Unit - II Surveying & Positioning

Survey - It is the science of (determining) locating relative position of any point on, above or beneath the earth surface by the means of direct and indirect measurement of distance direction or elevation.

Classification of

a) Primary division of Survey

Plane	Geodetic
a) Assumes earth surface as flat	a) Consider surface as curved
b) dist $\leq$ 12 km	b) dist > 12 km
c) less accurate	c) more accurate
d) Plane trignometry	d) Spherical trignometry

b) Based on object of survey (purpose)

i) Engineering Survey
ii) Military Survey
iii) Mine Survey
iv) Geological Survey
v) Archeological

① Engineering Survey:- It is defined as those activities involved in the planning and execution of surveys for the location, design, construction, operation and maintainance of civil and other engineering projects

② Military Survey :- This method of survey is employed for determining points of strategic importance

③ Mine Survey :- To explore mineral wealth of an area; a mine survey is done.

④ Geological Survey :- This type of survey is used to determine various layers of ~~strata~~ structure in earth crust

⑤ Archaeological survey :- It is a type of field research to find out location, distribution and organisation of past human cultures and civilizations.

2) Based on nature of the field of survey
   a) Land Surveying
      i) Topographical Survey
      ii) Cadastral Survey
      iii) City Survey
   b) Hydrographical Survey

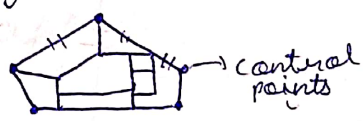
3) Based on instrument used
   a) Chain Survey - ~~In chain survey,~~
   b) Compass Survey
   c) Plane table Survey
   d) Levelling
   e) Theodolite Survey.

4) Based on System of Survey
   i) Triangulation
   ii) Traversing

Fundamental Principles of Surveying

i) Always work from whole to part

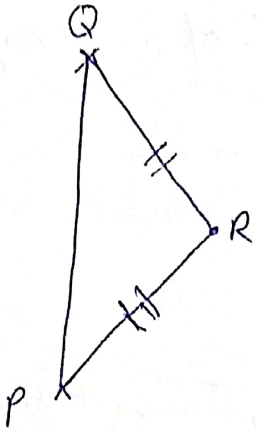
During a survey ~~when~~ we have to setup or establish the outside control points of the area. to do every measurements from whole to part.



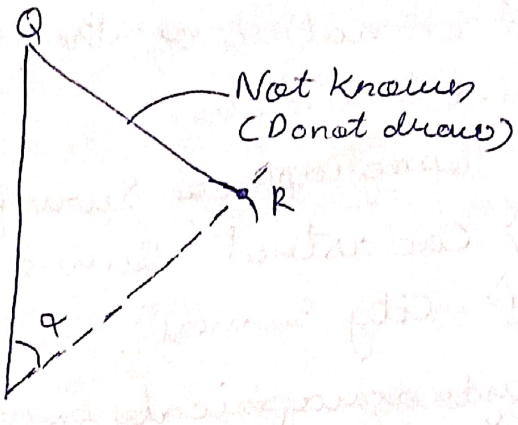
ii) Measurement of position/location of any point from two control point.

It means that when measuring any point we have to use two control points to measure the Position/location of any point.

Eg :-



① Not known (Donot draw)

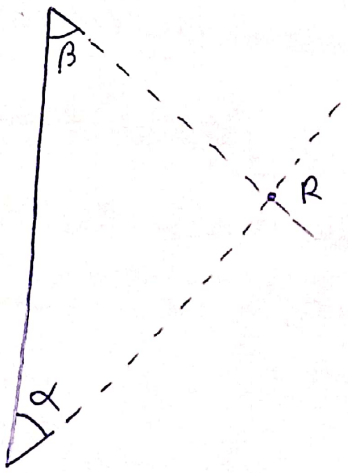


$\angle QPR$

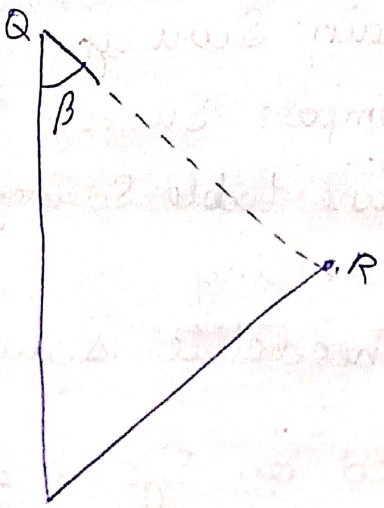
PR

② $\angle PQR$

$\angle QPR$



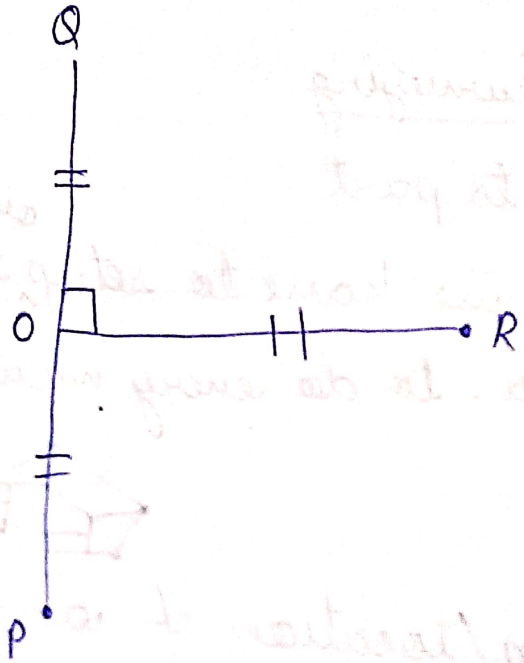
③



$\angle PQR$

PR

;)



OR

PO

* Linear Measurements

i) Direct Method

In Direct method we access both the points by connecting them and measuring the distance between them.

a) Pacing

In pacing we use our foot by walking the distance between the two points.

b) Passometer

It is a type of clock which is used to calculate your steps.

c) Padometer

It is similar to Passometer but it takes the size of your foot and it multiplies the size with the no. of steps travelled.

d) Odometer / Speedometer

It contains a wheel in which the circumference of the wheel is known and it is multiplied by distance travelled.

e) Chain and Tape

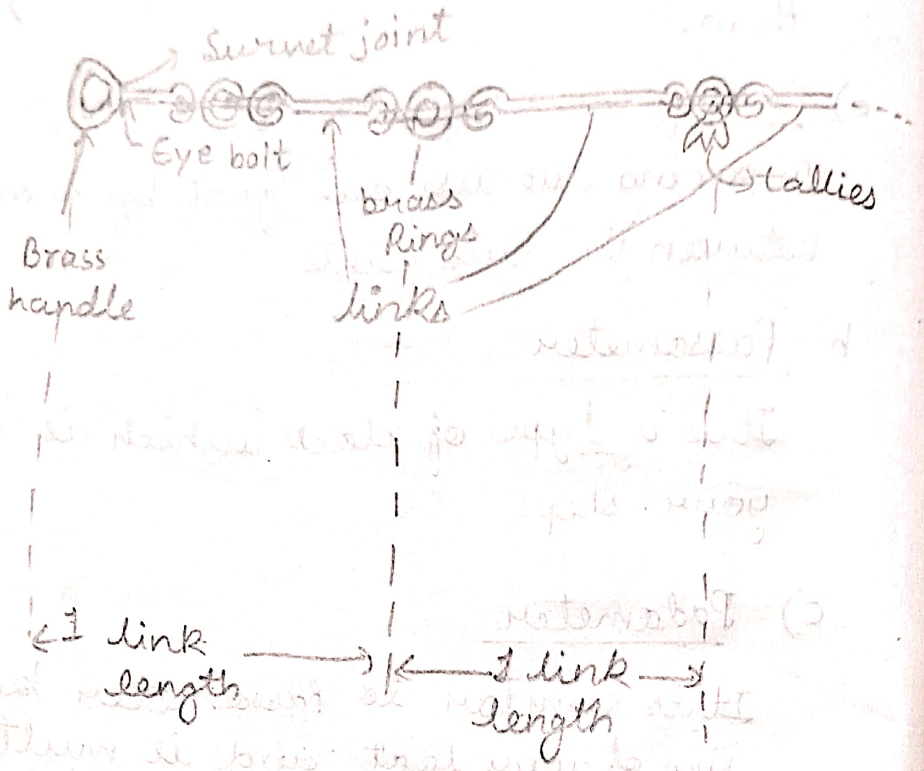
It contains a chain and a Tape

ii) Optical Method

iii) EDM

Instruments used in Chain Surveying

1) Chain



) Metric Chain — length - 10, 20, 30 m
↓
link length - 20 cm → No. of links - 50, 100, 150

Engineer's Chain → length - 100 ft
↓
link length - ~~20 cm~~ 1 ft → No. of links - 100

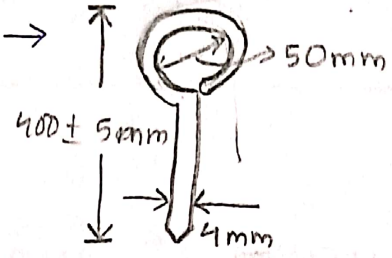
Gunter's chain → 66 ft - length
↓
link length → 0.66 ft → No. of links - 100

furlong = 660 ft

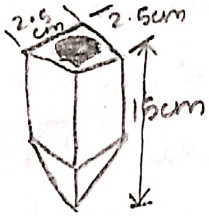
Tenenue chain → length → 33 ft
→ ling length → $2\frac{1}{16}$ ft
→ No. of links → 16

2) Tapes →
   a) Cloth tape - It have an elasticity flaw
   b) Mettalic tape -
   c) Steel tapes
   d) Innar tape → (64% Alloy steel
                → 36% nickel)

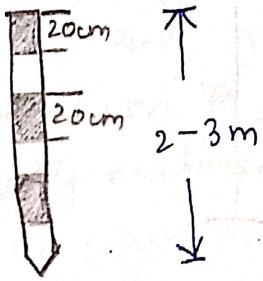
3) Arrow →



4) Pegs →

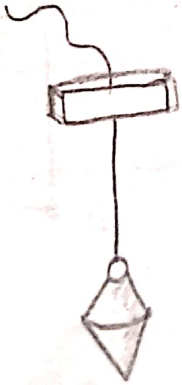


5) Ranging Rod →



6) Offset rod →

7) Plumb Bob →



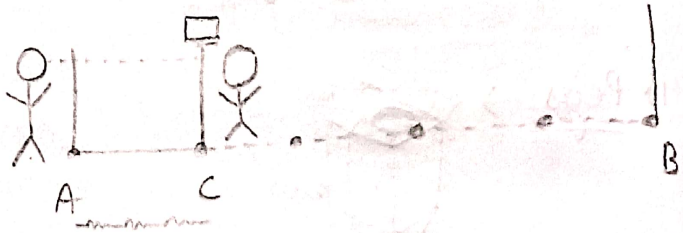
Ranging of line

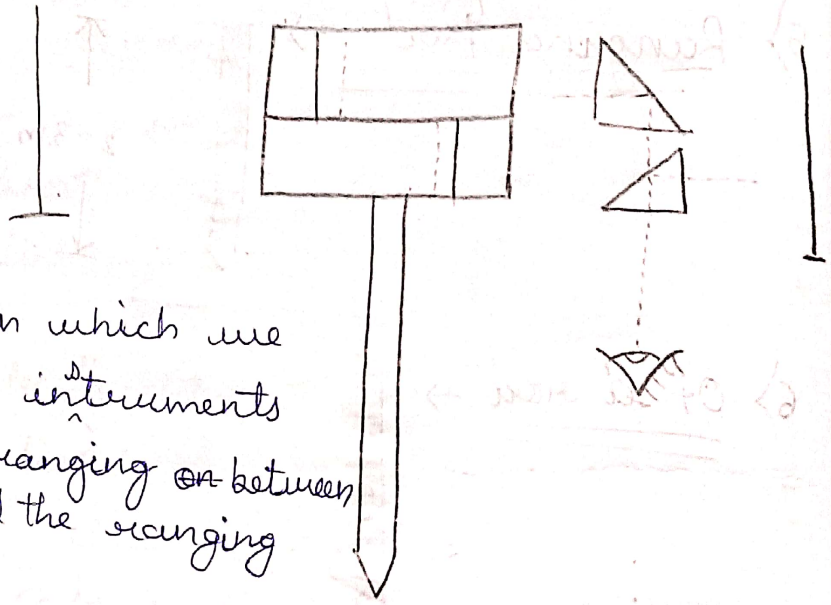
The process of establishing intermediate points on a survey line joining two stations on the field so, that the length between them may be measured correctly is called ranging.

Two methods of ranging

a) Direct method

i) Ranging by eye

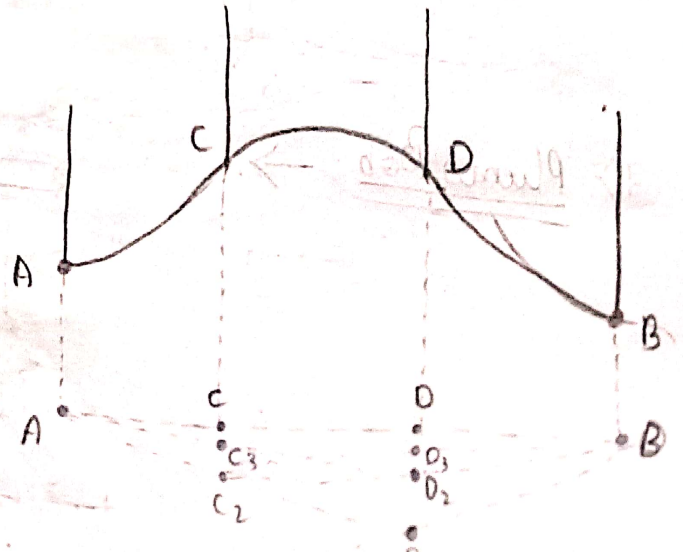




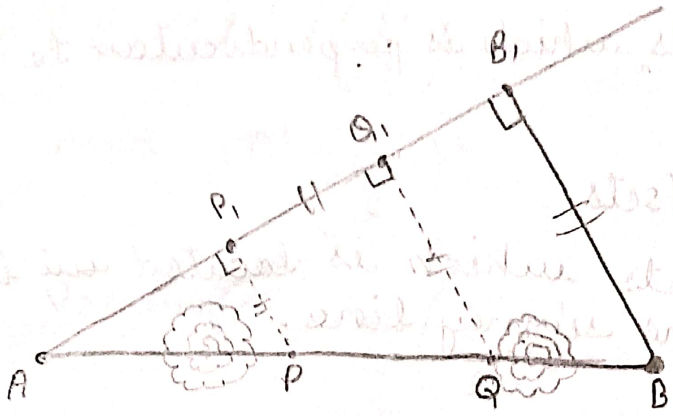
It is the method in which we use our eyes and instruments that helps us in ranging or between two points to find the ranging line.

Indirect ranging

) Reciprocal ranging



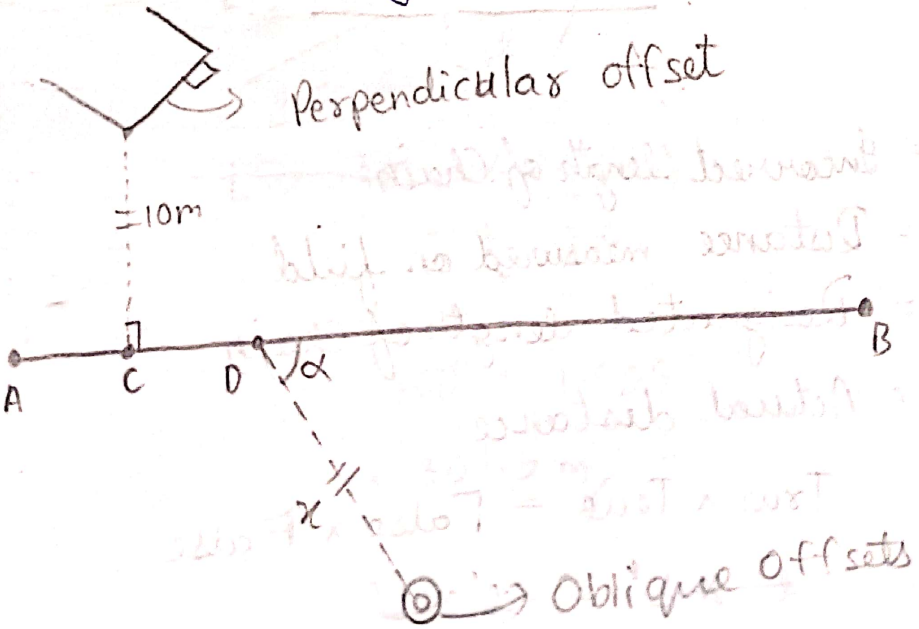
(ii) Ranging by random line method



First we have to draw a random line from A upto B, where B is perpendicular to B, and after using pythagorous theorem and by plotting points on $\overline{AB}$, line and pointing two intermediate on that line and drawing line perpendicular to the points P, and Q, and marks the points on the line $\overline{AB}$ and name them P and Q and verify them using Ranging by eye method.

* Offsets in Chain Surveying

Offsets are the lateral distances measured from the survey lines to locate the position of a point in respect to the survey line



i) Perpendicular Offset

It is the offsets which is perpendicular to the survey line.

ii) Oblique offsets

It is the offsets which is located in some angle from the survey line.

* Errors in Chain Surveying

1) Instrumental error →

(a) Incorrect length of chain/tape

2) Personal error →

(a) Bad Ranging
(b) Careless holding & marking.
(c) Bad Streightening
(d) Due to variation in pull

3) Natural Error →

(a) Error due to temperature

Error due to incorrect Chain

let

(False) l' = Incorrect length of Chain
(False) L' = Distance measured on field
(True) l = Designated length of Chain
(True) L = Actual distance

True x True = False x False

$l \times L = l' \times L'$

$$l \times L = l' \times L'$$

$$L = L' \times \left(\frac{l'}{l}\right)$$

$$\text{Area} = A' \left(\frac{l'}{l}\right)^2$$

$$\text{Volume} = V' \times \left(\frac{l'}{l}\right)^3$$

Qu The length of a line was measured with 20 m chain and found to be 300m. Calculate the true distance/length of the line if the Chain was ±10 cm too long.

Solution
OR
Ans Given,

$l = 20\,m$ (Designated length of Chain)

$L' = 300\,m$

$l' = 20 + \frac{10}{100} = 20.1\,m$

Actual Distance,

$$L = L' \times \left(\frac{l'}{l}\right)$$

$$L = 300 \times \left(\frac{20.1}{20}\right)$$

$$= 300 \times 1.005$$

$$= 301.5\,m$$

Qu A Distance of 5000m was measured by a 20m chain having actual length of 19.8 m. Calculate the correct distance measured.

$l = 20\,m$

$L' = 5000\,m$

$l' = 19.8\,m \Rightarrow Error = 0.2\,m$

Actual distance,

$$L = L' \times \left(\frac{l'}{l}\right)$$

$$= 5000 \times \left(\frac{19.8}{20}\right) = 4950\,m$$

Qu A 20m chain was found to be 10cm too long after chaining a distance of 1500m. It was found to be 18cm too long at the end of day's work. After chaining a total distance of 2900m. Determine the true distance if the chain was ~~to~~ correct before the start of the work.

Solution :-

$L' = 2900\,m \quad l = 20\,m$

$l' = ?$

0, +10cm, +18cm

* First 1500 m

$L_1' = 1500$ m

$e = \frac{10}{100} / = 0.1$ m

avg. error

$e_1 = \frac{0+10}{2} = 5$ cm $= \frac{5}{100} = 0.05$ m

l = Designated chain length

l' = Incorrect / Actual

L = True dist

L' = Measurement dist (Incorrect / False)

$l_1' = 20\text{m} + 0.05 = 20.05\text{m}.$

$L_1 = L_1' \times \left(\frac{l_1'}{l}\right)$

$L_1 = 1500 \times \left(\frac{20.05}{20}\right)$

$\boxed{L_1 = 1503.75\text{ m}}$

* Next 1400 m

$L_2' = 1400$ m

avg error

$e_2 = \frac{10+18}{2\times100} = \frac{14}{100} = 0.14$

$l_2' = 20 + 0.14 = 20.14$ m

$L_2 = L_2' \times \left(\frac{l_2^2}{l}\right)$

$L_2 = 1400 \left(\frac{20.14}{20}\right)$

$\boxed{L_2 = 1409.8\text{ m}}$

$L = L_1 + L_2$

$L = 1503.75 + 1409.8$

$\boxed{L = 2913.55\text{ m}}$

Ques A 20m chain was found to be 10 cm too long after chaining 1600 m. It was found to be 15 cm too long after chaining a total distance of 2700 m. If the chain was correct before the start of the work find the True distance.

Solution :- $L' = 2700\,m$ $l = 20\,m$ 0, +10, +15

$l' = ?$

l = Designated chain length

l' = Incorrect/Actual

L = True dist

L' = Measured dis (Increase/False)

* First 1600 m

$L_1' = 1600$

avg error

$$e_1 = \frac{0+10}{2} = 5cm \doteq \frac{5}{100} = 0.05\,m$$

$$l_1' = 20 + 0.05 = 20.05\,m$$

$$L_1 = L_1' = 1600 \times \left(\frac{20.05}{20}\right) = \underline{1604\,m}$$

* Next 1100 m

$$e_2 = \frac{10+15}{2} = 12.5 = \frac{12.5}{100} = 0.125\,m$$

$$l_2' = 20 + 0.125 = 20.125\,m$$

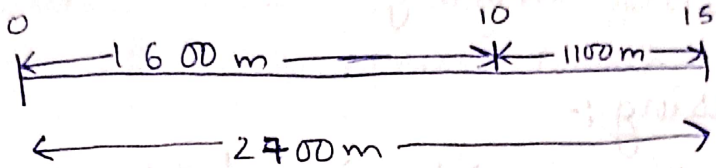
$$L_2 = L_2' \times \left(\frac{l_1'}{l_2}\right) = 1100 \times \left(\frac{20.125}{20}\right)$$

$L_2 = 1106.875$

$L = L_1 + L_2$

$= 1604 + 1106.875$

$L = 2710.875\,m$



Terms Related to chain Triangulation

i) Survey Stations

a) Main survey station

b) Tie survey station

ii) Main Survey line

iii) Base survey line

iv) Tie line

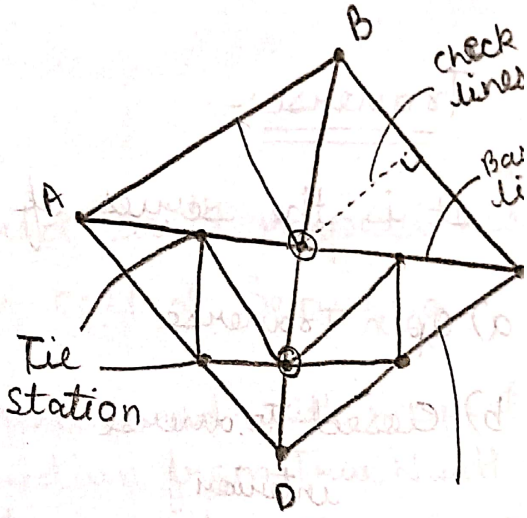
v) Check lines

vi) Well conditioned triangles

$30° < \theta < 120°$

vii) Chainage

A → C (Chainage)



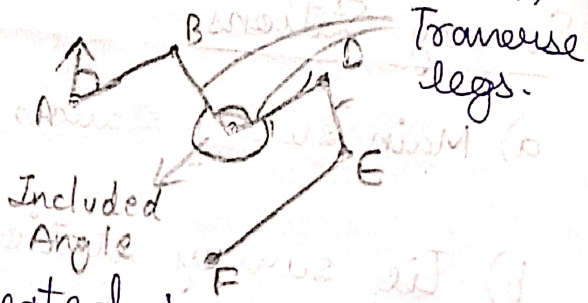
Compass Surveying

Compass surveying is the branch of surveying in which the directions of survey lines are determined by a compass and their length by chaining directly on the ground.

Principle - Traversing

Traversing :-

Surveying which involves a series of connected survey lines whose direction and length are measured is known as traversing.

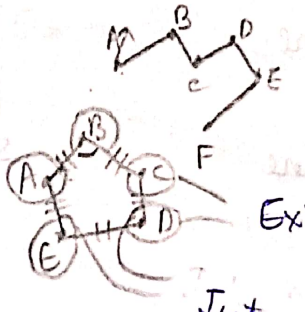


Traverse :-

It is the series of connected survey lines.

a) Open Traverse

b) Closed Traverse



Exterior Included Angle

Interior Included Angle

interior

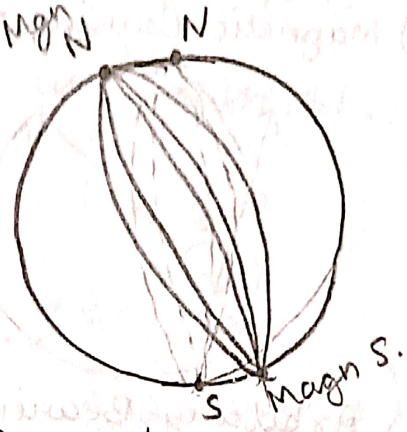
sum of all included angles $= (2n-4)90°$

Sum of all exterior included angles $= (2n+4)90°$

Basic Terms →

1) Meridian

a) True Meridian -
b) Magnetic Meridian
c) Arbitary Meridian



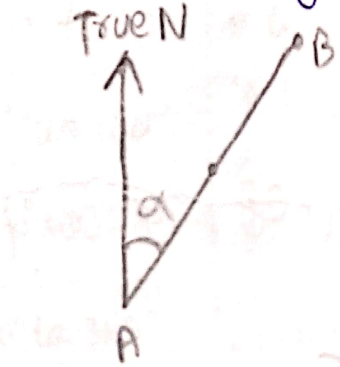
a) True Meridian - It is an imaginary line joining geographical North and South.

b) Magnetic Meridian - It is an imaginary line joining Magnetic North and Magnetic South.

c) Arbitary Meridian. -

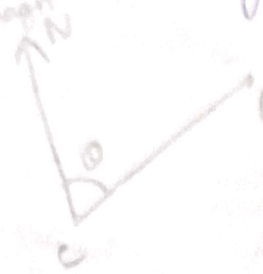
2) Bearing - Angle measured with respect to meridian is called Bearing.

a) True Bearing - Angle measured with respect a meridian from True North point is called True Bear



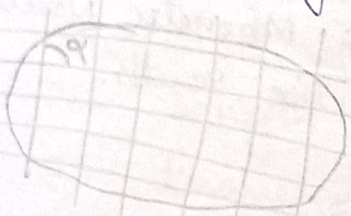
α = True bearing

b) Magnetic Bearing - It is the angle between meridian and Magnetic North is called Magnetic bearing.



c) Arbitary Bearing -

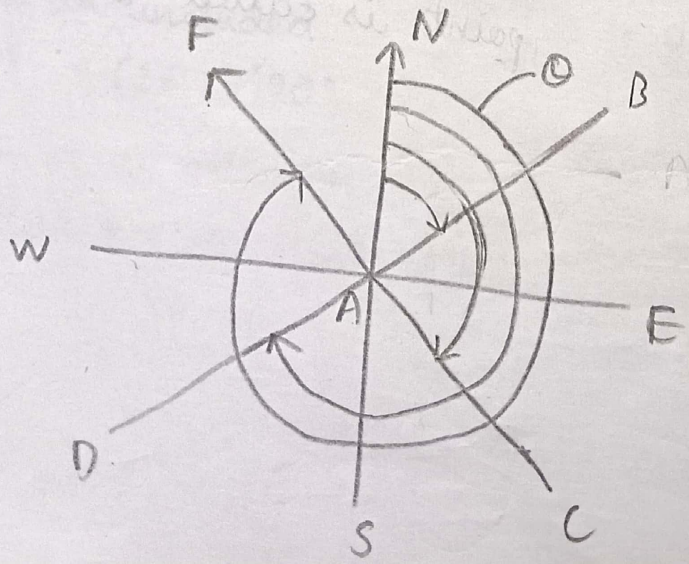
d) Grid Bearing - The angle measured between grid structure of an area is called grid bearing.



α = Grid Bearing.

System of Bearings :-

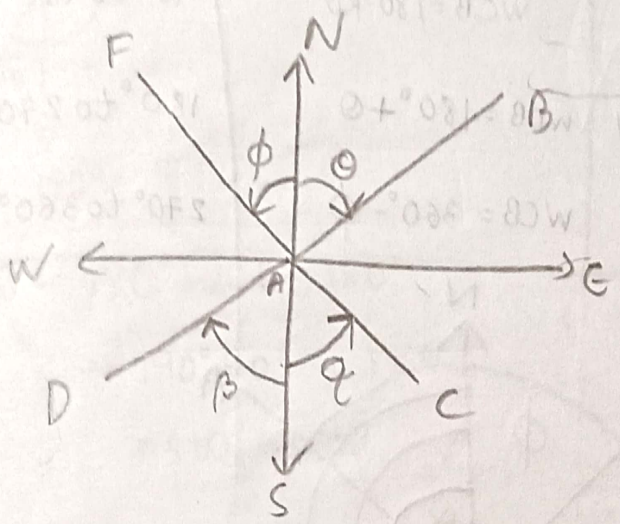
① Whole Circle Bearing (W.C.B.) (angle)
It is always measured from North in clock wise direction.



θ = (270° + 45°)

② Quandrantal / Reduced Bearing (QB/RB) (angle)

It is measured from North and South which one is closer

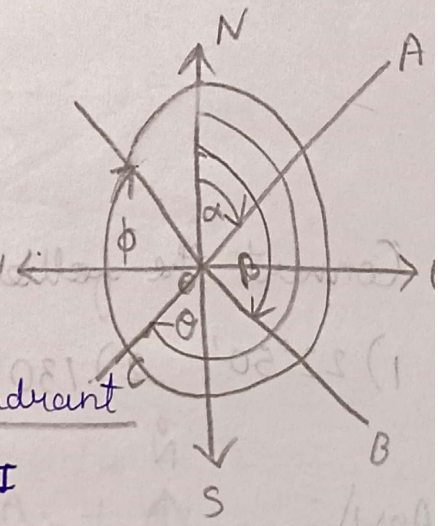


(Surveyor's Compass)

$\angle AB = N\theta E$

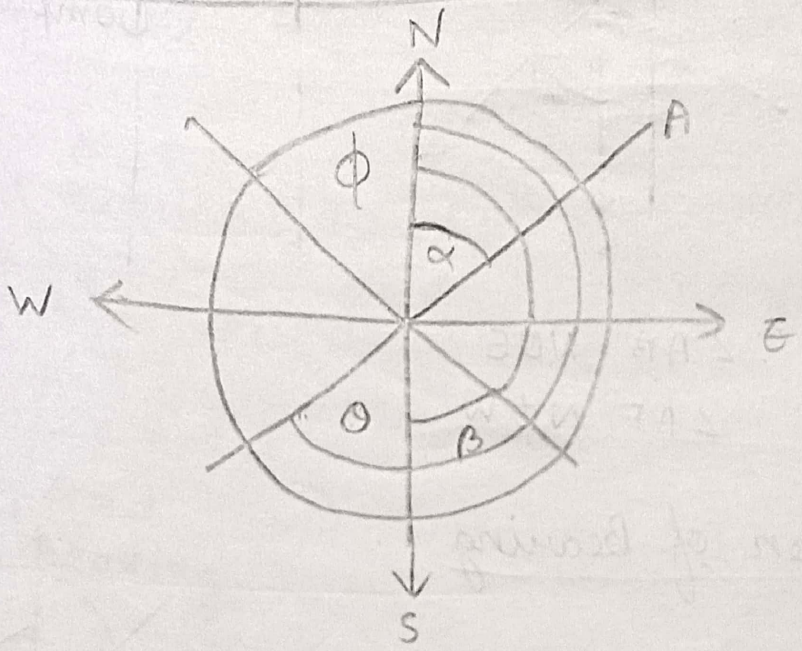
$\angle AF \; N\phi W$

Conversion of Bearing



S.No.	W.C.B between	Rule for RB	R.B	Quadrant
1.(OA)	$\alpha = 0°$ to $90°$	R.B. = W.C.B	N α E	I
2.(OB)	$\beta = 90°$ to $180°$	R.B = (180 - WCB)	S(180°-β) E	II
3.(OC)	$\theta = 180°$ to $270°$	RB = (WCB - 180°)	S(θ-180°) W	III
4.(OD)	$\phi = 270°$ to $360°$	R.B(360° - WCB)	N(360° - ϕ) W	IV

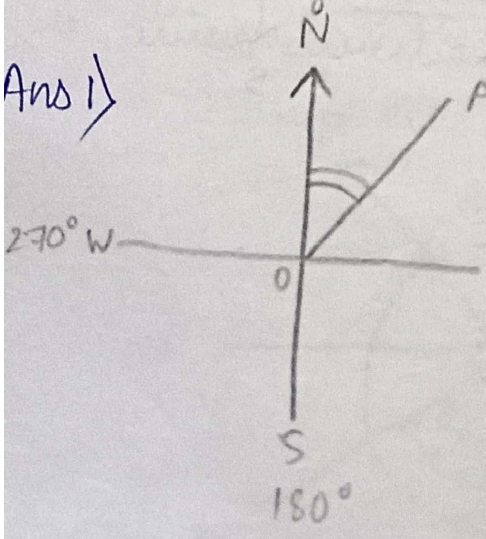
S.No	Line Name	RB	Rule for WCB	WCB between	Quadrant
1	OA	N∝E	WCB = RB	0 to 90°	I
2	OB	SβE	WCB = 180° - RB	90° to 180°	II
3.	OC	SθW	WCB = 180° + θ	180° to 270°	III
4.	OD	NϕW	WCB = 360° - ϕ	270° to 360°	IV



Convert the following W.C.B. to R.B.

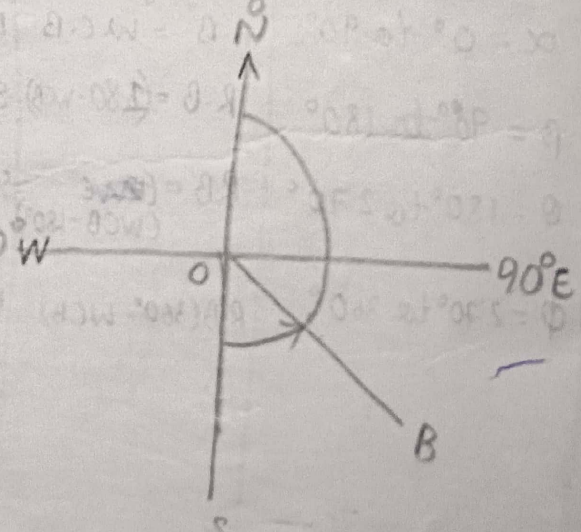
1) 22°50' 2) 130°20' 3) 190°40' 4) 290°30'

Ans 1)



R.B. = WCB

= N 22°50' E

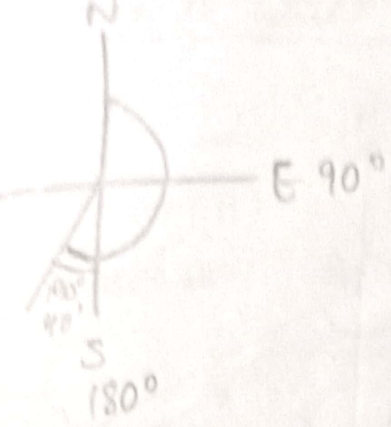


RB = 180° - WCB

= 180° - 130° 20'

= 5 49° [illegible]

Ans 3)

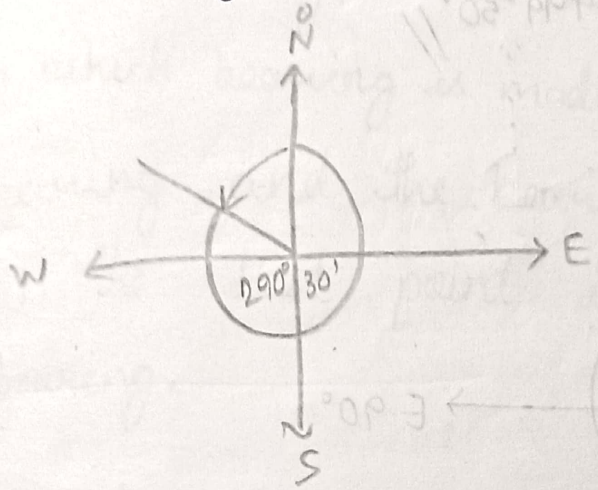


RB = 180° WCB - 180°

= 190° 40' - 180°

= S10° 40' W

Ans 4)



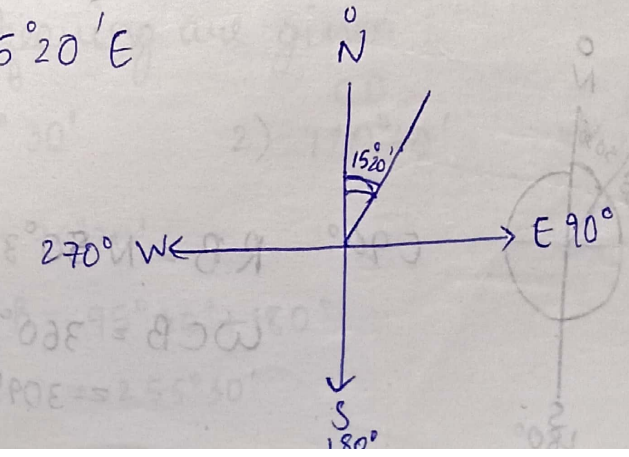
RB = 360° - WCB

= 360° - 290° 30'

= N6 9° 30' W //

Convert the following quandrantal bearings to whole circle bearing.

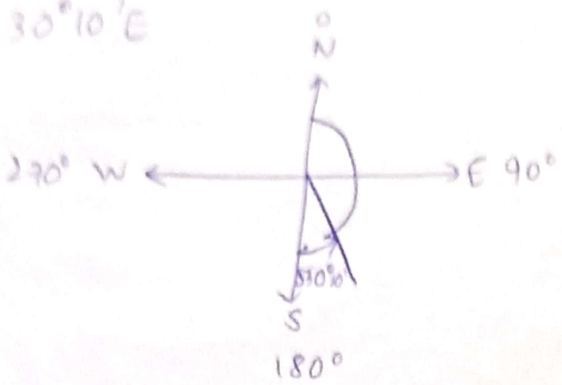
1) N 15° 20' E



RB = WCB

WCB = 15° 20'

2) S 30°10'E

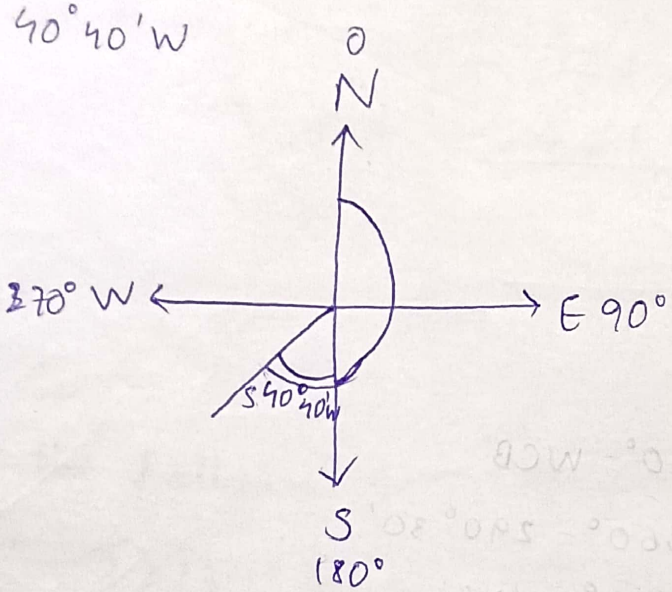


$RB = S 30°10' E$

$WCB = 180° - 30°10'$

$= 149°50'$ //

3) S 40°40'W

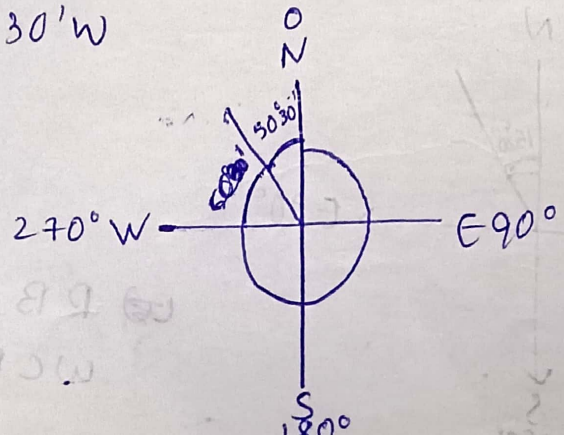


$RB = S 40°40' W$

$WCB = 180° + 40°40'$

$= 220°40'$ //

4) N 50°30'W

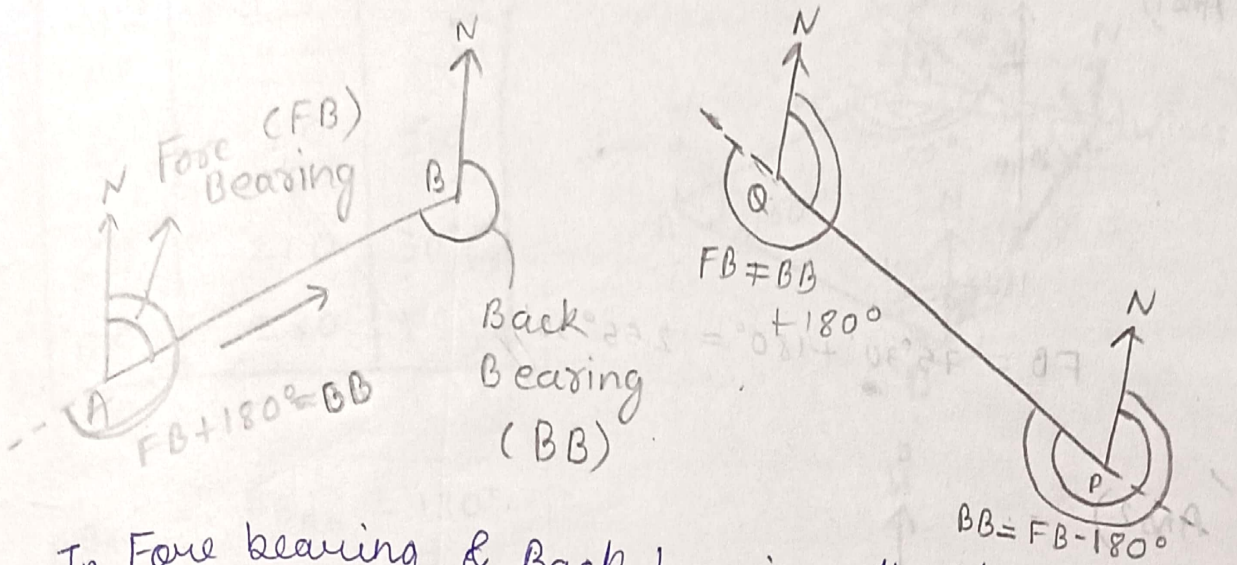


$RB = N 50°30' W$

$WCB = 360° - 50°30'$

$= 309°30'$ //

Fore Bearing & Back bearing



In Fore bearing & Back bearing the first point in which bearing is made it is called Fore bearing and the bearing which is made in the last point it is called back bearing.

Formula:-

$$FB = BB \pm 180^\circ \quad \{(+) \rightarrow BB < 180^\circ, (-) \rightarrow BB > 180^\circ\}$$

$$BB = FB \pm 180^\circ \quad \{(+) \rightarrow FB < 180^\circ, (-) \rightarrow FB > 180^\circ\}$$

Determine the forebearings of line $\overline{AB}$, $\overline{CD}$ & $\overline{EF}$ whose back bearing are given

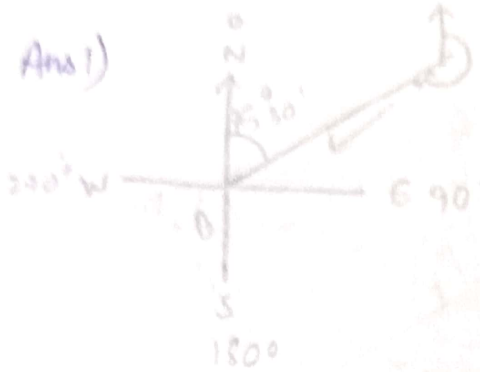
1) AB $75^\circ 30'$ 2) CD $120^\circ 40'$ 3) EF $260^\circ 10'$

$BB = 75^\circ 30'$

$FB = 75^\circ 30' + 180^\circ$

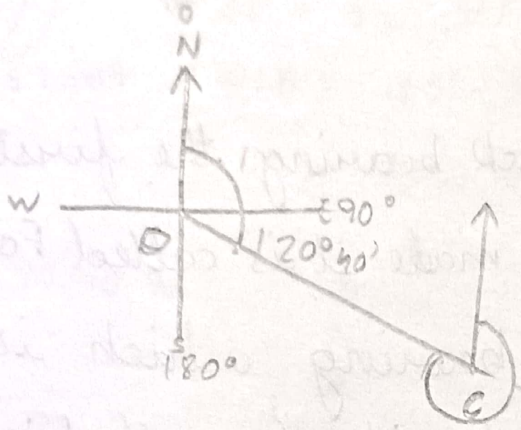
$= 255^\circ 30'$

Ans 1)



FB = 75°30' + 180° = 255°30' //

Ans 2)

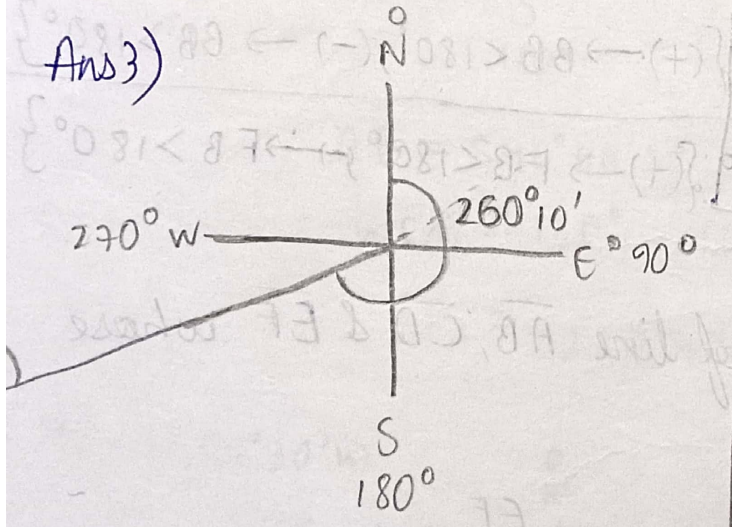


BB = 120°40'

FB = ~~180~~ 120°40' + 180°

= 300°40' //

Ans 3)



FB = 260°10' - 180°

= 80°10' //

Interior angle

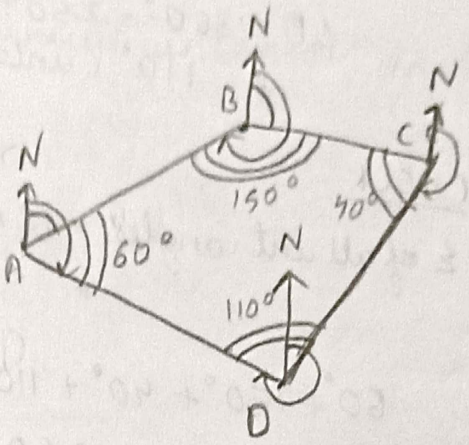
$\Sigma i = (2n-4)90°$

Exterior angle

$\Sigma e = (2n+4)90°$

Ques

Line	FB	BB
AB	40	220°
BC	70	250°
CD	210	30°
DA	280	100°



$BB_{AB} = FB_{AB} \pm 180°$

$= 40° + 180°$ (FB < 180° ; + is done)

$= 220°$

$BB_{BC} = 70° + 180° = 250°$ (FB < 180°; + is done)

$BB_{CD} = 210° - 180° = 30°$ (FB > 180°; − is done)

$BB_{DA} = 280° - 180° = 100°$ (FB > 180°; subtraction is done)

included angle

incl. ∠ = Bearing of previous line − Bearing of next line

∠A = Bearing of Line AD − Bearing of AB at A

$\angle A = BB_{DA} - FB_{AB}$

$\angle A = 100° - 40°$

$\boxed{\angle A = 60°}$

$\angle B = BB_{AB} - FB_{BC}$

$= 220° - 70°$

$\boxed{\angle B = 150°}$

$\angle C = BB_{BC} - FB_{CD}$

$\angle C = 250° - 210$

$\boxed{\angle C = 40°}$

$\angle D = BB_{CD} - FB_{DA}$

$= 30° - 280°$

$= -250°$ (exterior angle)

$\angle D = 360° - 250°$

$= 110°$ (interior angle)

CHECK

Σ of all int. angles $= (2n - 4)90°$

$60° + 150° + 40° + 110° = (2 \times 4 - 4)90°$

$360° = 360°$

compass. Identify Determine interior angles

line	FB	BB
AB	60°30'	240°30'
BC	120°	300°
CD	46°	226°
DE	205°30'	24°30'
EA	300°	120°

$BB_{AB} = FB \pm 180°$

$BB_{AB} = 60°30' + 180°$

$= 240°30'$ //

$BB_{BC} = FB_{BC} + 180°$

$= 120° + 180°$

$= 300°$ //

$BB_{CD} = 46° + 180°$

$= 226°$ //

$BB_{DE} = 205°30' - 180°$

$= 24°30'$ //

$BB_{EA} = 300° - 180°$

$= 120°$ //

included angle

incl. ∠ = Bearing of previous line − Bearing of next line.

$\angle A = BB_{EA} - FB_{AB}$

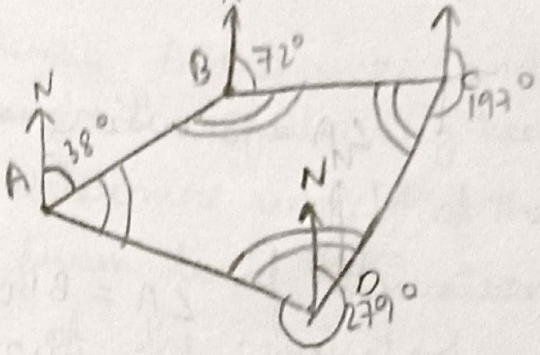
$= 120° - 60°30'$

$= 50°30'$

$\angle B =$

line	FB	BB
AB	38°	
B	72	

line	FB	BB
AB	38°	218°
BC	72°	252°
CD	197°	17°
DA	279°	117°



$BB_{AB} = FB_{AB} + 180°$ (As $FB_{AB} < 180°$)

$= 38° + 180°$

$BB_{AB} = 218°$

$BB_{BC} = FB_{BC} + 180°$ (As $FB_{BC} < 180°$)

$= 72° + 180°$

$BB_{BC} = 252°$

$BB_{CD} = FB_{CD} - 180°$ (As $FB_{CD} > 180°$)

$= 197° - 180°$

$BB_{CD} = 17°$

$BB_{DA} = FB_{DA} - 180°$ (As $FB_{DA} > 180°$)

$= 279° - 180°$

$BB_{DA} = 117°$

incl ∠ = Bearing of previous line - Bearing of next line.

$\angle A$ = Bearing of line AD - Bearing of line AB at A

$$\angle A = BB_{DA} - FB_{AB}$$
$$117° - 38°$$
$$\angle A = 79°$$

$$\angle B = BB_{AB} - FB_{BC}$$
$$= 218° - 72°$$
$$\angle B = 146°$$

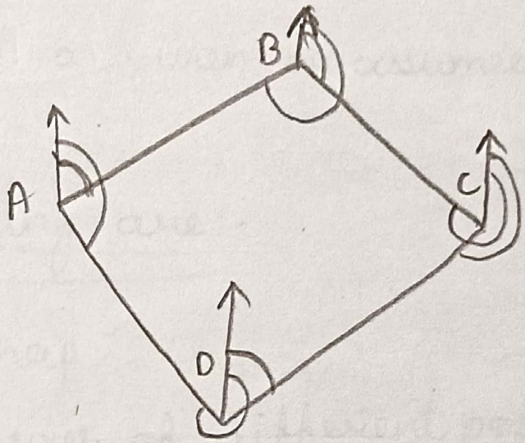
$$\angle C = BB_{BC} - FB_{CD}$$
$$= 252° - 197°$$
$$= 55°$$

$$\angle D = BB_{CD} - FB_{DA}$$
$$= 817° - 279°$$
$$\angle D = -262° \text{ (exterior angle)}$$
$$\angle D = 360° - 262°$$

$$\boxed{\angle D = 198° \text{ (interior angle)}}$$

Ques A closed compass traverse ABCD was conducted round a lake and the following bearings were observed. Determine which of the stations are suffering from local attraction and give the values of the corrected bearing by included angle method.

line	FB	BB
AB	74°20'	256°
BC	107°20'	286°20'
CD	224°50'	44°50'
DA	306°40'	126°



$\angle A = BB_{AD} - FB_{AB}$

$= 126° - 74°20' = 51°40'$

$\angle B = BB_{AB} - FB_{BC}$

$= 256° - 107°20'$

$= 148°40'$

$\angle C = BB_{BC} - FB_{CD} = 286°20' - 224°50'$

$= 61°30'$

$\angle D = BB_{CD} - FB_{DA} = 44°50' - 306°40'$

$= -261°50'$ (exterior $\angle$)

$= 360° - 261°50' = 98°10'$ (interior $\angle$)

$\sum$ ind angle $= \angle A + \angle B + \angle C + \angle D = 51°40' + 140°40' + 61°30' + 98°10'$

$\Rightarrow 360^\circ = 360^\circ$

Finding line which is free from local attraction.

LEVELLING

Levelling is the branch of surveying the objectives of which are :-

1. To find out elevations of given points w.r.t. a given or assumed datum
2. To establish points at a given elevation or at different elevations w.r.t. a given or assumed datum.

The various uses of levelling are:-

1. To prepare a contour map
2. To determine the altitudes of different point
3. To prepare longitudinal sections and cross sections of civil engineering projects
   Eg:- Roads, Railways, Canals etc.
4. To prepare a layout map for water supply sanitary or drainage scheme

Basic Definitions

) Levelling :- The science of determining the relative heights of different points on, above or belo the surface of the earth is known as levelling

② Level Surface - The surface which is parallel to curvature mean surface of the earth is called level surface.

③ Level line - line which is drawn on level surface is called level line and each point on level line is equi distance with mid-point of the earth

④ Horizontal plane - The plane

⑤ Horizontal line - The line which is tanjantial to the level surface or level line is called Horizontal line.

⑥ Vertical line - The line drawen towards earth surface which is perpendicular to level surface or line is called vertical line.

⑦ Datum - It is the reference point which is taken

⑧ Mean Sea level - (MSL)

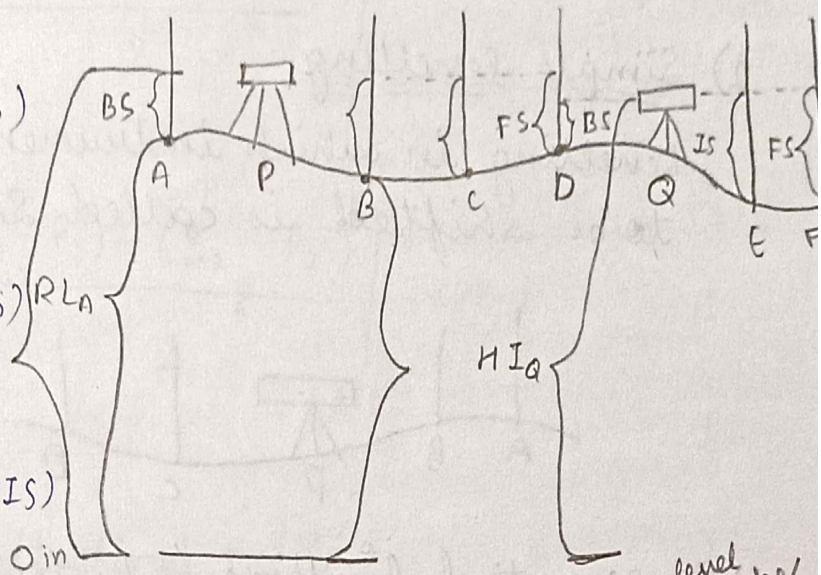
⑦ Benchmark → i) Great Trignometerical Survey (GTS) Benchmark.
ii) Permanent Benchmark.
iii) Temporary Benchmark.
iv) Arbitary Benchmark.

* Reduced level
It is the elevation of any point from the assumed datum.

* Back Sight Reading (BS)

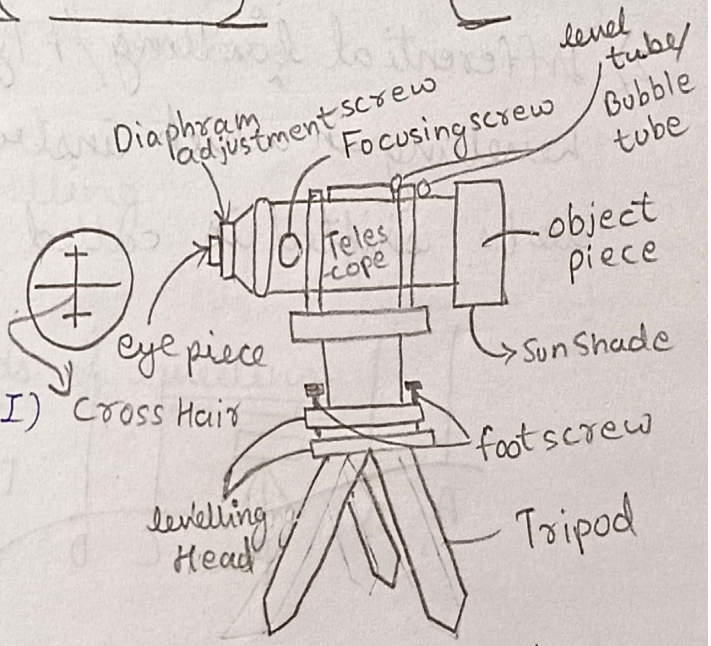
* Fore Sight Reading (FS)

* Intermediate Sight Reading (IS)



* Change Point (CP)

* Height of Instrument (HI)

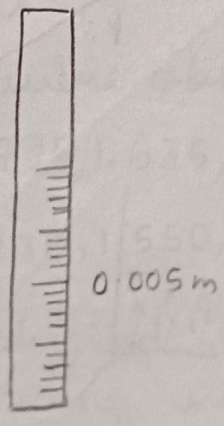


Levelling Instruments

1) A level machine → telescopic machine → pin point → shows reading

eg → Y-level
Dumpy level
Auto level
Tilting level

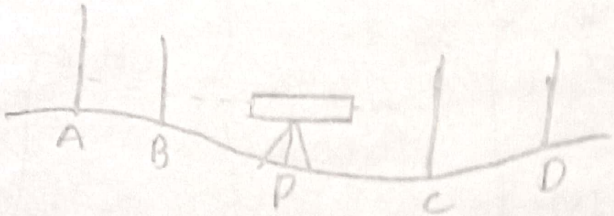
2) A levelling Staff → length → 4m



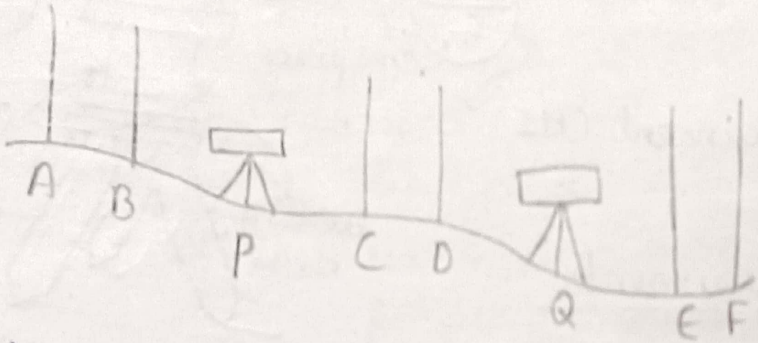
Classification of levelling

1) Simple levelling

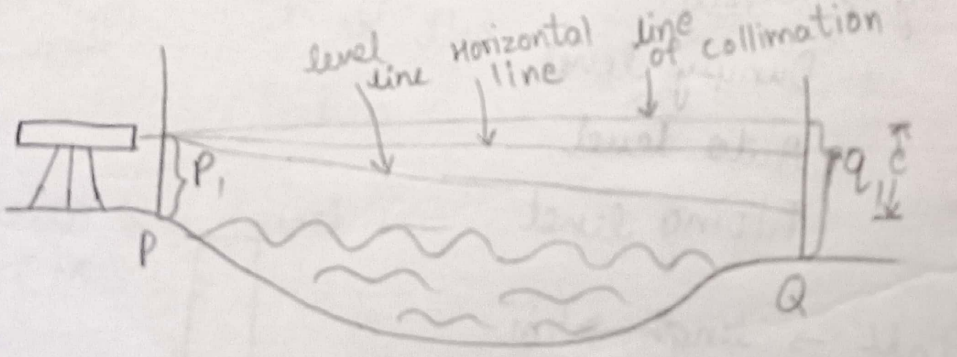
Levelling in which instrument is not needed to be shifted is called Simple levelling.

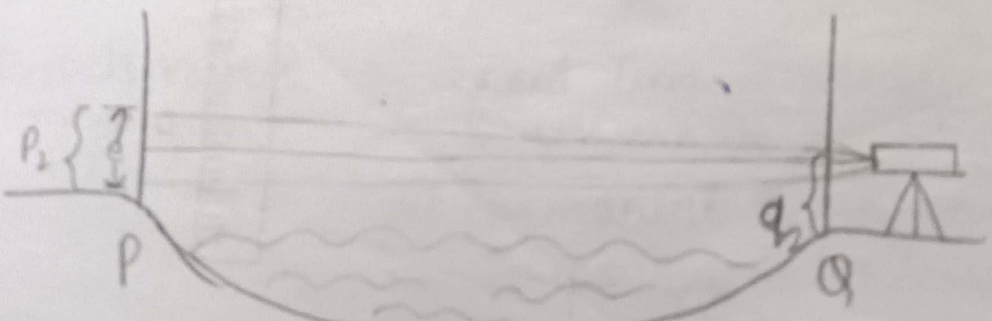


2) Differential levelling / Fly levelling / Levelling in which instrument is needed to be shifted is called Differential levelling.



3) Reciprocal levelling





$$d \text{ (difference in level)} = \left[\frac{(Q_1 - P_1) + (Q_2 - P_2)}{2}\right]$$

$$e \text{ (error)} = \left[\frac{(Q_1 - P_1) - (Q_2 - P_2)}{2}\right]$$

4) Profile or longitudinal levelling

5) Cross-sectional levelling

Methods of levelling

(1) Rise and Fall

(2) Height of instrument

Ques The following readings were observed with a dumpy level; 0.795, 1.535, 2.855, 3.125, 0.945, 0.635, 0.555, 0.230, 1.550, 0.995, 2.015. The instrument was shifted after 4th & 8th readings. The first reading was taken on a benchmark of reduced level 607.4.

Makes entries of above ... book. Calculate reduced levels of the points and apply check

Station	BS	IS	FS	Rise (+)	Fall (-)	R.L.	Remarks
A	0.795					607.4	B.M
					0.74	606.66	
B		1.535					
					1.32	605.34	
C		2.855					
					0.27	605.07	C.P.1
D	0.945		3.125				
						605.38	
E		0.635		0.31			
						605.46	
F		0.555		0.08			
						605.785	C.P.2
G	1.550		0.230	0.325			
H		0.995		0.555		606.34	
I			2.015		1.02	605.32	

$\Sigma BS = 3.29$ $\Sigma FS = 5.370$ $\Sigma Rise = 1.27$ $\Sigma Fall = 3.35$

Rise or Fall = previous reading - current reading.

CHECK

$\Sigma Rise - \Sigma Fall = 1.27 - 3.35 = -2.08$

$\Sigma BS - \Sigma FS = 3.29 - 5.37 = -2.08$

Last RL - First RL $\Rightarrow$ $605.32 - 607.4 = -2.08$

$-2.08 = -2.08 = -2.08$

Hence Checked

The following readings were observed with a dumpy level. The instrument was shifted after 3rd, 6th and 8th readings. Enter the below readings in level field book and determine reduced levels of points. If the first reading was taken on a benchmark of 432.384 m.

2.228, 1.606, 0.988, 2.090, 2.864, 1.262, 0.602, 1.982, 1.044, 2.684.

Station	BS	IS	FS	Rise	Fall	R.L.	Remark
A	2.228					432.384	
B		1.606		0.622		433.006	
C	2.090		0.988	0.618		433.624	
D		2.864			0.774	432.85	
E	0.602		1.262	1.602		434.452	
F	1.044		1.982		1.38	433.072	
G			2.684		1.64	431.432	
				Σ Rise = 2.842	Σ Fall = 3.794		

Σ BS = 5.964 Σ FS = 6.916

Σ Rise - Σ Fall = −0.952

Σ BS - Σ FS = −0.952

Last R.L. − First R.L. = 431.432 − 432.384 = −0.952

−0.952 = −0.952 = −0.952

Hence Checked.

Ques The following readings were taken by a level 0.875, 1.225, 1.285, 1.425, 1.165, 0.785, 0.925, 1.225, 2.825, 0.895, 1.255, 1.685, 0.915. The instrument was shifted after 5th and 9th Readings enter the data in level field book and Calculate RL of all the points if 1st reading was taken on a benchmark of 100.

Station	BS	IS	FS	HI	RL	Remarks
A	0.875			100.875	100	BM
B		1.225		100.875	99.65	
C		1.285		100.875	99.59	
D		1.425		100.875	99.45	
E	0.785		1.165	100.495	99.71	
F		0.925			99.57	
G		1.225			99.27	
H	0.895		2.825	98.565	97.67	
I		1.255			97.31	
J		1.685			96.88	
K			0.915		97.65	
	$\Sigma B = 2.555$		$\Sigma FS = 7.905$			

CHECK

$\Sigma BS - \Sigma FS$ = Last RL − First RL

$-2.335 = -2.335$

Hence, Checked.

The following consecutive readings were taken on a ground 0.225, 1.325, 1.465, 1.025, 1.115, 1.355, 2.455, 2.125, 2.135, 3.160, 2.100, 1.165 the instrument was shifted after 4th and 7th readings. Enter the data in level field book and calculate all the R.L's if the first reading was taken on a benchmark of 100.

Station	BS	IS	FS	Height of Ins. HI	RL	Remarks
				100.225	100	BM
A	0.225					
		1.325			98.9	
B						
		1.465			98.76	
C						
				100.315		
D	1.115		1.025	~~100.085~~	99.2	CPI
		1.355			98.96	
E						
			2.455	99.985	97.86	CP II
F	2.125					
					97.85	
G		2.135				
					96.825	
H		3.160				
					97.885	
I		2.100				
					98.82	
J			1.165			

$\Sigma BS = 3.465$ $\Sigma FS = 4.645$

-1.18

CHECK

$\Sigma BS - \Sigma FS$ = Last RL - First RL

$3.8465 - 4.645$ = $98.82 - 100$

-1.18 = -1.18

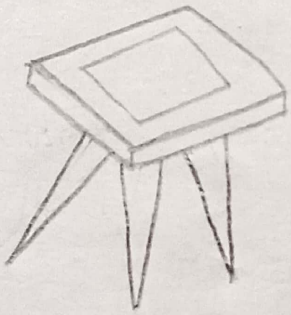
Hence, Checked

PLANE TABLE SURVEY

Plane Table surveying is a graphical method of surve in which the field observations and plotting are done simultaneously. The principle of plane table survey is that the rays drawn from stati -ons to object on the paper are parallel to the lines from the stations to the objects on the ground.

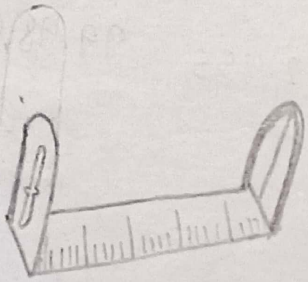
Instruments used →

① Plane Table.

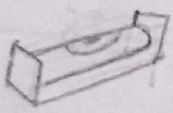


② Tripod

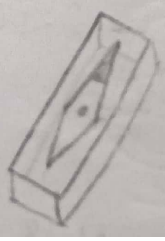
③ Alidade.



④ Spirit level



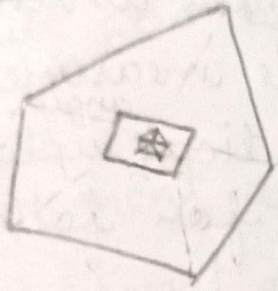
⑤ Trough Compass.



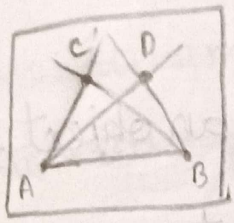
PLANE TABLE SURVEY

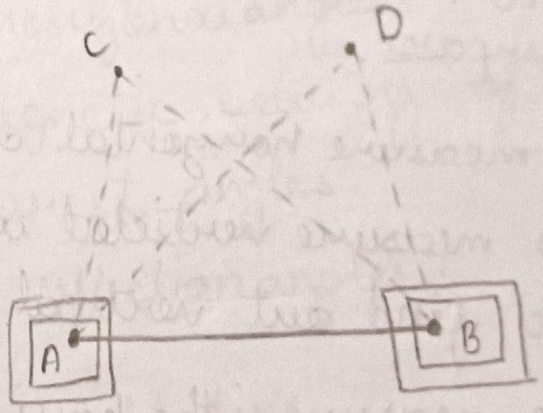
Methods

a) Radiation

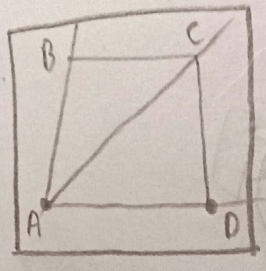


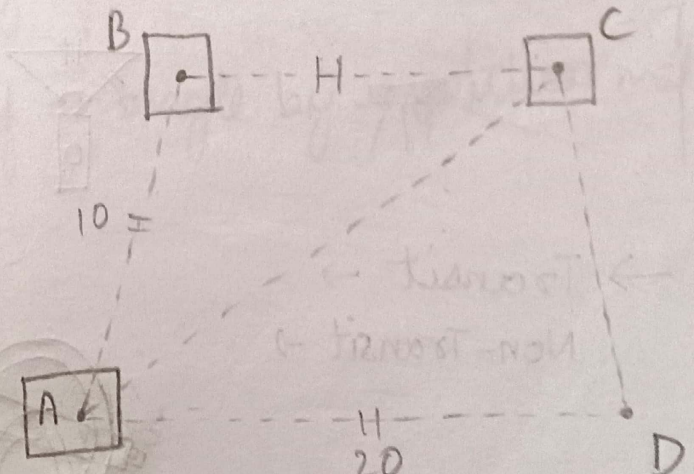
b) Intersection





c) Traversing



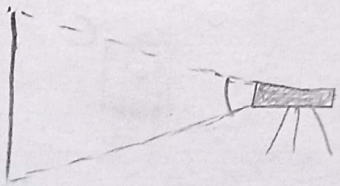


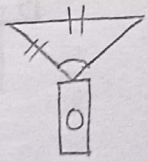
(d) Resection

Theodolite

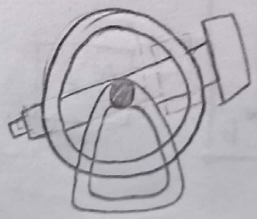
Theodolite is an instrument which is used mainly for accurate measurement for of horizontal and vertical angles upto 10' to 20'. Theodolite is used for following purposes.

1. To measure horizontal angles.
2. To measure vertical angles.
3. To find out vertical height of an object.
4. To measure the horizontal distance between two points.





Types → Transit →
Non-Transit →



In this type of theodolite the telescope can be revolved 180° in a vertical plane about its horizontal axis.

Non - Transit

In this type of theodolite the telescope cannot be revolved 180° in a vertical plane about its horizontal axis.

Uses of Theodolite

Theodo-lite can be used for following purposes.

1. Measurement of vertical angles.
2. Measurement of horizontal angles.
3. Measurement of magnetic bearing of line.
4. Measurement of direct angles.
5. Measurement of deflection angles.
6. Prolongation of straight line.
7. Running of line between two points
8. Laying of an angle by repetition method.

Unit - III

Mapping & Sensing

Contour →

Area & Volume Calculation

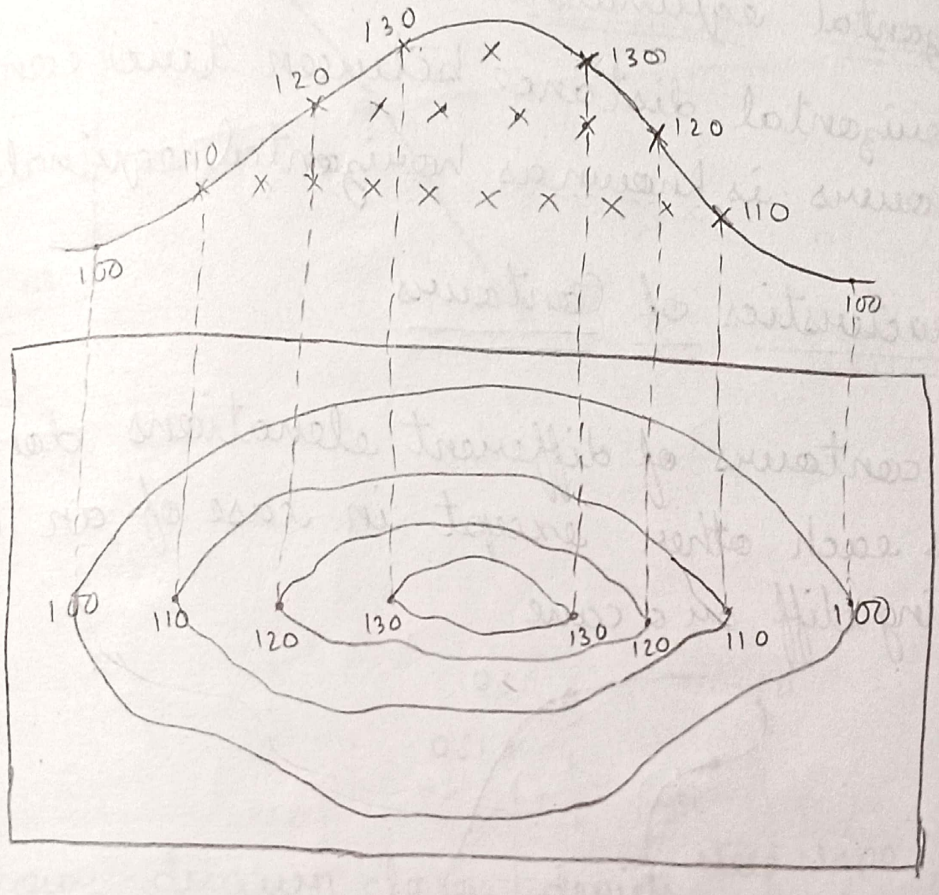
Mapping

The relative positions of points in a plan are represented by a map and the process of locati the relative positions of points in a plane is known as mapping.

The importance of the map is considerabely incr- ased if along with the horizontal positions of th features, their relative heights are also represent Such maps are known as topographical maps. Th map represents clear picture of the ground. It shows various ground features eg:- river, po- -ds, valleys, slopes, railways etc. Topographical m are nothing but contour maps on which var- -us features existing on the ground surface are relatively shown.

1) Contour lines

An imaginary line joining the points of same elevati
-on (Reduced level - RL) is known as contour line.



2) Contour map

A map or plan representing a 3-dimensional
picture of the ground with the help of conto
-ur lines is called contour map or plan.

3) contour interval

It is the difference in elevation between two
successive contour lines. For a contour ma
the contour interval is always constant.

4) Contour gradient

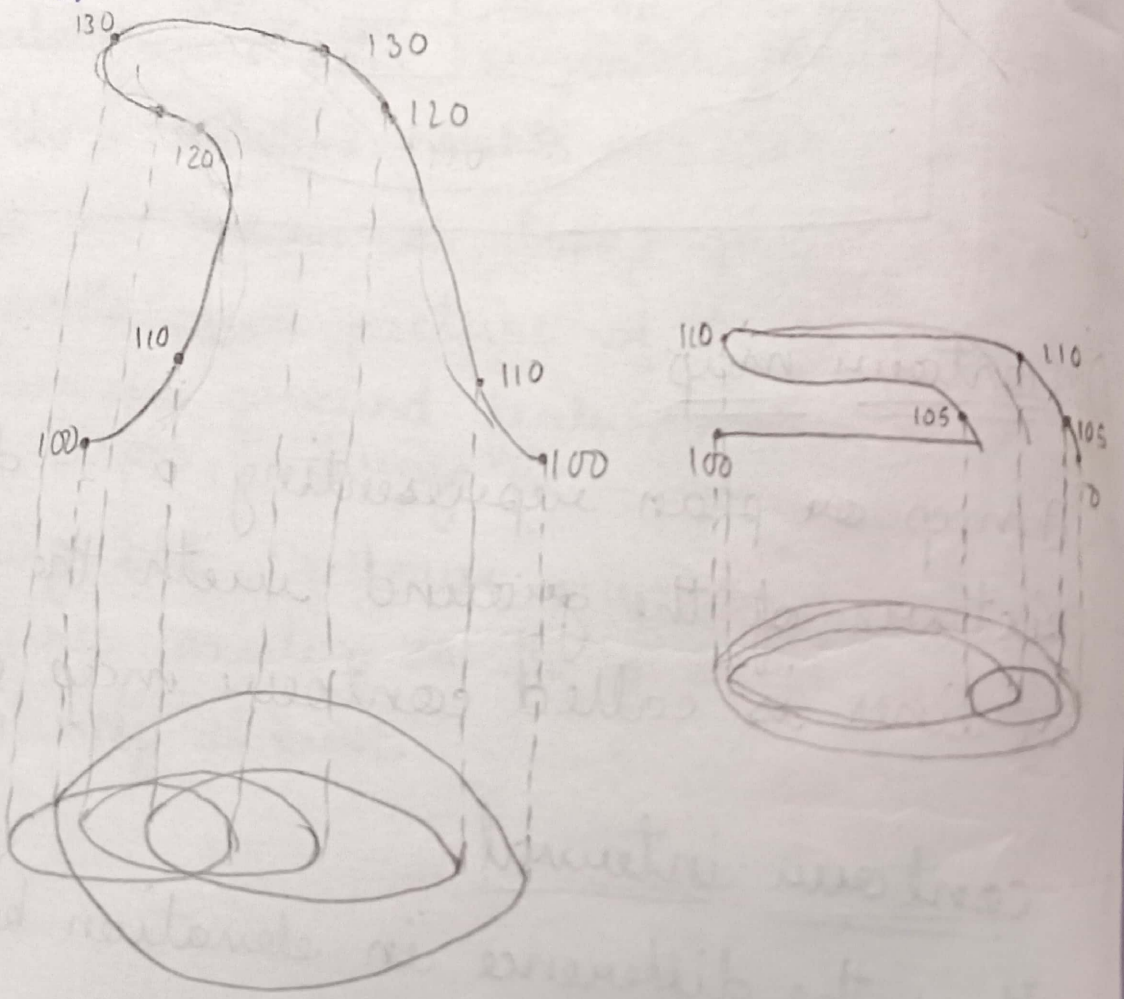
A line lying on the ground which maintains a constant inclination to the horizontal is known as contour gradient.

5) Horizontal equivalent

The horizontal distance between two consecutive contours is known as horizontal equivalent

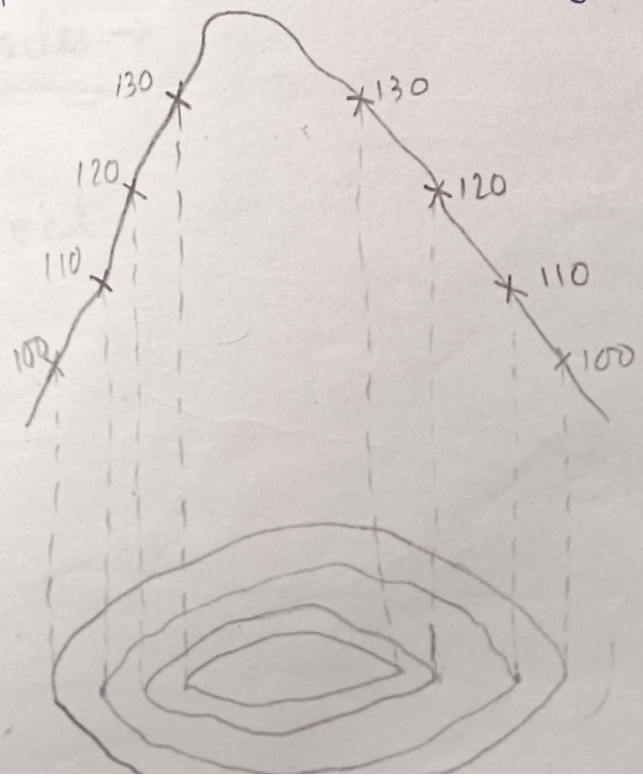
Characteristics of Contours

1) Two contours of different elevations do not cross each other except in case of an over hanging cliff or a cave

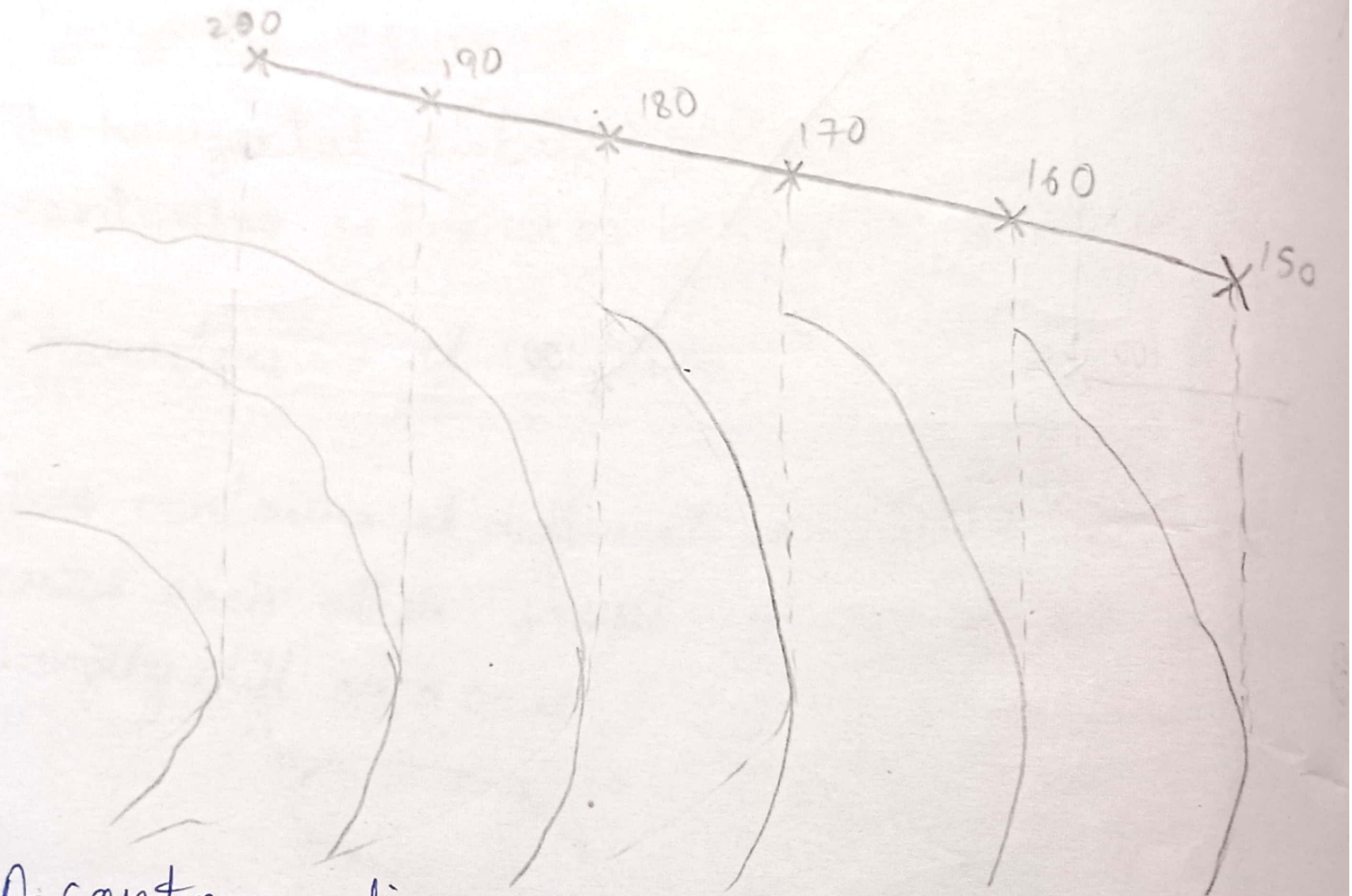


② Contours of different elevations do not unite to form one contour except in the case of a vertical cliff.

③ Contour drawn closer depicts steep slope, and if drawn far aparts, it represents gentle slope.



④ Contours equally spaced depicts a uniform slope when contours are parallel, equidistance and straight they represent an inclined plane surface.



A contour line at any point is perpendicular to the tangent line of the steepest slope at the point.

⑥ Contour line must be closed either within the map or outside the limit of the map.

Uses of Contour lines

① Suitable sight can be selected for construction

② Reservoir capacity can be determined.

③ Alignment of roads, canals, transmission lines are done efficiently with the help of contour map.

④ Nature of the ground surface may be determined.

⑤ Estimating the quantities

Methodes →

i) Direct

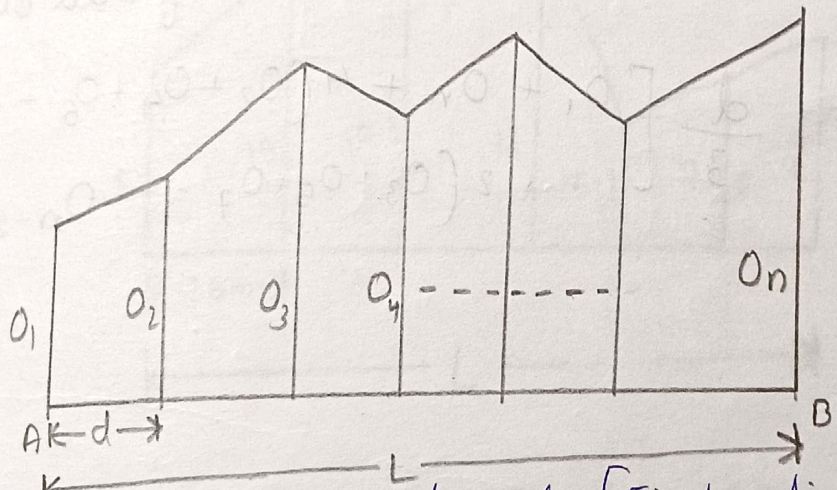
ii) Indirect →

a) Method of cross-section

b) Method of squares

c) Radial method

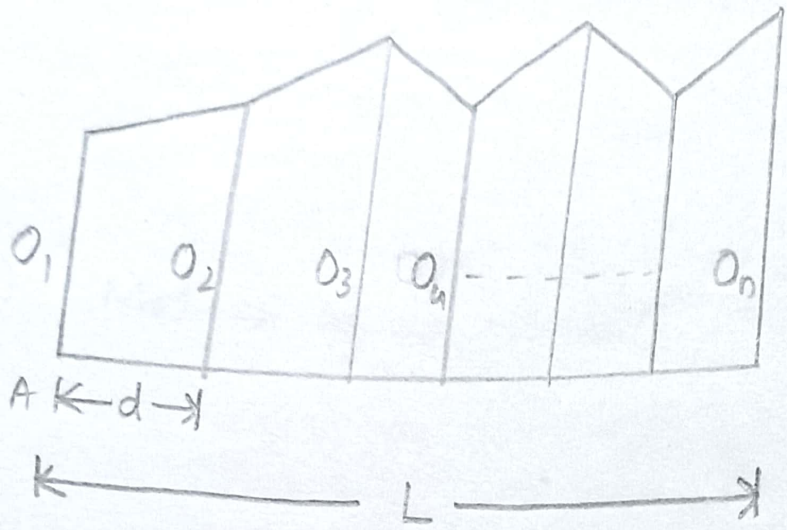
c) Tra



Area = $\frac{\text{common interval}}{2}$ [First ordinate + last ordinate + 2(rest of ordinates)]

Area = $\frac{d}{2}\left[O_1 + O_n + 2(O_2 + O_3 + O_4 \cdots O_{n-1})\right]$

d) Simpson's rule (Total no of ordinates must be odd)



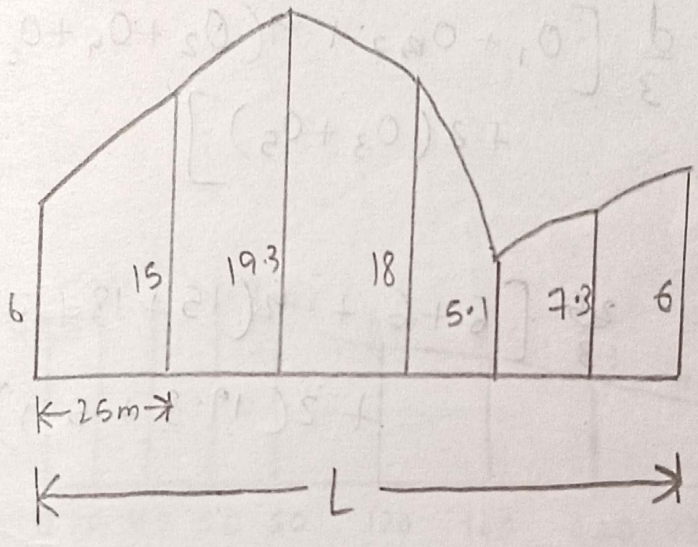
Area = $\frac{\text{common interval}}{3}$ [First ordinate + last ordinate + 4(sum of even ordinate) + 2(sum of odd ordinate)

$$\text{Area} = \frac{d}{3}\left[O_1 + O_n + 4(O_2 + O_4 + O_6 \cdots O_{n-1}) + 2(O_3 + O_5 + O_7 \cdots O_{n-2})\right]$$

eg: The following offsets were taken at distances 25m to hedge, 6, 15, 19.3, 18, 5.1, 7.3 and 6m determine the area included ~~in the~~ between the hedge and chain line using: ~~one~~.

(1) Average ordinate rule
(2) Trapezoidal rule
(3) Simpson's rule.

Solution:-



$$L = 25 \times 6 = 150m$$

$$\text{Area} = L \frac{\Sigma O}{n} = \frac{150}{7}(6+15+19.3+18+5.1+7.3+6)$$

n = no. of ordinates

L = total chain length

$$= \frac{150}{7} \times 76.7 = 1643.57$$

b) Trapezoidal rule

$$\text{Area} = \frac{d}{2}\left[O_1 + O_7 + 2(O_2 + O_3 + O_4 + O_5 + O_6)\right]$$

$$= \frac{25}{2}\left(6 + 6 + 2(15 + 19.3 + 18 + 5.1 + 7.3)\right)$$

$$= \frac{25}{2}(6 + 6 + 2(64.7))$$

$$= \frac{25}{2}(6 + 6 + 129.4)$$

$$= 1767.5 \text{ m}^2$$

c) Simpsons Rule

$$\text{Area} = \frac{d}{3}\left[O_1 + O_7 + 4(O_2 + O_4 + O_6) + 2(O_3 + O_5)\right]$$

$$= \frac{25}{3}\left[6 + 6 + 4(15 + 18 + 7.3) + 2(19.3 + 5.1)\right]$$

$$= \frac{25}{3}\left[12 + 161.2 + 48.8\right]$$

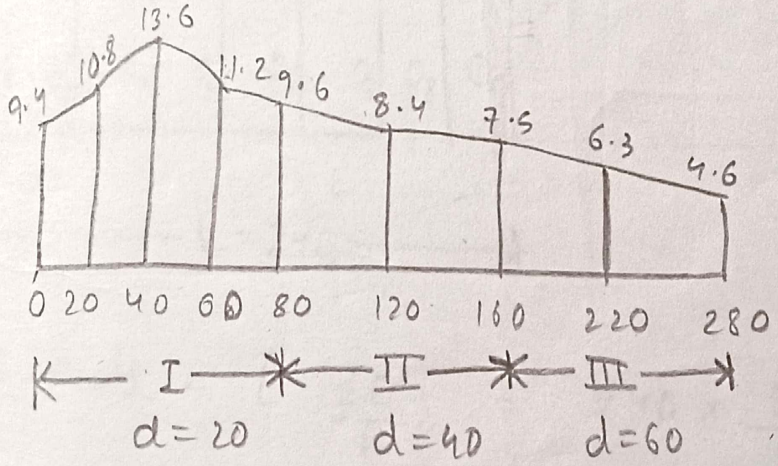
$$= 1842.6 \text{ m}^2$$

Ques The following observations were made by taking offsets from a chain line to a hedge. Compute the area included between the chain line and hedge by using

① Trapezoidal rule and Simpson's rule.

Dist	0	20	40	60	80
Offset	9.4	10.8	13.6	11.2	9.6

Dist	120	160	220	280
Offset	8.4	7.5	6.3	4.6



a) Trapezoidal Rule

$$A = \frac{d}{2}\left[O_1 + O_n + 2\Sigma O_{rest}\right]$$

$$\text{Area I} = \frac{20}{2}\left[9.4 + 9.6 + 2(10.8 + 13.6 + 11.2)\right.$$

$$= 902\ m^2$$

$$\text{Area II} = \frac{40}{2}[9.6 + 7.5 + 2\times 8.4] = 678\ m^2$$

$$\text{Area III} = \frac{60}{2}[7.5 + 4.6 + 2\times 6.3] = 741 m^2$$

$$\text{Total Area} = A_I + A_{II} + A_{III}$$

$$= 2321 m^2 \text{ // Ans}$$

b) Simpsons Rule.

$$\text{Area} = \frac{d}{3}[O_1 + O_n + 4\Sigma O_{even} + 2\Sigma O_{rest}]$$

$$\text{Area I} = \frac{20}{3}[9.4 + 9.6 + 4(10.8 + 11.2) + 2(13.6)]$$

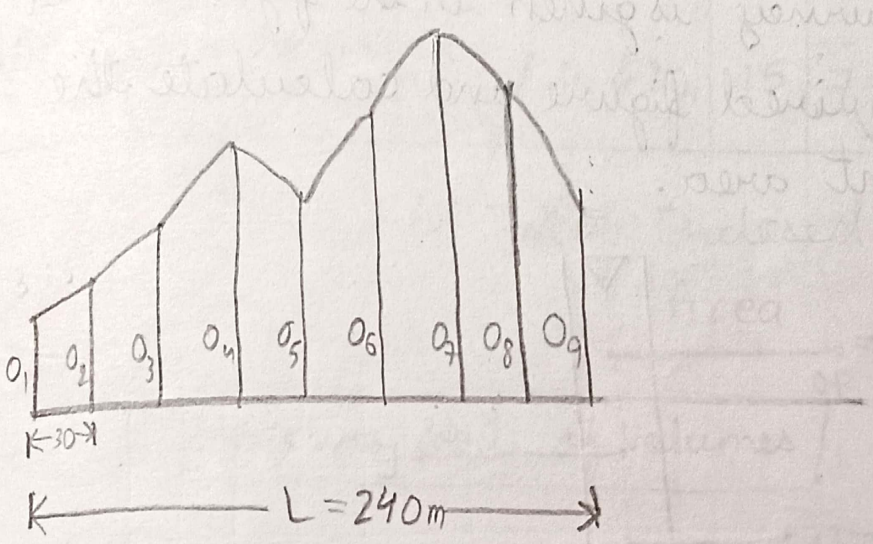
$$=$$

Ques

The following perpendicular offsets were taken at 30 m interval from a survey line to an irregular boundary.

3·25, 3·7, 3·95, 7·1, 4·9, 7·2, 9, 7·9, 6 m

Apply Trapezoidal rule, Simpson's rule and average ordinidal rule to find the area enclosed between survey line, boundary line and first and last offsets.



Avg ord. Rule = $L \cdot \frac{\Sigma O}{n}$ = $240 \times \frac{53}{9}$

= 1413.33 m^2

Trape. rule → $\frac{30}{2}$ [3·25 + 6 + 2(43·7

= $\frac{30}{2}$ [9·25 + 87·5]

= 1451·25 m^2

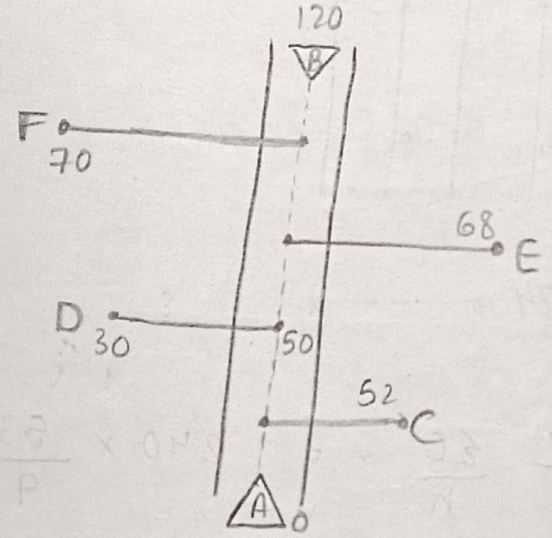
Simpson's Rule

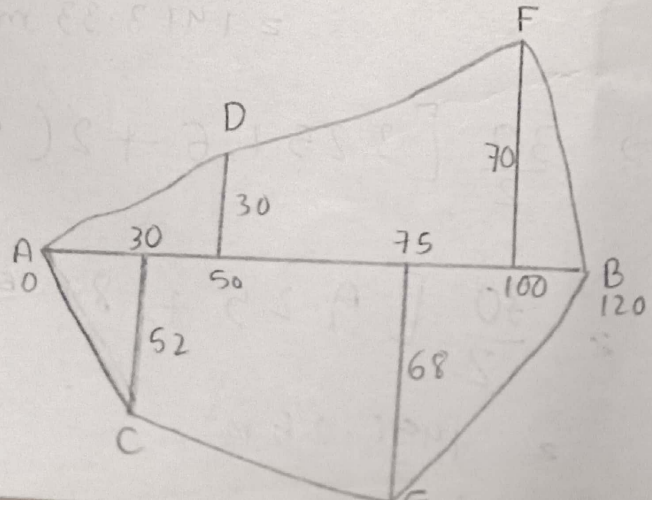
$$= \frac{30}{3}\left[9.25 + 4(25.9) + 2(17.85\right.$$

$$= \frac{30}{3}\left[9.25 + 103.6 + 35.7\right]$$

$$= 1485.5\ m^2$$

A page of the field book of a cross staff survey is given in the figure. Plot the required figure and calculate the relavent area.





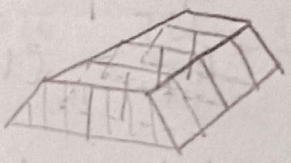
S.No	Figure II	Chainage III	Base IV	Offset (m) V	mean offset VI	Area VII	Remarks VIII
I							III × VI
1	ΔACG	0m to 30m	30m	0m & 52m	26	780	Area = Base × Mean Offse
2	Trap GCEI	30m to 75m	45m	52m & 68	60	2700	
3	ΔIEB	75m to 120m	45	68 & 0	34	1530	
4	ΔBFJ	100m to 120m	20	70 & 0	35	700	
5	Trap DHJF	50m to 100m	50	30 & 70	50	2500	
6	ΔAHD	0m to 50m	50	0 & 30	15	750	

Total Enclosed Area = 8960 m^2

Balast

Measurement of Volumes

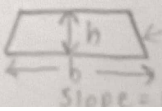
1) Trapezoidal rule.



$$\text{Volume} = \frac{d}{2}\left[A_1 + A_n + 2\Sigma A_{rest}\right]$$

2) Prismoidal Rule

$$\text{Volume} = \frac{d}{3}\left[A_1 + A_n + 4\Sigma A_{even} + 2\Sigma A_{rest\,ODD}\right]$$



Area = $(b + nh)h$

Ques A railway ~~embankment~~ embankment 10 m wide. The side slopes 1.5 to 1 assuming the ground to be level in a direction transverse to the centre line, make calculations for the volume contained in a length of 120 m. The centre heights at 20m intervals in meters 2.2, 3.7, 3.8, 4.0, 3.8, 2.8, 2.5.

Solution:- $n = 1.5$, $b = 10\,m$

Areas at different sections →

$A_1 = (b + nh)h = (10 + 1.5 \times 2.2) \times 2.2 = 29.26\,m^2$

$A_2 = 57.54\,m^2 = (10 + 1.5 \times 3.7) \times 3.7$

$A_3 = 59.66\,m^2 = (10 + 1.5 \times 3.8) \times 3.8$

$A_4 = (10 + 1.5 \times 4.0) \times 4.0 = 64\,m^2$

$A_5 = (10 + 1.5 \times 3.8) \times 3.8 = 59.66\,m^2$

$A_6 = (10 + 1.5 \times 2.8) \times 2.8 = 39.76\,m^2$

$A_7 = (10 + 1.5 \times 2.5) \times 2.5 = 34.38\,m^2$

Calculation of volume

Volume $= \frac{20}{2}(63.64 + 2(280.62))$

$= \frac{20}{2}(624.91)$

$= 6248.8\,m^3$

Prismoidal Rule

$$V = \frac{d}{3}\left[A_1 + A_n + 4(A_2 + A_4 + A_6) + 2(A_3 + A_5)\right]$$

$$= \frac{20}{3}\left[63.64 + 4(161.3) + 2(119.32)\right]$$

$$= \frac{20}{3}\left[63.64 + 645.2 + 238.64\right]$$

$$= \frac{20}{3}\left[947.48\right]$$

Volume = 6,316.33 m^3

Ques calculate the cubic content using prismoida formulae and Trapezoidal formula the leng of embankment of which the cross-sectio access at 50m intervals are as follo

Solution

Distance =	0	50	100	150	200	250	30
Area =	110	425	640	726	726	1790	26

Trapezoidal Rule

$$= \frac{50}{2}\left[2800 + 2(43307)\right]$$

$$= \frac{50}{2}\left[2800 + 8614\right.$$

$$= \frac{50}{2}\left[11414\right] \Rightarrow 285350\ m^3$$

Prismoidal Rule

$$V = \frac{50}{3}[2800 + 4(2941) + 2(1366)]$$

$$V = \frac{50}{2}[2800 + 11764 + 2732]$$

$$V = 432400 m^3$$

ques) The areas within the contour line at the site of reservoire and the phase of the proporsed dam are as follows

contour	101	102	103	104	105
Area (m^2)	1000	12800	95200	147600	872500

contour	106	107	108	109
Area (m^2)	1350000	1985000	2286000	2512000

Taking 101 as the bottom level of the reservoir and 109 as the top level determine the Capacity of the reservoir.

Trapezoidal rule

Vol $= \frac{1}{2}[2513000 + 2(6749100 \text{ or } 4982600)]$

$= \frac{1}{2}[16011200]$

$= 80,05,600 m^3$

Briezmaidal

Volume $= \frac{1}{3}[2513000 + 4(3796400) + 2(2952700)]$

Volume $= \frac{1}{3}[2513000 + 1,51,85,600 + 5905400]$

Volume $= \frac{1}{3}[23,604,000]$

Volume $= 78,68,000 m^3$

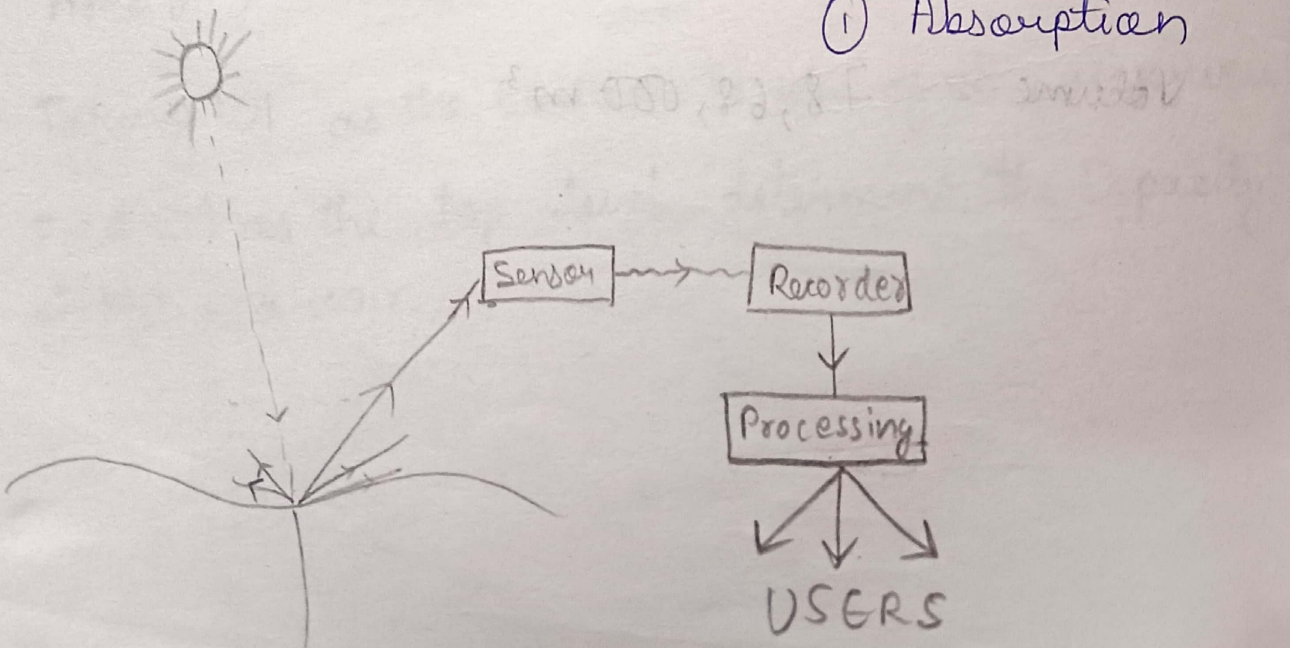
Remote Sensing

It is broadly defined as collection of information about a target without any physical contact. Remote sensing is a means to study physical and chemical characteristics of objects from a distance. This techniques includes the methods of obtaining pictures or other electromagnetic records of the earth surface from a distant point, their processing and interpretation. By this technique objects can be identified without touching them.

Aircrafts and sattelites are commonly used for remote sensing. Collection of data is usually carried out by highly saffacticated sensors eg:- cameras, scanners, radars etc.

Working

① Absorption



③ Scatter

④ Reflection

Application of Remote Sensing

Remote Sensing is a recent advanced tech-que it is being used in many fields the important applications are as follows

① Environmental application

② Mineral exploration

③ Land used and Land coven analysis

④ Natural Hazards

⑤ Archaeology

Advantages of Remote Sensing

There are various advantages of remote sensing over other method of surveying.

1. It provides information about an object situated at a long distance.
2. It is cheaper than other methods of surveying.
3. It covers more area than other methods of surveying
4. It provides more accuracy.
5. It helps in identifying risk prone to an area.

Various Systems of Remote Sensing

) Framing

Scanning

Building material

Stones → It is a composite or aggregature of minerals or mineraloids.

→ A stone is a naturally occuring solid aggregate of minerals or mineraloids, forming a fundamental component of the earth's crust. They do not have any definite shape and structure. In actual these are the fragmanted parts of the rocks.

In construction stones are valued for their strength durability and aesthatic qualities, commonly used in masonary, cladding, paving, and structural applications.

1. A solid aggregate of minerals or mineraloids
2. Major component of earth's crust
3. Naturally occuring
4. Smaller fragment of Rocks
5. It doesn't have any definite shape, size or composition.

Source of Stone → Rocks

→ ① Monomineralic → If only one kind of mineral is found.

② Polymineralic → If more than one mineral is found.

Rock forming minerals →

① Augite
② Chloronite
③ Feldspar
④ Mica
⑤ Quartz
⑥ Olivine
⑦ Hornblende

Classification of Rocks

1) geological Classification

a) Igneous rocks

The rocks which are formed by cooling of magma or Lava are known as igneous rocks.

i) Plutonic
↳ Greater depth
ii) Hypabyssal
↳ Near Crust
iii) Volcanic
↳ Out on earth surface.

b) Sedimentary rocks

These rocks are formed by the deposition of products of weathering on the pre-existing rocks. The products of weathering are ultimately carried away from their place of origin by the agents of transports. These agents are rain, wind, frost, flowing water etc.

1. Residual deposits
2. Sedimentary deposits
3. Chemical deposits
4. organic deposits

c) Metamorphic rock

These are formed by the change in character of pre-existing rocks. The process of change is known metamorphism. The igneous as well as sediment rocks change their character when they are -jected to great heat and pressure.

1. Thermal metamorphism
2. Catastatic metamorphism
3. Dynamo thermal metamorphism
4. Plutonic metamorphism.

Marble is made up of lime.

2) Physical Classification

a) Stratified rocks

These rocks possess planes of stratification and can be easily split up along these planes.

b) Unstratified rocks

These rocks are unstratified and their structure may be crystalline, granular or compact granular. The igneous rock of volcanic and sedimentary rocks affected by movements of the earth are the examples of these type of rocks.

c) Foliated Rocks

These rocks can split up in a definite direction only. Metamorphic rocks are mostly foliated types of rocks

3) Chemical Classification

a) Sillicious rocks

These are hard and durable rocks in which silica pre-daminates. These are not easily affected by the weathering agencies.
Eg:- granites and quatites.

b) Argillaceous rocks

In these rocks clay predominates. Such rocks are dens and compact. It may also be sofft. These stones may be hard and durable but brittle. Eg:- Slates and laterites

c) Calcareous rocks

In these rocks calcium carbonates predominates. Eg:- Marbles

Stone Quarrying

The process of taking out stones from natural rocks beds is known as the query

1) Excavation or digging
2) Heating
3) Wedging
4) Blasting

Characterstics of a Good Building stone

(1) Crushing Strength

It should be greater than 100 N/mm² for a good structural stone.

(2) Apperance

The stones which are to be used for face work should be decent in appearance and they should be capable of preserving

their colour uniformity
time.

(3) Durability

A good building stone should be durable.

Final setting time of cement Initial - @ 30 minutes to 1 hour.

9 - 10 hours

2) Water Absorption of water absorbed by brick

Percentage absorbed

W_1 = dry brick weight

W_2 = wet brick weight

$$= \frac{W_2 - W_1}{W_1} \times 100$$

3) Efflorescence test

<10% white patches less than 10% Good

10 - 15% white patches between 10 to 15% Moderate

>15% white patches more than 15% Bad or Weak

Uses of bricks

- They are used for construction of buildings, dams, bridges, piers and ~~apartments~~ abutments.

piers - columns supporting bridges.

- They are also used in sewers, roads, tunnels, linings and pitching work of water structure.

→ First class bricks are used for architectural and ornamental works.

→ Jhama - bricks are used for road as metal, as aggregate in concrete and in foundation.

Comparison between bricks & stones

Stones	Bricks
(1) Stones are heavier in weight than bricks	(1) Bricks are lighter in weight than bricks.
(2) Stones are not easily available in uniform shape and size everywhere as that of brick.	(2) Bricks are maded in uniform shape and size as that compared to stones
(3) Stones are comparitively difficult to mold in desired shape.	(3) Bricks can be easily molded into desired shape
(4) Stones are costlier than bricks.	(4) Bricks are cheaper than stones
(5) Stones have less fire resistance as compared to bricks	(5) Bricks have more fire resistance as compared to stones
(6) The size and weight of stones being comparitively more as that of bricks.	(6) The size and weight of bricks being comparitively less as that of stones.

CEMENT

Cement is a binding material which is used in construction industry it is obtained by pulverizing clinkers formed by calcination of raw materials primarily consisting of lime, silica, alluminum and iron oxide. The basic raw materials used in manufacture of portland cement are argillaceous and calcarious substances. Calcarious materials are limestones, chalk, marine shells etc. and argillaceous materials ares shell and clay, blast furnance slag etc.

Raw materials of cement

Raw material	Range
lime (CaO)	60-65%
Silica (SiO_2)	20-25%
Alumina (Al_2O_3)	5-10%
Iron oxide (Fe_2O_3)	1-6%
Magnesia (MgO)	1-4%
Alkalies	0.5-1%

Properties of Cement

The properties of a good cement, which primarily depend upon its chemical composition, thoroughness of burning dop and finess of grinding are:

1. It gives strength to the masonary. HG > Strength
2. It is an excellent binding material.
3. It is easily workable.
4. It offers good resistance to the moisture.
5. It posses a good plasticity.

Types of Cement

1) Ordinary Portland Cement (OPC)

2) Portland Pozzolana Cement (PPC)

3) Rapid Hardening Cement (RHC)

→ Tri-calcium-silicate in more

4) Quick setting time cement

5) High alumina cement

6) Low heat cement

7) Sulphate resisting cement

→ 80-85% of Granulated Slag

→ Upto 1% of OPC

White Cement

d) Colour

cobalt → Blue

Cromium Oxide →

Test of Cement

) Field tests

a) colour

↳ grey - with light greenish tint or Shade

b) Physical properties

① The cement should feel smooth when rubbed in between fingers ② When hand is inserted into heap of cement it should feel cold or cool. ③ If small quantity of cement is thrown into bucket of water it should settle down.

c) Presence of lumps.

→ The cement should be free of hard lumps

1) Fineness Test

2) Compressive Strength Test

It is carried out to determine compressive strength of cement

i) 1:3 cement sand mortar

ii) $P = 2.5 P_n + 3.5$

P_n ↓ normal consistancy

iii) Fill in cube mould of side 7.06 cm

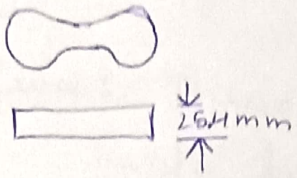
iv) Remove the mould after 24 hours

v) ~~kept~~ Keep the cubes submerged in water for 3 days, 7 days

vi) The cubes are then tested in Compressi - on Testing Machine

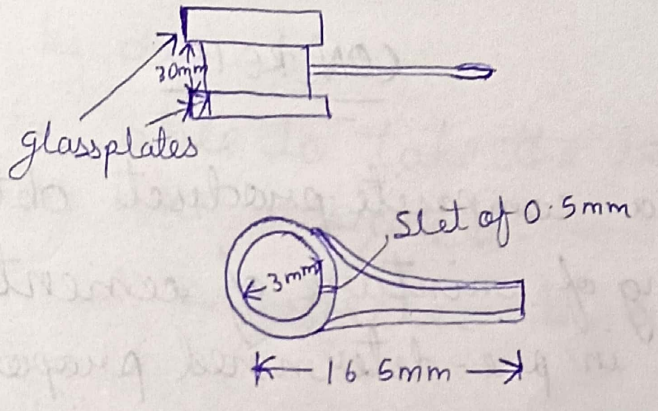
OPC - 160 Kg/cm² - 3 days
- 220 Kg/cm² - 7 days

3) (Split Tensile Test) - This test was formerly used for indirect indication of tensile strength of cement



4) Soundness Test

The change in volume of cement after setting is known as unsoundness and it may cause cracks distortion and disintegration of cement. Lee-Chatelier's apparatus is used for this test



5) Consistency Test

6) Initial and Final setting time test

Uses of Cement

①

CONCRETE

Concrete is a composite product obtained artificia
by hardening of mintwre of cement, sand, grav
and water in pre-determined proportions. When th
ingredients are mixed they form a plastic mass, w
-ch can be molded in desired shape. It gets harden
into hard solid mass. Water is one of the impo
-ant ingredients of the concrete.

Ingredients of concrete

1) Cement : It is binding material in concrete

2) Aggregate : It is a chemically inactive mate
- which when bonded together by cement form
concrete. Eg :- Crushed rocks, sand

③ Water: Water acts as lubricant for the fine and coarse aggregate and reacts chemically with cement to form the binding paste for the aggregate and reinforcement.

④ Admixture: These are added to cement, concrete for imparting certain specific properties to the concrete. Eg:- Accelerators, air and training agents, water reducing agents, setting time controlling agents etc.

Qualities of a good concrete

① It should be durable
② It should be able to take the loads for which it has been designed.
③ It should not be affected by wear, abbreti-on, climate etc.
④ It should be water proof and have density of 3000 Kg/m³
⑤ It should be easily workable

Workability of Concrete

It may be defined as the ease with which concrete may be mixed, handled, transported, placed in position and compacted. According to Indian stands workability of concrete is that property of concrete which determines the amount

of internal work necessary to produce full compaction.

- Factors Affecting the workability of Concrete

1. Water content.
2. Size of aggregates.
3. Shape of aggregates.
4. Surface textures of aggregates.
5. porosity and absorbtion of aggregates.
6. Air entraining agents.
7. Atmospheric Temperature.

Properties of Concrete / Cement Concrete

1. It has a high compressive strength
2. It is free from corossion and there is no appreci-able effect of atmospheric agents on it.
3. It hardens with age and process of hardening continues for a long time after the concrete has attained sufficient strength.
4. It is proved to be more economical than steel
5. It forms a hard surface capable of resisting abberation

Concrete Production

① Batching of Ingredients of concrete

The measurement of materials for making concrete is known as batching. There are two methods of batching

a) Volume batching

b) Weight batching

② Mixing of concrete

a) Hand mixing

b) Machine mixing

③ Transportation of Concrete

④ Placing of concrete :-

⑤ Compaction of Concrete **

ⓐ Hand Compaction :-

ⓑ Machine Compaction :-

- Pin Vibrator or needle vibrator
- Plate Vibrator
- Table Vibrator
- Surface Vibrator

⑥ Curing (Water) of Concrete

- By spraying
- By ponding
- By Chemical
- By Jute Bags
- By polythene sheets

⑦ Finishing of Concrete

Segregation / Honeycombing

It is defined as seperation of coarse aggregate particles from the concrete mass in its plastic stage. It is harmful to concrete properties. Sand streaks, rock pockets and porous layer in hardened concrete are the result of segregation. Segregation increases when the concrete mixture is very lean and wet

Bleeding

The tendency of water to rise to the surface of the freshly placed concrete is known as bleeding. Due to bleeding homogeneity of concrete is disturbed which result in weak in chorous concrete.

Proportioning of Concrete

Cement : Sand : Cement

Types of Mix :

i) Nominal Mix / Arbitrary Method
ii) Design Mix

C : S : A

Grade	Proportion	Strength
M 25	1 : 1 : 2	25 N/mm²
M 20	1 : 1½ : 3	20 N/mm²
M 15	1 : 2 : 4	15 N/mm²
M 10	1 : 3 : 6	10 N/mm²
M 7.5	1 : 4 : 8	7.5 N/mm²

Design Mix

① Finness modulus method
② Minimum voids method
③ Maximum Density method
④ Water Cement Ratio Method

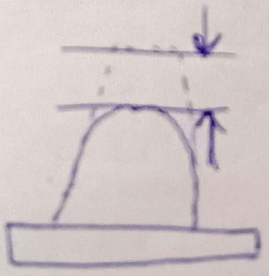
Test of Concrete

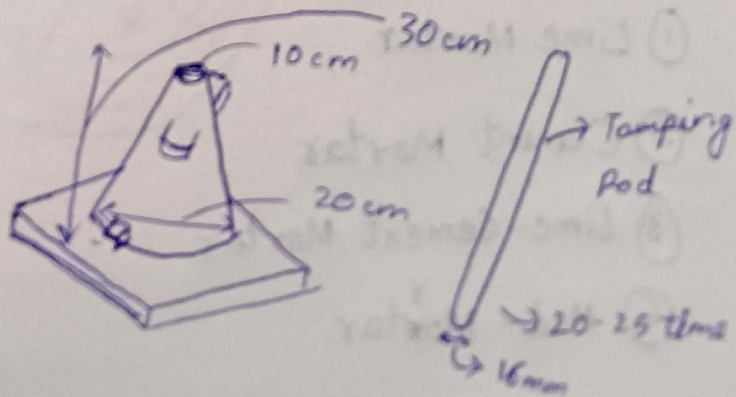
) Workability Test - Slump Cone Test :

It is performed to check or determine the work-ability of cement concrete. For road construction 20-40 mm of slump value must be of 20-40 mm

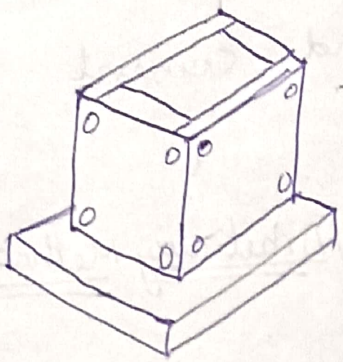
For Canal lining it is 70-80 mm

For Builing of RCC is 50-60 mm





② Compressive strength



→ 15×15×15 cm³

Uses of Concrete

① Dams
② Roads
③ Canals
④ ~~Concrete~~ Buildings
⑤ Towers

Mortar → 4.75m > size or fineness

① Mortar is a mixture containing a binding material, fine aggregate and water.

Types of Mortar

① Lime Mortar
② Cement Mortar
③ Lime-Cement Mortar
④ Mud-Mortar.

Timber

It is the type of wood which is suitable for use as a structural material is called timber.

Rough Timber

When Trees

converted Timber

Trees

Exogenous Trees - The trees in which new layer grows outside.

Endogenous Tress - The trees in which new layers grows inside