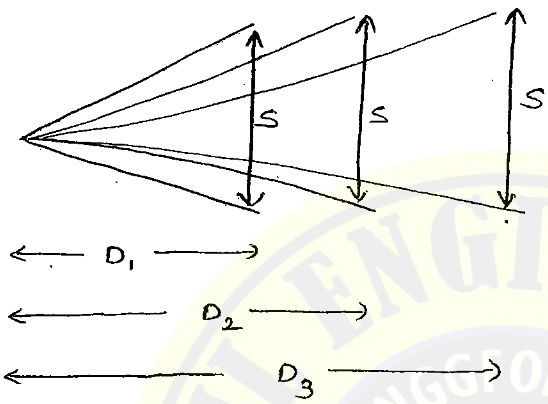
Ex:-) Find the distance between instrument station and staff station from the following data, verticle angle = −3°45' then staff readings 1·450, 0·900, 0·350 m. $K = 100$, $C = 0$.

A. Given staff readings 1.450, 0.900, 0.350

$$S = 1.45 - 0.35$$
$$= 1.100$$

$$D = KS\cos^2\theta$$
$$= 100\,(1.1)\cos^2(3^\circ 45')$$
$$= 109^\circ.53'$$

Movable hair method :-



i → changes
S → constant

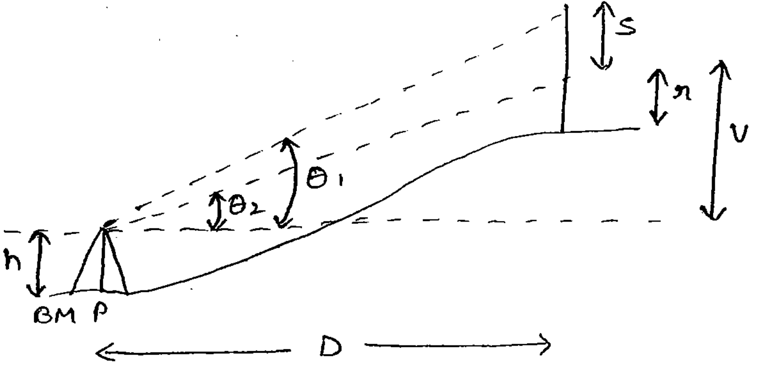
In this method a special type of instrument i.e, subtance theodolite having the arrangement of measuring the stadia interval (i) very accurately.

2. Tangential method :-

In this method two targets on the verticle staff is considered. The verticle angles θ_1 and θ_2 are measured with respect to two targets.

Depending on the angles θ_1 and θ_2 the following three cases are considered.

i) Both angles of elevation :-



θ_1 = verticle angle made by upper target

θ_2 = verticle angle made by lower target

S = staff intercept between the two targets

r = reading corresponding to lower target

V = verticle intercept

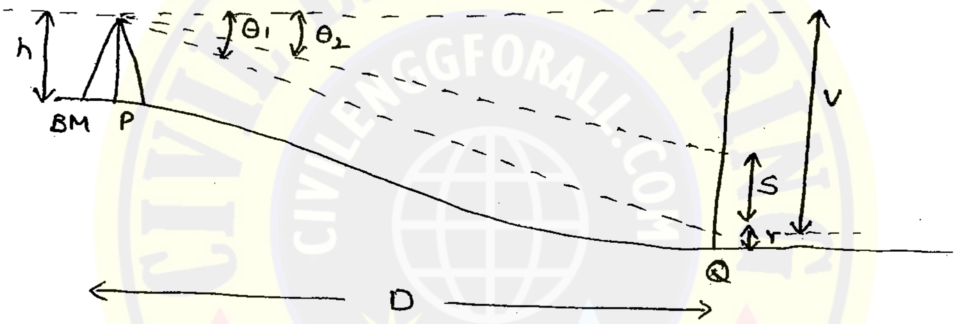
$$D = \frac{S}{\tan\theta_1 - \tan\theta_2}$$

$$V = D \tan\theta_2$$

RL of Q = R·L of BM + h + v − r

Now consider the both angles of depression.

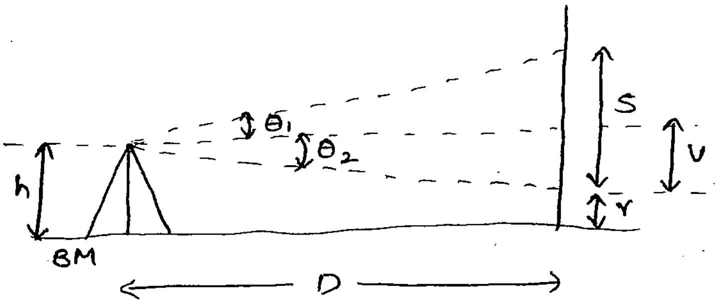
ii) Both angles of depression:-



$$D = \frac{S}{\tan\theta_1 - \tan\theta_2}$$

$$V = D \tan\theta_1$$

iii) One angle of elevation and other of depression:-



$$D = \frac{S}{\tan\theta_1 + \tan\theta_2}$$

$$V = D \tan\theta_2$$

Ex:-) Verticle angles at 1 m and 3 m above the foot of the staff are $2° 30'$ and $5° 48'$. Find the horizontal distance between the staff station and instrument station.

A. $S = 3 - 1 = 2m$

$\theta_1 = 2° 30'$

$\theta_2 = 5° 48'$

$$D = \frac{S}{\tan\theta_1 - \tan\theta_2}$$

$$= \frac{2}{\tan(2° 30') - \tan(5° 48')}$$

$$D = 34.53 \, m$$

3. Subtense bar method:-

The length of the substance bar either 2m or 3m. The subtense bar is kept at one end of the line to be measured and theodolite is kept at other end of the line the angle subtended by the bar with the theodolite is measured The horizontal distance $D = \frac{206265 \, S}{\beta \leftarrow \text{sec}}$

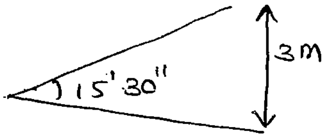
S = Length of the subtense bar

β = Horizontal angle in sec.

Ex:- The horizontal angle subtended at the theodolite station with subtense bar having 3m length is $15' 30''$. Find the horizontal distance between the theodolite and subtense bar.

A. $$D = \frac{206265 \, S}{\beta}$$

$$= \frac{206265 \, (3)}{(15 \times 60 + 30)''} \leftarrow \text{sec}$$



D = ~~930~~'' 665.37 m

Note:-

The analytical lens is generally provided in external focussing type of telescope. Generally the analytic lens is placed between diaphram and the objective at a fixed distance then substitute additive constant $c=0$

$$D = KS + C$$

$$D = KS$$

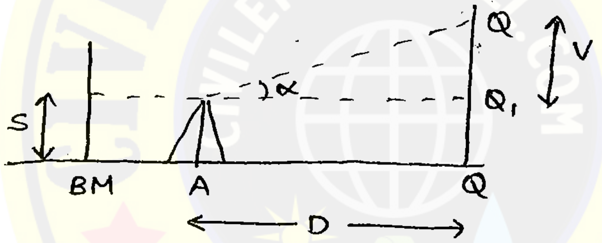
Trigonometrical levelling:-

It is used to find the difference of elevation of situations from observed vertical angles, horizontal distances and trigonometric ratio's.

The following three methods are considered.

1. when base of the object is axisible.
2. Base of object is inaxisible (the instrument station and elevated objects are same in the vertical plane)
3. Base of object is inaxisible (the instrument station and elevated objects are not in the same vertical plane).

1. Base object is axisible:- (α_1)



D, $V = D \tan\alpha$

R.L of Q = R.L of BM + S + V

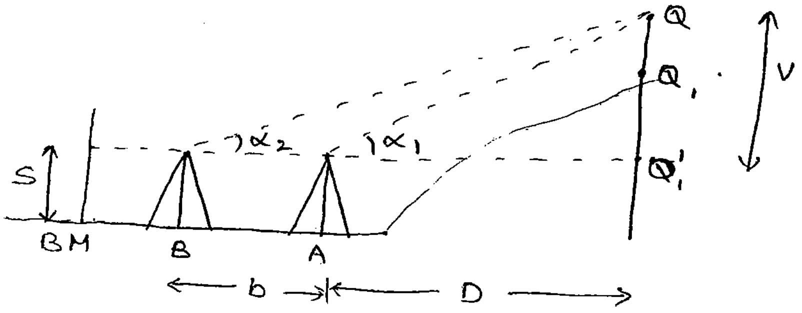
2. Base object is inaxisible (α_1, α_2):-

a. The instrument axis at the same level

b. The instrument axis at the different level but difference is small.

c. Instrument axis at very different levels, the difference is large.

The instrument axis at the same level:-



where

α_1 = verticle angle at instrument station A

α_2 = verticle angle at the instrument station B

b = Distance between two instrument stations A & B

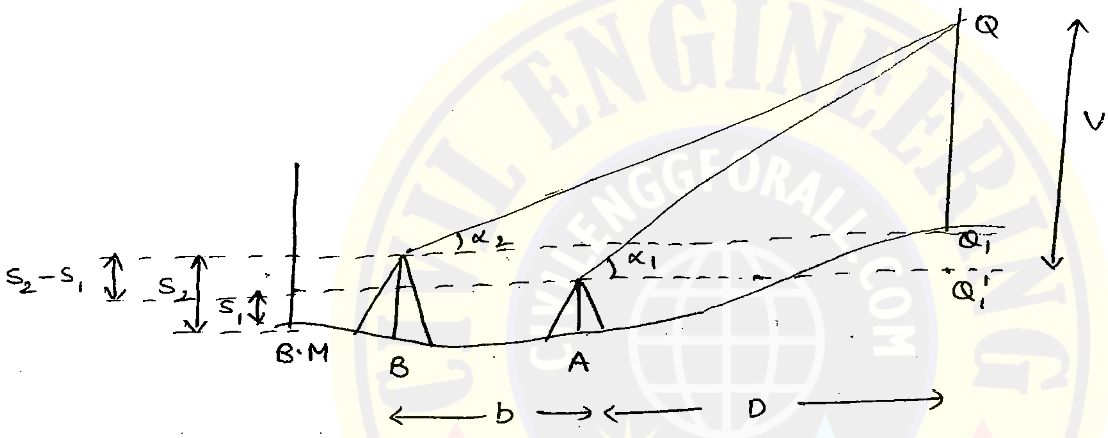
D = Horizontal distance between instrument station A & base of object

$$D = \frac{b \tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2}$$

$$V = D \tan\alpha_1$$

R·L of Q = R·L of BM + S + V

b. When instrument axis at different level but difference level is small:

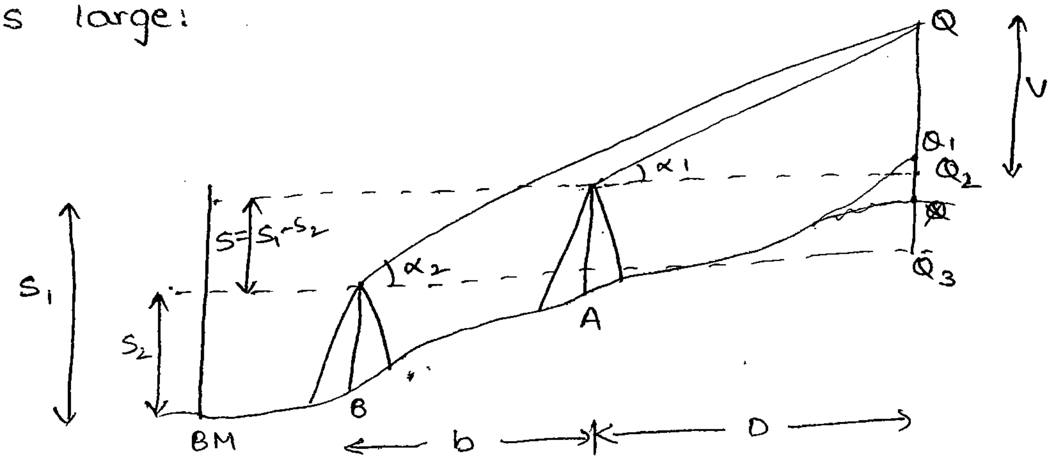


$$D = \frac{(b \pm s \cot\alpha_2)\tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2}$$

Use positive sign when instrument station A is lower than B. −ve sign use when station A is higher than B

R·L of Q = R·L of B·M + S_1 + V

c. When instrument axis at very different levels, the difference is large:

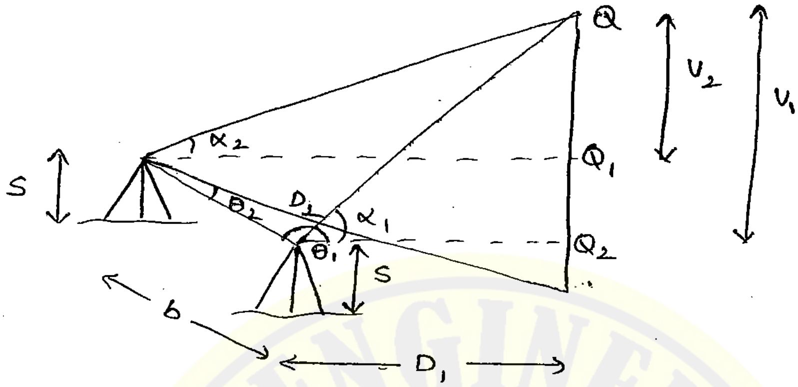


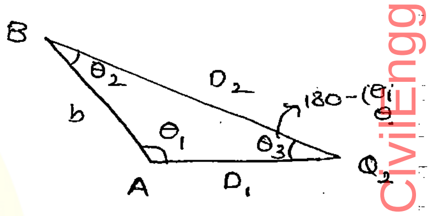
$$D = \frac{b \tan\alpha_2 - s}{\tan\alpha_1 - \tan\alpha_2}$$

$$V = D \tan\alpha_1$$

$$R\cdot L \text{ of } Q = R\cdot L \text{ of } BM + s_1 + V$$

3. Base of object is inaxisible (the instrument station a elevated object are not in the same verticle plane):





Apply sine rule:-

$$\frac{b}{\sin(180-(\theta_1+\theta_2))} = \frac{D_1}{\sin\theta_2} = \frac{D_2}{\sin\theta_1}$$

$$D_1 = \frac{b\sin\theta_2}{\sin(180-(\theta_1+\theta_2))}$$

$$D_1 = \frac{b\sin\theta_2}{\sin(\theta_1+\theta_2)}$$

$$D_2 = \frac{b\sin\theta_1}{\sin(180-(\theta_1+\theta_2))}$$

$$D_2 = \frac{b\sin\theta_1}{\sin(\theta_1+\theta_2)}$$

$$V_1 = D_1 \tan\alpha_1$$

$$V_2 = D_2 \tan\alpha_2$$

$$R\cdot L \text{ of } Q = R\cdot L \text{ of } BM + S + V_1$$

α_1 = verticle angle of instrument station 'A'

α_2 = verticle angle of instrument station B

$\theta_1 \theta_1$ = Horizontal angle of A in b/w instrument station B and elevated object.

θ_2 = Horizontal angle at B between instrument station A and elevated object.

D_1 = Horizontal distance between instrument station A and base of object.

D_2 = The horizontal distance between instrument station B and base of the object.

11-12-2014

UNIT - 7

CURVES

Horizontal curves:-

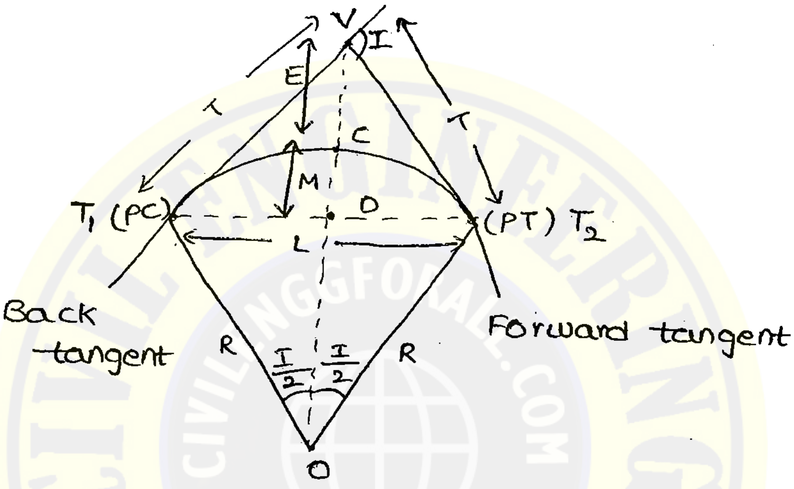
Circular curves are used as a Horizontal curves

Vertical curves:-

Parabola shape of curves are used in verticle curv

Simple curve:-

It consists of a single arc of a circle.



1. Back tangent:-

The tangent line before the begining of the curv is called Back tangent. It is also known as Rear tangent

2. Forward tangent:-

The tangent line after the end of curve is calle forward tangent.

3. Vortex (v):-

It is also known as point of Intersection. The bac tangent and forward tangent extended intercepts at a point is known as vortex (v).

4. Intersection angle (I):-

It is also known as deflection angle and deviation angle. The angle between back tangent and Forward tangent

5. Point of Curvature :-

It denoted (T_1). It is the point on the back tangent at the beginning of the curve.

6. Point of Tangency (PT) :-

It is denoted as T_2. It is the point on the forward tangent at the end of the curve.

7. Tangent distance (T) :-

Distance between point of curvature to the point of intersection (or) Distance between point of Intersection and point of tangency.

8. External distance (E) :-

Distance between point of intersection and middle point of the curve (c).

9. Mid Ordinate (M) :-

Distance between mid point of the curve and mid point of long chord.

10. Long curve (L) :-

It is chord of circle from T_1 to T_2.

Note :-

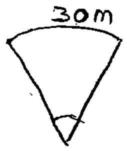
1. A curve can be designated in terms of ~~either~~ radius (or) degree of curve.

Arc - D_a

chord - D_c

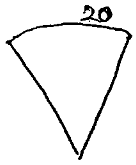
The degree of curve is the angle sub-tended at the centre by an arc (or) a chord of specified length.

EX :- $D_a = \frac{360}{2\pi r} \times 30 = \frac{1718.5}{R}$



$D_c = D_a \cong \frac{1720}{R}$

EX :- $D_a = \frac{360}{2\pi r} \times 20 = \frac{1145.9}{R}$



$D_c = D_a = \frac{1145.9}{R}$

2. The chord defination generally used in railways and arc defination used in highways.

l = Length of the curve

$$l = \frac{30 I}{D_a}$$

D_a = Degree of curve with reference to arc.

T = tangential distance

$$T = R \tan \frac{I}{2}$$

L = Length of the long chord

$$L = 2R \sin \frac{I}{2}$$

E = External distance = Apex distance

$$E = R\left(\sin \frac{I}{2} - 1\right)$$

M = Mid ordinate

$$M = R\left(1 - \cos \frac{I}{2}\right)$$

P.g No:- 52

1. Given $L = 60$ m, $R = 50$ m, $M = ?$

$$M = R - \sqrt{R^2 - \left(\frac{L}{2}\right)^2}$$

$$= 50 - \sqrt{(50)^2 - \left(\frac{60}{2}\right)^2}$$

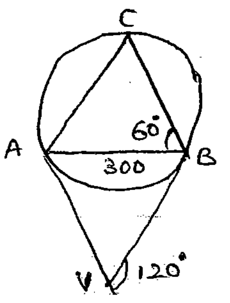
$$= 10 \text{ m}.$$

5. Given $L = 300$ m, $I = 120$

$$L = 2R \sin \frac{I}{2}$$

$$300 = 2R \sin\left(\frac{120}{2}\right)$$

$$R = 173.2 \text{ m}$$



6. $I = 60°$, $R = 600$ m

i.) $L = 2R \sin \frac{I}{2}$

$$= 2 \times 600 \times \sin \frac{60}{2}$$

$$L = 600 \text{ m}$$

ii) $M = R\left(1 - \cos \frac{I}{2}\right)$

$$= 600\left(1 - \cos \frac{60}{2}\right)$$

$$= 80.4 \text{ m}$$

10· $L = T$

$$2R \sin \frac{I}{2} = R \tan \frac{I}{2}$$

$$\frac{\sin \frac{I}{2}}{\tan \frac{I}{2}} = \frac{1}{2}$$

$$I =$$

Methods used for setting out a simple curve:-

1· Linear method - chain, tape

2· Angular method - Theodolite, tacheometer

Linear method:-

1· By ordinates or off sets from the long chord·

2· By successive bisection of arcs

3· By offsets from the tangent

4· By offsets from chords produced·

Note:-

The fourth method (d) is used for long curves for set out simple curve for high ways when theodolite is not available.

Angular method:-

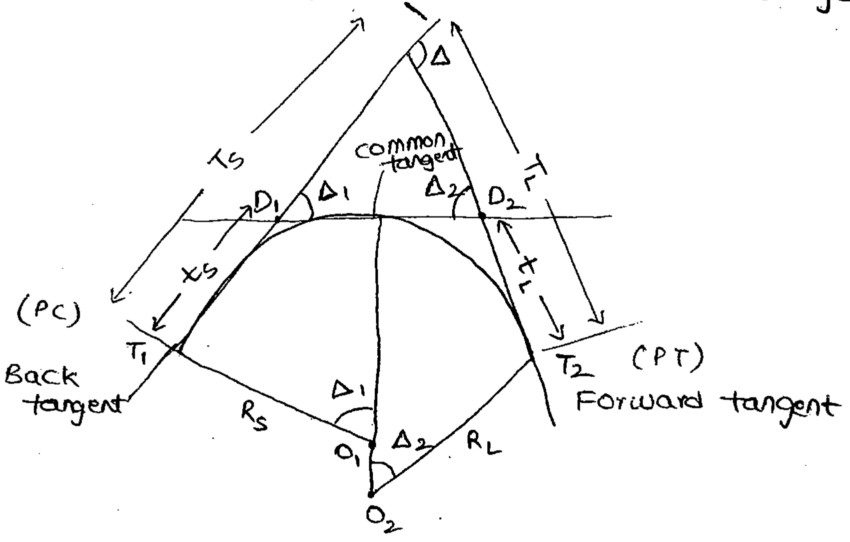
1· Rankine's method of tangential angle·

2· ~~Two~~ theodolite method - It is more accurate than first method·

3· Tacheometric method - It is less accurate than second method·

Compound curve:-

Compound curve consists of different radius with centre of curvatures on the same side of common tangent·



T_2 = point of tangency

O_1, O_2 = centre of two arcs of circles.

R_S = smaller radius.

R_L = Larger radius

D_1, D_2 = common tangents

Δ_1 = Deflection angle b/w back tangent and common tangent.

Δ_2 = Deflection angle b/w common tangent and forwar tangent.

$\Delta = \Delta_1 + \Delta_2$ total deflection angle.

T_S = Tangent distance with respect to shorter radius

T_L = Tangent distance with respect to longer radius.

$$T_S = t_S + (t_S + t_L)\frac{\sin\Delta_2}{\sin\Delta}$$

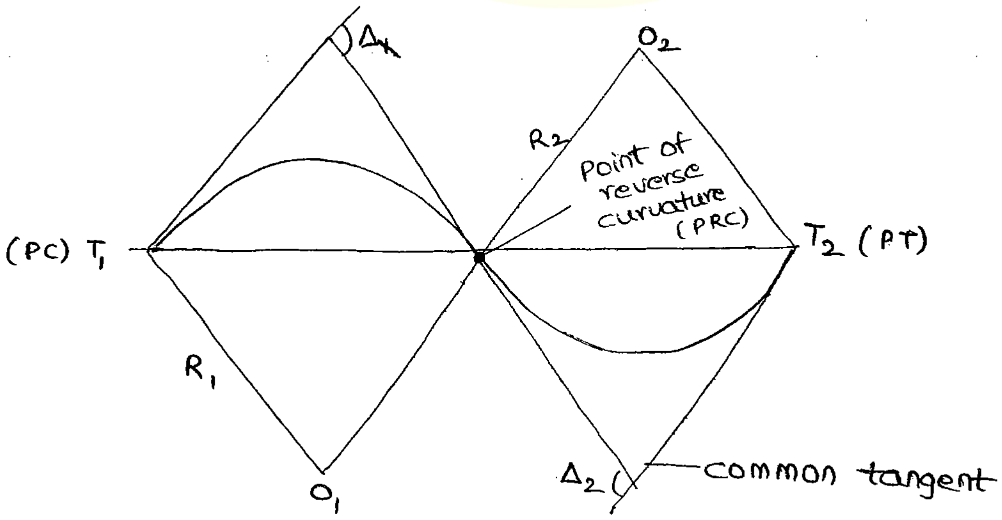
$$T_L = t_L + (t_S + t_L)\frac{\sin\Delta_1}{\sin\Delta}$$

Note:-

The compound curve can be set out by angular metho by using deflection method.

Reverse curve:-

The reverse curve consists of two simple curves of opposite direction and joint at a common tangent point which is known as point of reverse curvature.



There is no super elevation provided at point of reverse curvature.

Verticle curve:-

1. A verticle curve is used to join two intersecting gradient.
2. parabola is used as a verticle curve.
3. In parabola the rate of change of centrifugal acceleration. is uniform through out the length of the curve. cubic parabola is used in valley.
4. length of verticle curve = $\frac{\text{change of gradient}}{\text{rate of change of gradient per one length of chain}}$

$$L = \frac{g_1 - g_2}{r}$$

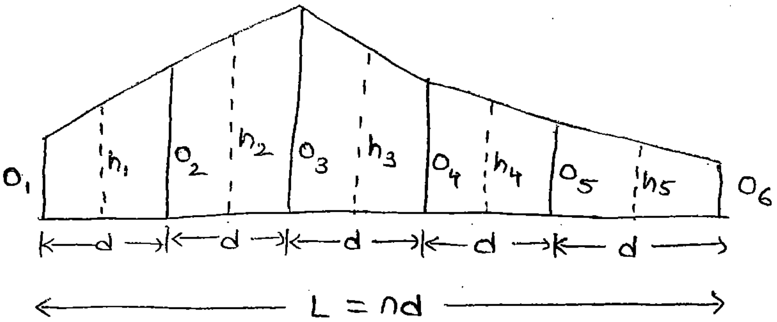
15-12-2014

UNIT - 10

AREAS AND VOLUMES

Areas :-

Mid Ordinate method :-



d = common interval between two ordinates

n = no. of segments or bays

$A = L(h_1 + h_2 + \cdots + h_n)$

Average Ordinate method :-

$$A = \frac{\text{sum of the ordinates}}{\text{No. of ordinates} \times \text{Base length}}$$

$$A = \frac{\Sigma O}{n+1} \times L = \frac{O_1 + O_2 + O_3 + \cdots}{n+1} \times L$$

Trapezoidal Rule :-

This method is used to find the area consists of Straight irregular boundaries.

$$A = d\left[\left(\frac{O_1 + O_{n+1}}{2}\right) + \text{remaining ordinates}\right]$$

$$A = d\left[\left(\frac{O_1 + O_{n+1}}{2}\right) + O_2 + O_3 + \cdots + O_{last-1}\right]$$

This method is more accurate than mid ordinate method and average ordinate method.

Simpson's rule :-

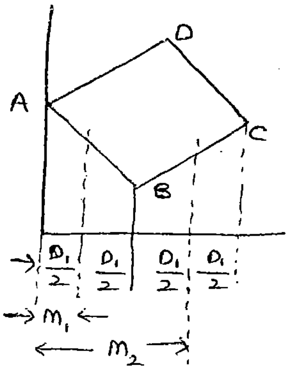
If the irregular boundaries are curved in shape this method is used to find the area.

$$A = \frac{d}{3}\left[(O_1 + O_{Last}) + 4(\text{even ordinates}) + 2(\text{odd ordinates})\right]$$

The area obtained by simpson's rule is greater than obtained by trapezoidal rule if the shape of the curve is concave towards the base line and the area is less if the shape of the curve is convex towards the base line.

Calculations of areas for closed traverse :-

1. Meridian and Departure method (or) Longitude method (or) By Latitude and Meridian distance (MD) method :-



$A = LM$

$L =$ Lattitude

$m =$ meridian distance of the line

Meridian distance of AB $(m_1) = \frac{1}{2}(D_1)$

$D_1 =$ departure of first time.

Meridian distance of BC $(m_2) = \frac{1}{2}D_1 + \frac{1}{2}D_1 + \frac{1}{2}D_2$

$= m_1 + \frac{1}{2}D_1 + \frac{1}{2}D_2$

Meridian distance of a line = meridian distance of preceeding line + $\frac{1}{2}$ departure of preceeding line + $\frac{1}{2}$ departure line

$m_3 = m_2 + \frac{1}{2}D_2 + \frac{1}{2}(-D_3)$

-ve sign because of departure towards west side.

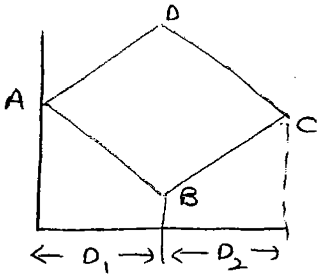
$m_4 = m_3 + \frac{1}{2}(-D_3) + \frac{1}{2}(-D_4)$

$A = -L_1 m_1 + L_2 m_2 + L_3 m_3 - L_4 m_4$

L → N +ve
S −ve

D → E +ve
W −ve

2. Double Meridian distance method (DMD):-



$A = \frac{1}{2}ML$

$L =$ Lattitude of a line

$M =$ double meridian distance of line.

Double meridian distance of line (M_1) = Meridian distance of A + Meridian distance of B.

$M_1 = 0 + D_1$

$M_1 = D_1$

Double meridian distance of line M_2 = Meridian distance of B + Meridian distance of C.

$M_2 = D_1 + (D_1 + D_2)$

$$M_1 + D_1 + D_2$$

$$\boxed{M_2 = M_1 + D_1 + D_2}$$

Double meridian distance of a line = double meridian distance of preceeding line + Departure of preceeding line + Departure of that lin

$$A = \frac{1}{2}\left[-M_1 L_1 + M_2 L_2 + M_3 L_3 - M_4 L_4\right]$$

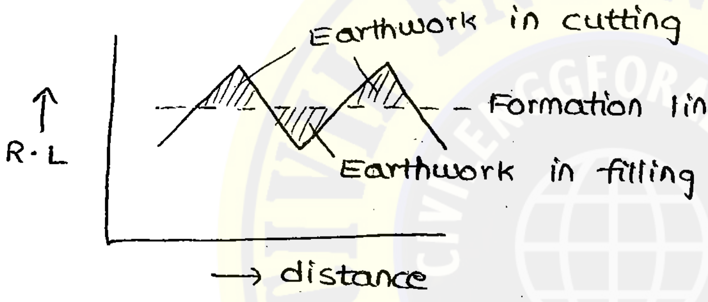
Volumes :-

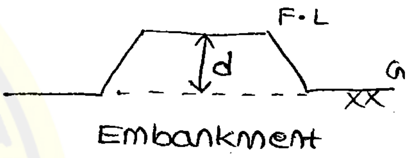
1. Trapezoidal method :-

$$V = h\left[\frac{A_1 + A_{last}}{2} + \text{Remaining areas}\right]$$

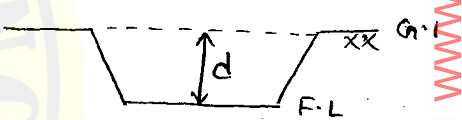
$$V = h\left[\frac{A_1 + A_L}{2} + A_2 + A_3 + \cdots\cdots\right]$$

h = common interval (or) distance.





Embankment



cutting

2. simpson's rule (or) prismoidal rule :-

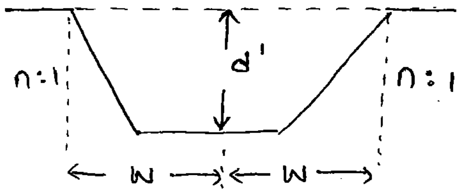
$$V = \frac{h}{3}\left[A_1 + A_{Last} + 4\,(\text{even areas}) + 2\,(\text{odd areas})\right]$$

$$V = \frac{h}{3}\left[A_1 + A_{Last} + 4\,(A_2 + A_4 + \cdots\cdots) + 2\,(A_3 + A_5 + \cdots\cdots)\right]$$

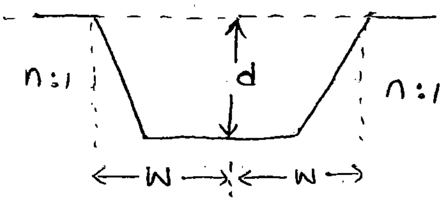
Prismoidal correction (CP) :-

The difference between the volume calculated by the trapezoidal rule and simpsons rule.

(a) Level section :-



Other end



One end

$$C_p = \frac{hn}{6}(d-d')^2$$

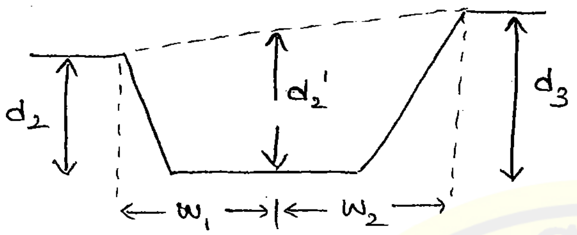
h = common interval b/w one section to other section

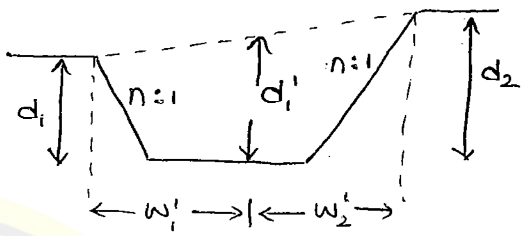
n : 1 = n is horizontal : 1 is verticle.

d = depth at one section

d' = depth at other section.

b) Two Level section:-





$$C_p = \frac{h}{2n}\left[(w_1 - w_1') + (w_2 - w_2')\right]$$

Curvature correction:-

1. It is the formula the centre line of embankment or cutting is assumed as a straight line.
2. If the centre line is a curved path from one section to another section curvature correction is applied.

$$C_c = \frac{h}{6R}(w_1^2 - w_2^2)\left(d + \frac{b}{2n}\right)$$

where

h = common interval

R = Radius of the curve

d = depth of cutting or embankment

b = bottom width of the cutting (or) top width of the embankment.

n = slope (n:1)

3. The correction is positive if the centroid and centre of curvature are opposite sides of the centre line and it is negative if the centroid and centre of curvature are same sides of the centre line.
4. Simpson's rule is applicable when there are odd no. of ordinates or even no. of segments.

5. If offsets are even in number the simpson's rule applie to found area up to last but one segment then the area o last segment is calculated seperately and added to the area obtained by simpson's rule.

P.g NO:- 66.

7. $A = \frac{15}{3}[(2.5+1.5) + 4(3.5+3.0) + 2(4.0)]$

$= 190 \, m^2.$

11. $A = 10\left[\left(\frac{0+5.74}{2}\right) + 2.68+3.64+3.7+4.6+3.62+4.84\right]$

$= 259.5 \, m^2$

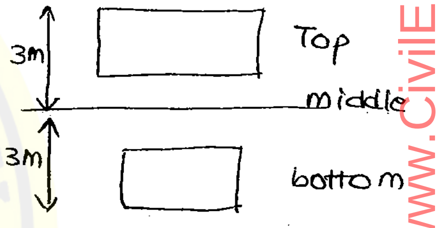
20. A_1 = top section = $6 \times 4 = 24 \, m^2$

A_2 = bottom section = $4 \times 2 = 8 \, m^2$

A_m = middle section = $\left(\frac{6+4}{2} + \frac{4+2}{2}\right)$

$= 5 \times 3$

$A_m = 15 \, m^2$



Depth = 6m

Interval = $\frac{6}{2}$ = 3m

volume = $\frac{h}{3}[A_1 + A_L + 4(A_m)]$

$= \frac{3}{3}[24+8+4(15)]$

$V = 92 \, m^3$

P.g NO:- 68.

6. $V = h\left[\frac{a_1+a_L}{2} + \text{remaining}\right]$

$= 30\left[\left(\frac{30+105}{2}\right) + 63\right]$

$V = 3915 \, m^3$

7. $V = \frac{h}{3}[(a_1+a_L) + 4(\text{even}) + 2(\text{odd})]$

$= \frac{30}{3}[(30+105) + 4(63)]$

$V = 3870 \, m^3$

11. $V = \frac{h}{3}\left[(a_1 + a_L) + 4(\text{even}) + 2(\text{odd})\right]$

$= \frac{30}{3}\left[(20+30) + 4(40+50) + 2(60)\right]$

$= 5300\ m^3.$

12. $V = \frac{5}{3}\left[(3850+450) + 4(3450+800) + 2(2600)\right]$

$h = 200 - 195$

$= 5m$

$= 44166{\cdot}66\ m^3$

UNIT - 9

CONTOURS

An imaginary line on the ground joining the points of equ elevation.

Contour interval:-

The verticle distance between two consecutive contours.

Horizontal equivalent:-

The horizontal distance between two consecutive contours. The choice of contour interval depends on

a. Nature of the ground
b. Scale of the map
c. purpose of the survey
d. Time of conducting survey

Interval = 95-90
= 5m

Scale of Map	Type of ground	Contour Interval (m)
Large 1cm = 10m or less	Flat	0·2 - 0·5
	Rolling	0·5 - 1·0
	hill	1, 1·5 or 2
Intermediate 1cm = 10 to 100m	Flat	0·5, 1, 1·5
	Rolling	1, 1·5, 2
	hill	2, 2·5, 3
Small 1cm = 100m (or) more	Flat	1, 2, 3
	Rolling	2 - 5
	Hill	5 - 10

Characteristic of contours:-

The following characteristics are used while plotting or reading a contour plan

1. Two contour lines of different elevations cannot cross each oth
2. contour lines of different elevations can unite to form one line only in the case of over hanging cliff. (A cave penetrating a hill side).

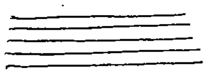
3. If contour lines close together then it is indicating steep slope.

4. If contour lines are far distances that indicates a gentle slope.

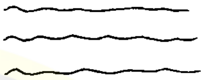
5. If contour lines are equally spaced the indicate uniform slope.

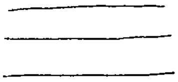
6. If contour lines are parallel and equally spaced it is indicating a plane surface.

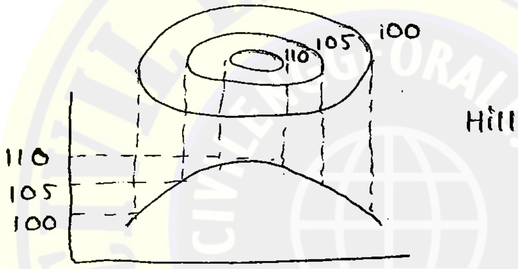
7. A closed contour line with one or more higher values inside then it represents a hill.


Steep slope

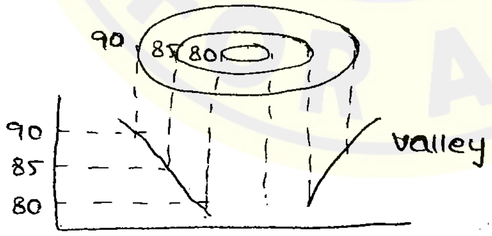

Gentle slope


Uniform slope


plane

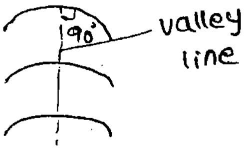


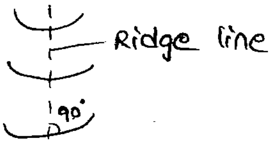
8. Similarly a closed contour line with one or more values lower inside then it represents a valley or depression.



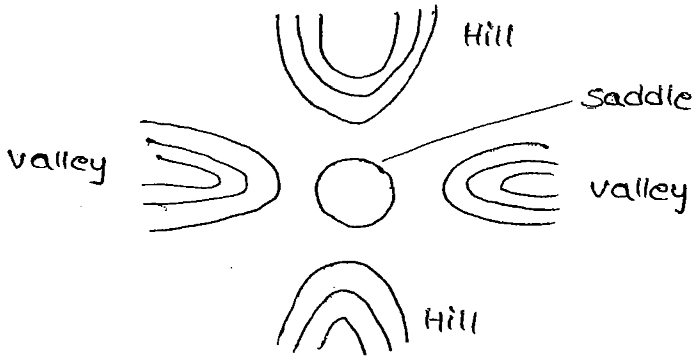
9. Two contour lines having the same elevations can not unique and continue as one line. A contour line must close up on itself

10. Contour line crosses a valley line and a ridge line at right angles.





11. A depression between summits called saddle. In case of saddle on two opposite sides the ground slopes are upward direction where as on other two sides the ground slopes are downward direction.



Uses of contour map:-

1. Drawing both longitudinal section and cross section of road.
2. Determination of intervisibility between two points.
3. Tracing of contour gradient and location of route from origin to destination.
4. Measurements of drainage areas
5. calculation of reservoir capacity.
6. Intersection of surface and measurement of earth work.

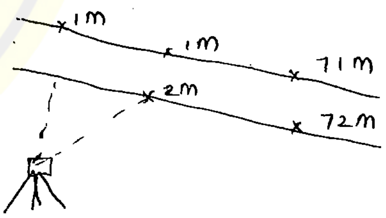
Methods of locating contours:-

1. Direct method:-

Each contour is located by finding the position of a series of points where a contour is possess. This process is also known as "tracing out contours".

It is a very accurate method and it is time taken process.

In this method you draw contours with known elevations.



2. Indirect method:-

Some guide points are selected on a straight lines and elevations on these guide points are find then plotted on the drawing sheet and contours are drawn by interpolation

The guide points are selected by

1. Squares:-

It is used when the given area is small and existing ground is a plane surface.

Cross section:-

selecting the guide points transuerse to centre line of a road, railway track.

Tacheometry method:-

If existing type of terrain is hilly this method is used.

Interpolation:-

It is the process of spacing the contours proportionately between the plotted ground points or guide points by using i) estimation ii) arithmatic calculation iii) graphical method.

Contour gradient:-

It is a line on the surface of the ground preseruing a constant inclination with respect to horizontal. To locate a contour gradient in the field a clinometer or theodolite is used.

The contour interval is 1m and if horizontal equivalent is 25m with point A as centre and with radius 25m (same scale as that of contour plan draw a arc to cut the point on the contour line 100 that is indicating the point A, the similar procedure is adopted for all other contour line.

SPATIAL INFORMATION & GEOMATICS

Geo graphical Information system:-

GIS is a specific information system applying to geogra phic information data to support capital management, manupulation, analysis, modelling and display of spatially reference data for solvi complex planning and management problems.

1. GIS data consists of two types of data
   a. spatial data
   b. Non spatial data (or) Attribute data

Spatial data:-

Spatial data has a physical dimensions and geographic locations on the earth surface.

The spatial data indicated by three types of entities.

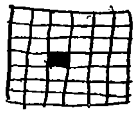
1. point :-
   EX:- capital city of a state, Buddha statue in Hyderabad.
2. Line :-
   EX:- Railway
3. polygon:-
   EX:- Catchment area, forest area, Reservoir.

Non spatial data (or) Attribute data:-

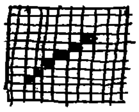
Description of spatial data. Spatial data can be represe nted by two types of formats

1. vector format :-
   It is a good representation of very accurate graphics
2. Rastar format:-
   It is a discritisation of the geometric broken into Grid cells of uniform size

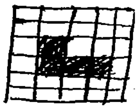
point →



line →



polygon →



Elements of GIS :-

1. Hardware :-

2. software

3. Data

4. Live ware

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UNIT - 15

REMOTE SENSING

Remote sensing refers to gathering and processing of information about the earth surface without having physical conta

1. Aircraft Remote sensing:-

Aircraft is used as a platform to carry a camera

2. Satellite Remote sensing:-

Satellite is used as a platform to carry a sensor. Satellite Remote sensing refers to the science of taking the pictures or the reflectance data of objects on earth surfa and interpretation to identify the objects. The satellite launc into the space are basically two types.

1. Geostationary satellite:-

The satellites move in a particular orbit around th earth surface in horizontal direction. These satellites revolves at a distance of 35,000 km from the earth surface. these are used for telecommunication and weather forecasting studies.

EX:- Indian geostationary satellites are INSAT I-A, INSAT I-

2. Polar satellites (or) Sunsynchronous satellites:-

These satellites revolve in a particular orbit in verticle direction from North pole to south pole (or) south pole t North pole. these satellite revolves 900 km from the earth surfac These satellites are used for resource assesment disaster management and thematic mapping.

EX:- Indian polar satellites are IRS 1A, 1B, 1C, B2, B3.

The Indian space research was organised by Indira Gandhi in the year 1972, Department of space (D.O.S) which is consists of three groups.

a. ISRO (Indian space Research organisation)
b. NRSC (National Remote sensing centre)
c. IIRS (Indian Institute of Remote sensing)

The objectives of Remote sensing is measuring the electro magnetic radiation (EMR) emitted or reflected by the objects of earth surface. Therefore the complete process of remote sensing data capturing is related to transfer of energy.

The electro magnetic radiation received by the sensor symbolizes the object from where it is reflected and this is the basic principle of object identification and mapping by using Remote sensing.

The sun is the main source of energy for the solar system energy from the sun propagates in the form of electromagnetic waves. The various types of waves are grouped together into a few bands of energy.

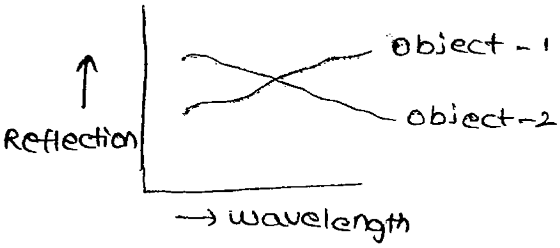
Bands of energy:-

It is only the optical wavelength region consisting of visible region near infrared and middle infrared ranging from 0·3 µm to 16 µm in wavelength are used by various remote sensing sensors.

Spectral signature:-

Spectral signature of objects refers to the reflectance of various bands of wavelength of the objects received by sensors for the identification of the objects.

Ex:- The thumb impression of a person do not tally with thumb impression of another person simlarly the spectral signature of one object do not tally with other object. This is the basic principle of Remote sensing object identification.



Differences between Arial photography and Satellite Remote sensing:

Arial photography	Satellite Remote sensing
1. The platform is aeroplane	1. The platform is satellite
2. It is more costly and time taking	2. It is very cheap and easily available
3. It is used for large scale maps	3. It is used for small scale maps.
4. It is required defence clearence.	4. Not required defence clearen

Types of sensors in the satellite:-

* Sensors are the devices gathered the energy and convert into signal and present in a form suitable for obtaining the information data about the features on earth surface.

The sensors are basically two types.

1. passive sensor:-

The source of energy is emitted by sun.

2. Active sensor:-

The source of energy is emitted by sensor itself

Scanners :-

sensor consists of scanners to scan the features on earth surface. Scanners are classified into two types.

1. Whisk broom:-

This scanners, scanning across the track of the satellites

Ex:- MSS scanner, TM scanners of land sat 5 (name of satellit

2. push broom:-

These scanners scanning along the track of satellites

Ex:- LISS 1, 2 scanners of IRS 1A, 1B (name of satellites)

Data products:-

1. Raw data:-

The data without any corrections.

2. Browse data:-

It is also known as Browse product. Little corrections ~~are~~ or resampling on the raw data.

3. partially corrected data:-

Radio metrically corrections and partially corrected for geometric corrections.

4. standard product:-

Data is corrected for geometric and radiometric corrections. These product widely used by user community.

5. Geo coded product:-

It is a standard product matching with survey of India toposheets in terms of area scale and alignment

6. special product:-

The products generated ~~fo~~ after further processing of standard products by extracting enhancing, mosaicking and merging.

Satellites:-

Satellite	sensor	Resolution	Area in km.
IRS 1C	PAN	5·8	70x70
	LIS-III visible	23·5	141x141
	LIS-III		
IRS 1A & 1B	LISS-I	72·5	148x174
	LISS-II	36·25	74x87
Land sat	MSS	80	185x185
	TM	80	170x185
spot ($\frac{1}{2}$)	PLA	10	60x60
ERS-I	SAR	30	100x100
NOAA	AVHRR	1100	2700x2200

The elements of photogrammetry image interpretation in deciding the identify of object on the satellite imagery as follow

1. shape
2. size
3. Tone :

colour as density the terms light medium and dark are used to describe variations in terms of shadow, pattern, texture

4. site
5. Resolution.

Spatial Resolution:-

It refers the area on the ground and imaging i.e, sensor capturing the data.

Spectral Resolution:-

Spectral width of band used from the wavelength of electromagnetic spectrum.

Temparate Resolution:-

Quantify the number of descrinable signal levels in a band.

2 bit (4 levels)	4 bit (16 levels)	8 bit (256 levels)

Swath:-

It is refers to the width of the area scanned by Scanners of the satellite.

Digital elimination model (DEM):-

It is a digital representation of attitude and it is a rafter 3D representation of surface information.

1. The vector 3D representation of surface information is called triangulated irregular network (TIN), it can be seen as a series of polygons in the form of triangles in between the three point
2. Each triangle has a uniform slope steepness and slope direction
3. If the terrain is more complex, the no. of triangles required to represent terrain also increases.
4. The accuracy of digital elevation model depends on the contour interval and scale of topographical map.

Applications of DEM :-

1. slope steepness maps
2. Slope direction maps
3. 3D views
4. preparation of longitudinal section and cross section.

UNIT - 13

GLOBAL POSITIONING SYSTEM

1. It is a satellite based system operated by department of defence U.S.A operates around the clock in all weather conditions.
2. There are 24 satellites revolving at 20,000 km altitude with orbit time of 12 hours in six orbital clanes.
3. The distribution of satellites are visible any where on the earth surface at any time.
4. The weight of each satellite is 1900 pounds and has a life span of 7.5 years
5. The master control station, 4 monitor stations, 3 upload statio regulate the entire satellite system.
6. GPS signals are received by users, using GPS receivers.
7. The user must have axes to a minimum three - satellite signals to get the position interms of 2D latitudes and longitudes, and it is required to axes a minimum of four
8. Satellites signals to get 3D charecteristics.
8. It is a electronic distance measuring instrument finding the co-ordinates of point and distance between two points on the earth surface.

NAVSTAR GPS:-

Navigation Satellite timing and Ranging global positionin system. GPS consists of three major components

1. Space segment:-

It consists of 24 satellites orbiting the earth surface.

2. Ground control segment:-

It has a network of a master control station and other station.

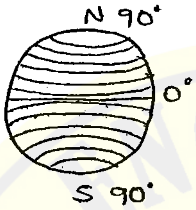
3. User segment:-

GPS tracking equipment to receive GPS signals by the users.

1. A single GPS unit is used to position accuracy in 'm'.
2. Two GPS units i.e., one GPS unit is at known reference points and other GPS unit is at another point whose coordinates are to be calculate. It is possible to get an accuracy in sub meter then it is called differential GPS.
3. Differential GPS used in aircraft landing vehicle tracking.

Lattitude:-

1. It is also known as parallel.
2. Lattitude measures the distance of a point on the earth surface with respect to equator.



Longitude or Meridian:-

1. It measures the distance of a point on the earth surface with respect to prime meridian.

Graticular network:-

combination of both longitudes and Lattitudes

Functions:-

the GPS technology basically perform the following function

1. Determination of position of points:-

Interms of geographical coordinates of the stations either in 2D (or) 3D.

2. Navigation:-

GPS is to provide information about how to navigate from one place to another place and to get root details.

3. Tracking:-

It is used to track the vehicles to motion like taxes, ambulance, ships and air craft.

4. Mapping:-

It is also used for the preparation of maps.

GPS instrumentation:-

The components of GPS receiver are as follows.

1. Antenna and preamplifier:-

It is used for receiving the signals from the GPS Satellite.

2. Radio frequency section and computer processor:-

Processing the received signal and used to find elevation azimuth of satellite and control that tracking.

3. Control unit interface:-

This enables the operator and to interact with the micro processor.

4. Recording device:-

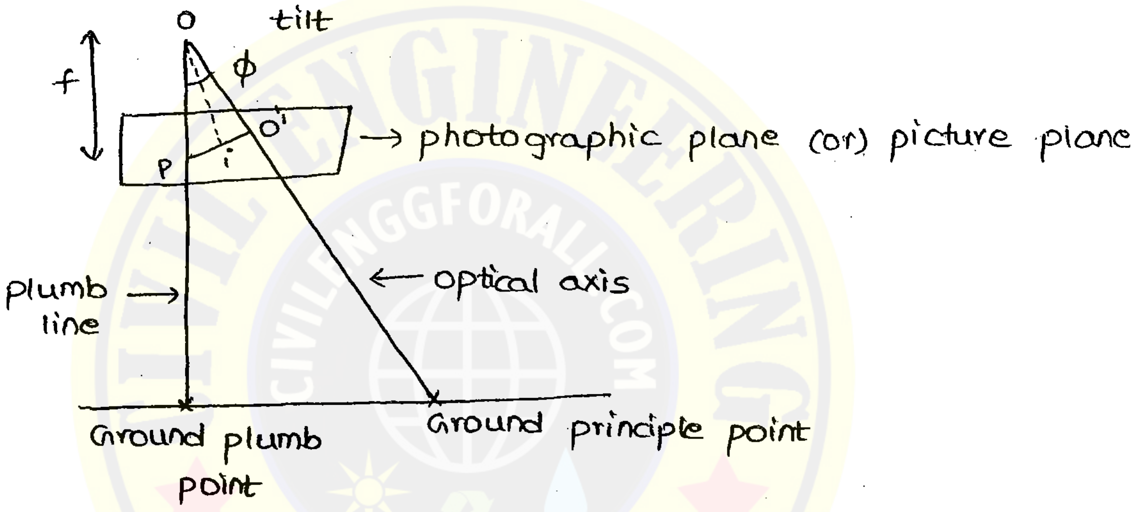
The measured data must be stored for data processing

4-1-2015

UNIT - 14

PHOTO GRAMETRIC SURVEYING

1. It is the science of obtaining, the accurate measurement by use of photograph.
2. If photographs are taken from the stations on the ground surface then, it is called Terrestial photogramety.
3. The principle of terrestrial photogrammetry is exactly similar to plane table surveying.
4. If photographs are taken by a camera from a aircraft then it is called "Aerial photogrammetry".



O - optical centre P - Nadir point.

O' - principal point

i - iso centre

Camera axis:-

It is the line passing through the centre of the camera lens perpendicular to picture plane.

picture plane (or) photographic plane:-

It is the plane perpendicular to camera axis at the focal distance of optical centre of the camera lens.

Focal length:-

It is the perpendicular distance from the optical centre to the picture plane.

principal point :-

The point of intersection of the optical axis of the camera ~~it~~ with the photographic plane. when the optical axis is extended downwards the point of intersection with the surface of the ground is called as principle ground point.

Iso centre :-

The point on the photograph where the bisector of ang of tilt meeting the photographic plane.

Ground plumb point :-

The points where the verticle line passing through th optical centre intersecting at the photographic plane is known as Nadir point (P) by extending this line on to the ground surface intersecting at ground plumb point.

Verticle photograph :-

It is obtained with arial camera when the ground is perfectly flat and optical axis is verticle. ~~Th~~

Tilted photograph :-

It is obtained when the optical axis is inclined to th verticle at an angle not more than 3°.

Oblique photograph :-

It is obtained when the optical axis is tilted more th 3°.

~~pho~~ $$\text{photo scale} = \frac{\text{Distance on photo}}{\text{Distance on ground}}$$

$$\text{Map scale} = \frac{\text{Distance on Map}}{\text{Distance on ground}}$$

$$\text{Ground distance} = \frac{\text{Map distance}}{\text{Map scale}}$$

$$\text{photo scale} = \frac{\text{photo distance}}{\left(\frac{\text{Map distance}}{\text{Map scale}}\right)}$$

Relief displacement (or) Height distorsion :-

The relief of the terrain i.e., undulating ground surface is the major source of an image displacement. It is termed as Relief displacement (or) Height distorsion.

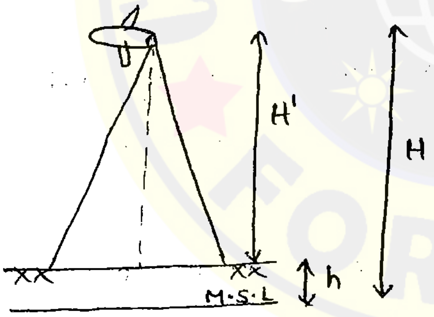
If the photograph is truely verticle and the ground is horizontal. If other sources of errors are neglected the scale of the photograph is uniform and such a photograph represents a true orthographic projection. when the ground is not horizontal the scale of the photograph varies from one location to another location and it is not constant. Therefore every point on the photograph is displaced from the true orthographic projection. These displace is called Relief displacement

$$\text{photo scale} = \frac{f}{H'}$$

where

f = focal length of the camera lens

H' = flying height of aeroplane above the ground surface



H = Height of the aeroplane above the Mean sea level

h = height of the ground above the MS.L

Ex:- If relief displacement of an object is measured from photograph the top and bottom of the tower on the image at a distance of 90 mm and 87 mm from the centre of a verticle arial photograph flying height of aircraft is 1500 m. Find the height of tower.

A. $h = \frac{d \cdot H'}{r}$

h = height of the tower or object

d = relief displacement (or) distance on the photo

H' = Height of the aeroplane above the ground surface

r = parallex at the top of the object

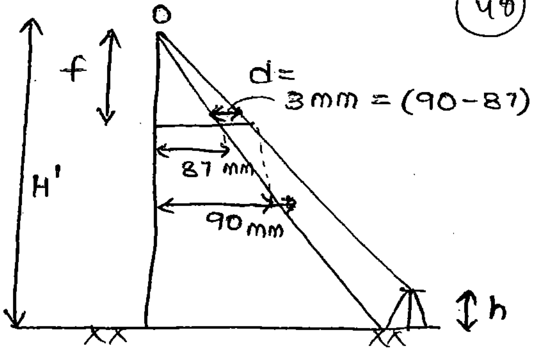
$d = 3\ mm$

$H' = 1500\ m$

$r = 90\ mm$

$$h = \frac{3 \times 1500}{90}$$

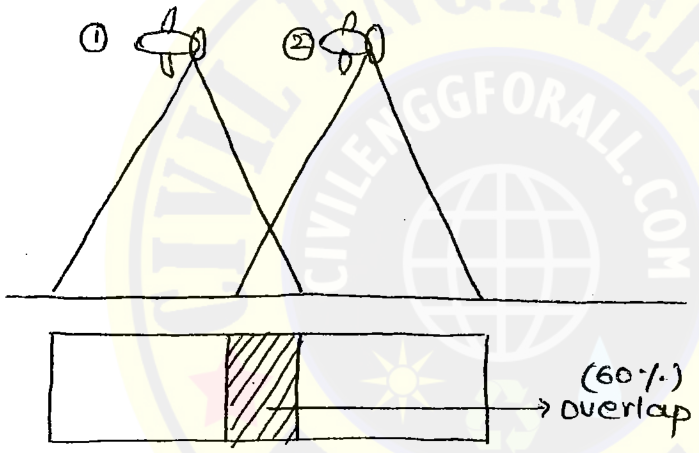
$h = 50\ m$

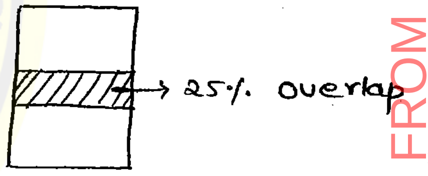


In truely verticle photograph the three points i.e., nadi point (P), principle point, isocentre are coincide each other.

Stereo pairs:-

An arial photograph is a two dimensional view of th object if photographs are available in stereo pairs. It is possi to get a three dimensional view of the object.





In arial photography photographs are taken from two camera positions with sufficient overlap in the photographs.

To get a 3-D view arial photography is normally having 60% forward overlap and 25% side overlap to provide entire coverage of the area.

Applications:-

1. Modern plotting machine and automated operations are used in the process of preparing the maps from the arial photographs.
2. It is extensively used in urban planning transportation networ design, disaster management, mining operations, reservoirs

Plotting:-

plotting is the process of adding more details w.r.t control points. There are two methods for plotting

1. Radial method (or) photo triangulation method
2. slotted template (or) mechanical.

4-1-2015

UNIT-16

THEORY OF ERRORS AND ADJUSTMENTS

The one classification of errors are

1. Instrumental errors
2. Personal errors
3. Natural errors

The second classification of errors are

1. Systematic errors
2. Accidental errors

Systematic errors:-

1. certain factors causing systematic errors. these errors ca be calculated by using formula and respective corrections are applied.
2. These errors can be either positive or negative. These erro follow a definite phisical law and these are generally cumulative.

Correction for standardization:-

$$\left.\begin{array}{l}\text{temperature correction}\\ \text{pull correction}\end{array}\right\} \begin{array}{c}+\\ (\text{or})\\ -\end{array} \quad \text{cumulative}$$

$$\left.\begin{array}{l}\text{slope correction}\\ \text{sag correction}\end{array}\right\} (-) \quad \text{compensatory}$$

Accidental errors:-

1. Errors that are beyond the control of observor. These errors do not follow any specific rules and these errors may be either positive or negative.
2. These errors will follow the law of probability
3. Based on probability curve

$$E_s = \pm 0.674\sqrt{\frac{\Sigma v^2}{n-1}}$$

where

E_s = the probable error in a single observation

v = difference between any single observation and mean of observations

n = no. of observations

$$E_m = \pm 0.674 \sqrt{\frac{\Sigma v^2}{n(n-1)}}$$

$$E_m = \frac{E_s}{\sqrt{n}}$$

where

E_m = the probable error in the mean no. of observations

V = the difference between individual observation to mean observation.

Mean square error:-

The square root of arthmatic ~~errors~~ mean of squares of individual errors.

$$M.S.E = \sqrt{\frac{v_1^2 + v_2^2 + \cdots + v_n^2}{n}}$$

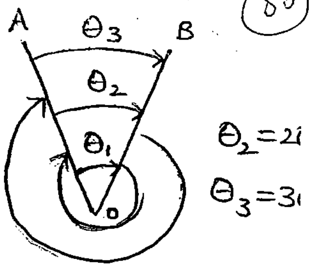
$$E_s = \pm 0.674 \sqrt{\frac{\Sigma v^2}{n-1}}$$

Observed value of quantity:-

1. The observed value of quantity is the value obtain when it is corrected for all the known errors.
2. True value of quantity is the value obsulately free from all the errors.
3. Most probable value of quantity is one which has more chances of being true value then any other value generally it is emstimated from the several measurement on the field.
4. True value is the difference between observed value of quantity and true value of quantity (① ~ ②)
5. Most probable error, is the difference between the value of quantity and its most probable value (② ~ ③).
6. Residual error it is the difference between the most probable value of quantity and its observed value (① ~ ③)

Laws of weight:-

The reliability of observation is indicated by its weight The weight assumed are relative weights are assign to the observation based on the confidence in the observed values all the observations are not taken at the same time with equal are any conditions will change in the time of survey work.



The following are laws of weight :-

1. The weight of arithmatic mean of a no. of observations of equal weight is equal to the no. of observations.

EX:- The following six observations are having equal weigh find the arithmatic mean and weight of arithmatic mea

42° 22′ 32″ 42° 22′ 30″ 42° 22′ 33″ 42° 22′ 34″
42° 22′ 29″ 42° 22′ 30″.

weight of A.M = 6

$$\text{Mean} = \frac{\text{sum}}{6} = 42° \; 22' \; 31.33''$$

2. The weight of the weighted arithmatic mean of observatio is equal to sum of all the weights of observations.

EX:- From the following six weighed observations of angle A Find the weight of mean of angle A.

2, 4, 3, 2, 3, 4.

Sum of the weights = 18

$$\text{Mean angle 'A'} = \frac{42.22' \; 32'' \times 2 + 42° \; 22' \; 30'' \times 4 + 42° 22' 33'' \times 3 -}{18}$$

$$\angle A = 42° \; 32' \; 31''$$

weight of mean of $\angle A = 18$

3. The weight of algebraic sum of two (or) more quantities is equal to the Reciprocal of the sum of reciprocal of individual weight the same is applied to the difference in quantities.

EX:- Two angles A and B are

$\angle A = 32° \; 16' \; 18'' \longrightarrow 3$

$\angle B = 26° \; 14' \; 12'' \longrightarrow 2$

Find the values and weight of A+B and A-B.

A. $A+B = 58° \; 30' \; 30''$

$A-B = 6° \; 2' \; 06''$

$$\text{weight } (A+B) = \frac{1}{\frac{1}{3}+\frac{1}{2}} = \frac{6}{5} = 1.2$$

$$\text{weight } (A-B) = \frac{1}{\frac{1}{3}-\frac{1}{2}} = 1.2$$

4. If weighted observation is multiplied by a factor the weight of product is obtain by dividing the weight by by the square of the factor.

EX:- ∠A = 42° 22' 33.33" ⟶ 6 (wt.)

Find the value and weight of 3A.

$3A = 3(42° 22' 31.33")$

$\therefore$ The weight of $3A = \frac{6}{3^2} = \frac{6}{9} = \frac{2}{3}$

5. If weighted observations is divided factor if weight of the result is equal to the weight multiplied by the square of the factor.

EX:- ∠A = 42° 22' 31.33" ⟶ 6. Find the value of $\frac{A}{4}$

$$\frac{A}{4} = \frac{42° 22' 31.33"}{4}$$

$\therefore$ The weight of $\frac{A}{4} = 6 \times 4^2 = 96$

6. If an equation is multiplied by its own weight the weight of resulting quantity is the reciprocal of the weight of the equation.

EX:- Two angles of a triangle are ∠A = 42° 31' 40" ⟶ 3
∠B = 51° 29' 20" ⟶ 2

Find the value and weight of ∠C.

A) $\angle C = 180° - (\angle A + \angle B)$

$= 180° - (42° 31' 40" + 51° 29' 20")$

$$\text{weight of } (\angle A + \angle B) = \frac{1}{\frac{1}{3}+\frac{1}{2}}$$

$$= \frac{6}{5}.$$

$$\text{weight of } \angle C = \frac{5}{6}$$

21-1-2015

UNIT - 12

ASTRONOMICAL SURVEYING

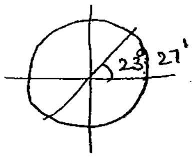
Astronomy is science deals with Heavenly bodies.

Earth surface :-

Earth is third planet from the sun after mercury and venus. The earth rotates at its own axis as well as at the sun the earth rotates in a plane inclined at 23° 27' to the plane of equator.

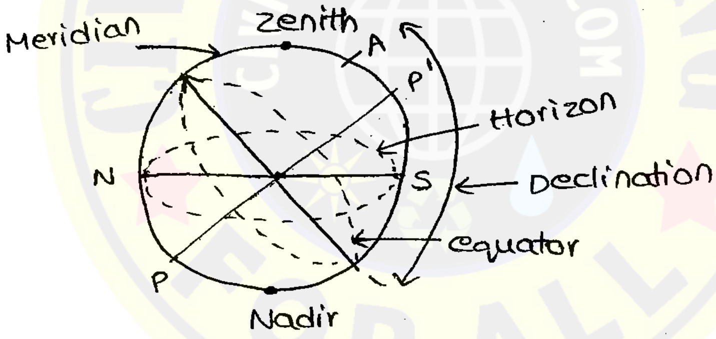
Sun is at 150 million KM from the earth surface. Dia of sun is at 100 times of earth diameter.

6300 KM — Radius of earth.



MOON :-

It is only a satellite to the earth surface. It revolves earth surface is 29.5 days



Celestail sphere :-

The universe is considered to be a sphere of infinite radius.

Polar axis (PP') :-

The diameter joining the poles at which the earth is rotating.

Horizon :-

A great circle in which a plane right angles to zenith and Nadir line and pusses the centre of the earth.

Zenith and Nadir points:-

These are the poles of the celastail origin a verticle line drawn through the observer station intersect the celestail sphere at two points. The point at the observer is called zenith and the point below the observer is called Nadir.

North south points:-

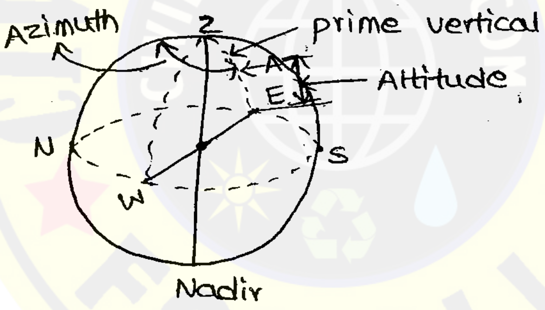
The projected points of the north and south poles on to the Horizon.

Meridian:-

Meridian at a place is the intersection of a great circle passing through celestail poles zenith and Nadir points with the celestail sphere.

prime verticle:-

The verticle circle at right angles to the meridian at a place meridian passing through the E-W Horizon points



Azimuth:-

The azimuth of heavenly body is the angle between the observers meridian the verticle circle passing through the body.

Declination:-

The declination of a heavenly body is the angular distance from the equator measured along the meridian.

Attitude:-

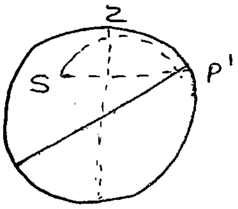
The attitude of a heavenly body is the angular distance above the horizon measured along the vertical circle passing through the body.

zenith distance (or) co-attitude:-

The angular distance from the zenith to the body along the prime vertical.

Spherical triangle:-

A triangle bounded by three axis of great circle is known as spherical triangle.



S - celestail body.

Spherical excess:-

The quantity by which the sum of the three angle of spherical triangles exceeds 180° is known as spherical excess of triangle.

Relation between degree and time:-

Degree may be converted in hours

360° ⟶ 24 hrs

15° ⟶ 1 hr

1° ⟶ 4 min

15' ⟶ 1 min

1' ⟶ 4 sec

15'' ⟶ 1 sec

Ex:- Express the following angle to the hours, min and seconds 12° 32' 48''.

A. 12° ⟶ 4x 12 = 48 min

32' ⟶ 4x 32 = 128 sec (or) 2 min 8 sec

48'' ⟶ ?

15'' — 1 sec

48'' — ?

$\frac{48}{15} \times 1 = 3.2''$

Total 50 min 11.2 sec.