

ARYAN SCHOOL OF ENGINEERING & TECHNOLOGY

BARAKUDA, PANCHAGAON, BHUBANESWAR, KHORDHA-752050



LECTURE NOTE

SUBJECT NAME-MINE SURVEY-I

BRANCH- MINING ENGG.

SEMESTER-3RD SEM

ACADEMIC SESSION-2022-23

PREPARED BY-MUKESH BEHERA

Mining :-

An excavation made on the ground/surface in economically is called mining.

Mineral :-

Mineral is a natural occurring homogeneous inorganic substance have definite an composition an atomic str. which is economical called mineral.

Rock :-

Aggregated of mineral is called Rock.

Ore :-

Economical value of mineral is called ore.

gangue :-

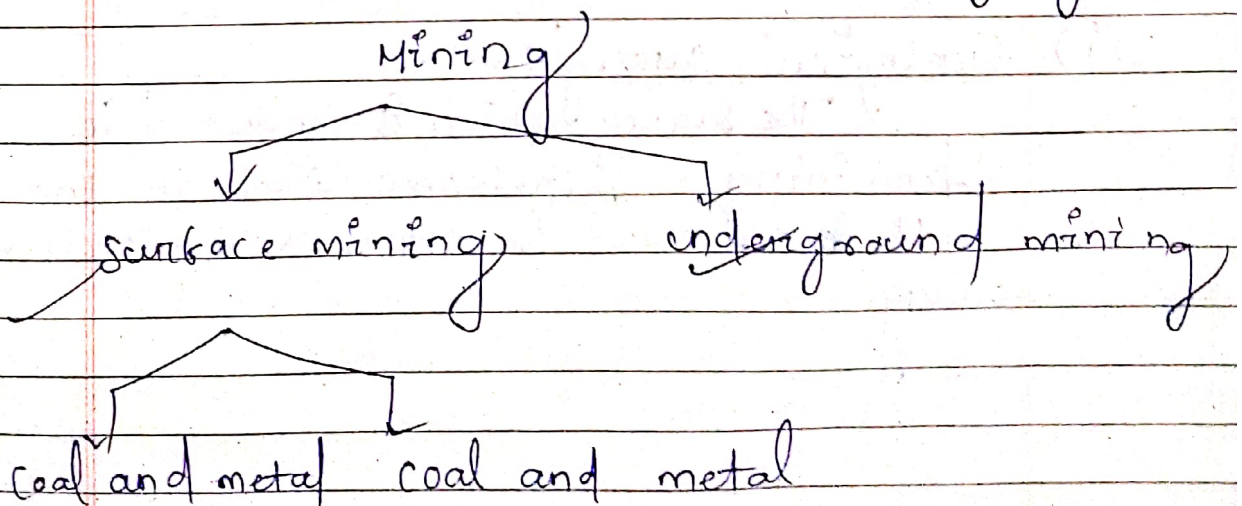
The mineral which has not economical variable associated with ore is called gangue.

OB → Over Burden (OB)

→ The material which is covered the mineral is called OB.

Survey :-

It is an act which determine the point or position in the earth's surface by direct and indirect which is known as surveying.



plane :- Representation of map on a paper & it is called plane.

what is the principle of surveying :-

- To work whole part to a particular part
- To fix position of new station at list + Independent process.

Classification of surveying method :-

Classification of surveying are two types

(i) Geodetic surveying

(ii) plane surveying

(i) Geodetic surveying :-

= In this method the earth curvature taken into account.

= The curvature is not constant.

(ii) plane surveying :-

= In this method the curvature of earth is not taken into account.

= The plane is constant.

Classification of surveying according to the object of surveying :-

(i) Geological survey :-

The survey which is conducted for determining different state in the earth's crust is known as Geological survey.

(2) Mine Survey :-

The survey which is done for exploring mineral wealth under the earth's crust such as coal, copper, gold, etc is known as mine survey.

(3) Military Survey :-

The survey which is conducted for determining the best position of attack and defence from military point of view, and also for finding out the best storage size for keeping ammunition is known as military survey.

(4) Archaeological survey :-

The survey which is done to trace out the relics of the past is known as archaeological survey.

(5) Engineering Survey :-

The survey which is conducted to collect data for carrying out any ^{engg.} project such as construction of road, railway, dam, water supply, etc is known as ~~eng.~~ engineering survey.

Leveling :- It defined as the act of determination and representation of height or elevation of different object on the earth surface.

Raining :-Method of Raining :-

There are two methods in raining -

- (i) direct method
- (ii) indirect method.

(i) Direct method :-

In this method the intermediate ranging road or point are fixed directly below to the end of to point.

(ii) Indirect method :-

In this method the Intermediate ranging road can't fixed directly and done by reciprocal ranging and auxiliary line parallel to it.

Chain Surveying :-

Types of chain survey :-

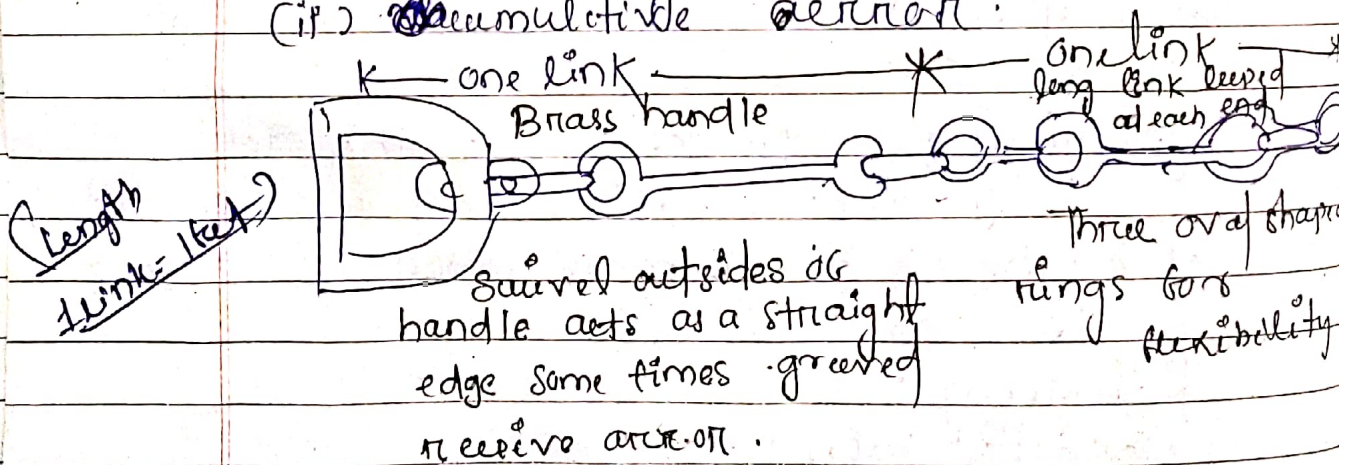
Chain survey mainly are three types -

- (1) Gunter's chains (66' / 100 links)
- (2) Revenueing chain (33' / 100 links)
- (3) Engg. chain (100' / 100 links)

Errors Chain Surveying :-

It is mainly two types :-

- (i) Compensating error.
- (ii) ~~Accumulative~~ cumulative error.



(1) Compensating error :-

Compensating errors are those which can an either direction of the line

(3) ~~various~~ Cumulative Error
 (comes) live errors :-

Cumulative errors are those which occurs in same direction goes on adding

(3M) Obstacle chaining :-

These are mainly three types of obstacle chaining.

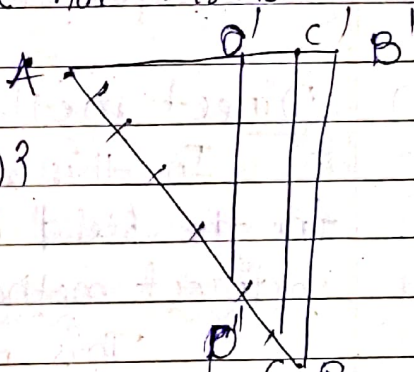
- (1) chaining free, vision/obstruction
- (2) vision free, chaining obstruction
- (3) chaining and vision both obstruction

(1) chaining free, vision obstruction :-

In the obstruction the chaining is free to measured length of the line but at the end point of line are not visible.

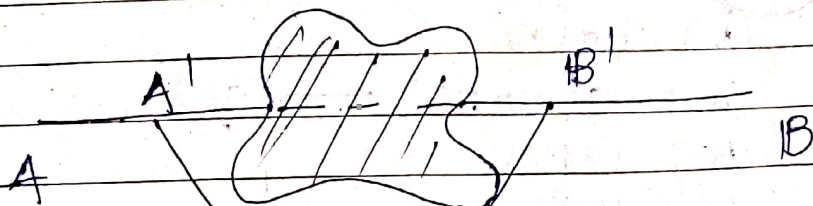
$$AB = \sqrt{(PB')^2 + (AB')^2}$$

$$h = \sqrt{p^2 + b^2}$$



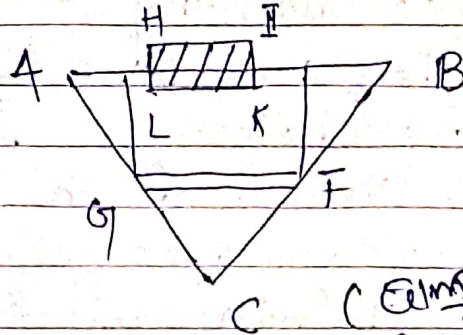
(2) vision free, chaining obstruction

In this types of obstruction the vision is free but chaining is obstruction to measured the length of line.



$$AB' = \sqrt{(A'C)^2 + (B'C)^2}$$

- (3.) Chaining and vision are both abstract.
In this type of abstraction both chaining and vision are abstraction.



Chaining along a sloping ground :-

There are mainly two methods :-

(i) Direct method :-

(ii) Indirect method

(i) Direct method :-

In this method ρ is directly measured in the field by the method of sloping.

(ii) Indirect method :-

This method is used where the ganque of slop is long and gently. This method is activity more than the direct method.

Instrument of chaining surveying :-


(1) chain

(2) arrow \rightarrow ρ

(3) Tapes

(4) Ranging rods

(5) offset rods

(6) Cross tabern optical square \rightarrow 

(7) plumb

(8) pegs

(9) wooden mallet

Purpose of chain surveying :-

- = To locate to the boundary of a land.
- = To determine the area of a piece of a land.
- = To divided the surveyed area into no. of unit.

Survey station :-

An important point of the chain line is called survey point or ending point of the line.

→ It mainly two types -

- (i) Main station
- (ii) Subsidiary or tip station

(i) Main station :-

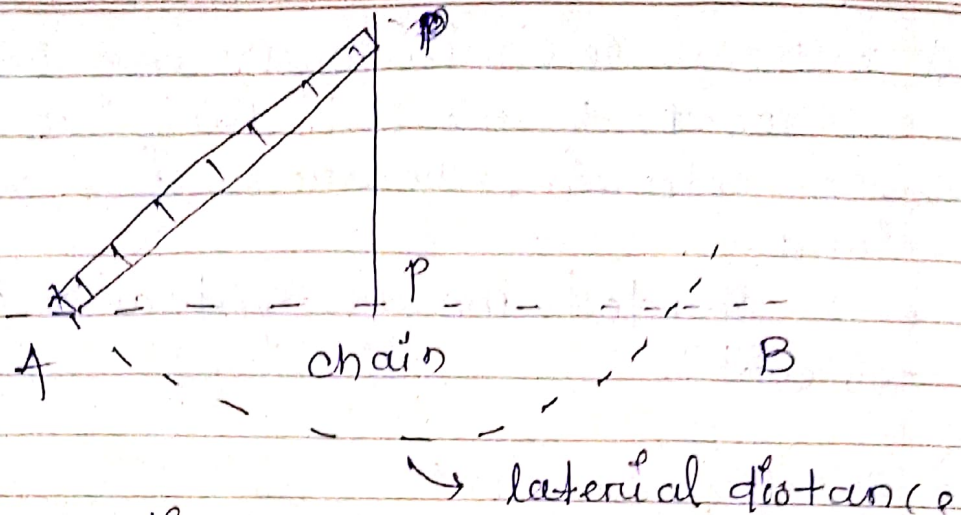
The end of survey line which command the boundary of survey are called main station.

(ii) Subsidiary or tip station :-

Sometimes it will be necessary to select other points on the main survey line to run two line. order to locate more interior distance from the main lines. Such point are known as subsidiary or tip station.

(Imp) What is offset :-

The lateral distance of an object on ground features measured from a chain line is called an offset.



Perpendicular offsets :-

When the angle offsets from a point on the chain lay into 90° it is called perpendicular offsets.

(Chapter)

Plane table surveying :-

Define plane table survey :-

Plane table surveying is the graphical method survey in which the field observation and plotting proceeds simultaneously.

Equipments of plane surveying :-

- = The plane table with tripod stand
- = Alidade
- = trough compass
- = plumb line
- = protracting paper and drawing
- Equipments
- = Spirit level

Principle of Chain Surveying :-

- The principle of chain surveying is best on symmetric and parallel lines.
- The plane table is considered to be a point of negligible dimension when compared to the area of survey.

Plane table Survey :-

- A plane table survey is a method of surveying in which the field work and plotting are done simultaneously.
- The method is very suitable for filling in the details of the point betⁿ the stations which are previously fixed by the transverse-sing or other method.
- The method is not ~~equa~~ accurate compared to other method of surveying.

Advantages :-

- plotting and field work are done simultaneously.
- It is very much suitable for small medium shape mapping.
- It is not accurate mapping.

Disadvantages :-

- It is an tropical instrument or surveying method.

- It has lot accessories so chance of lossing in the field is high.
- It is very heavy and awkward to carry.
- Not suitable for large scale mapping.

Adjustment of plane Surveying :-

- The table should be set up at convenient height.
- The leg tripod should be spread well apart & firmly fixed in the ground.
- The table should be so placed the station on ground that the point plotted on the set exactly at the station on the ground.
- The table is level means of levelling screw with reference to the level tube. Or circular level placed on the table.

Methods of plane Surveying :-

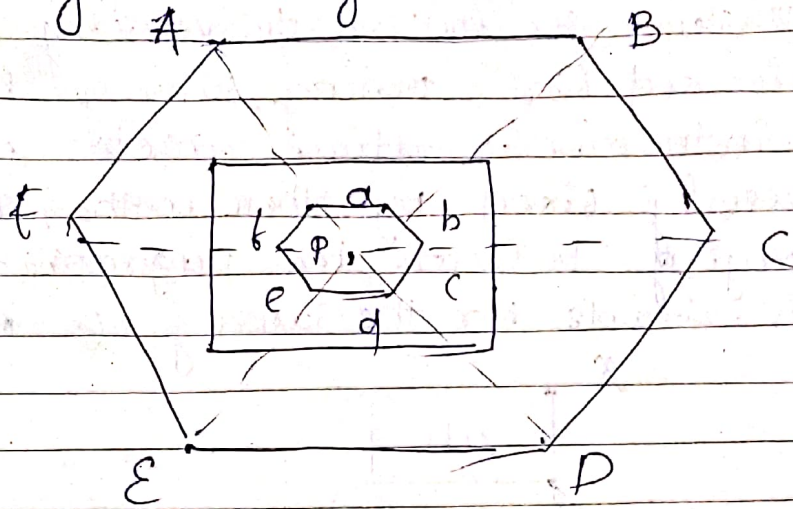
- Radiation
- Intersection
- Traversing
- Rejection

again rejection is two types -
 (i) two point problem.
 (ii) three point problem.

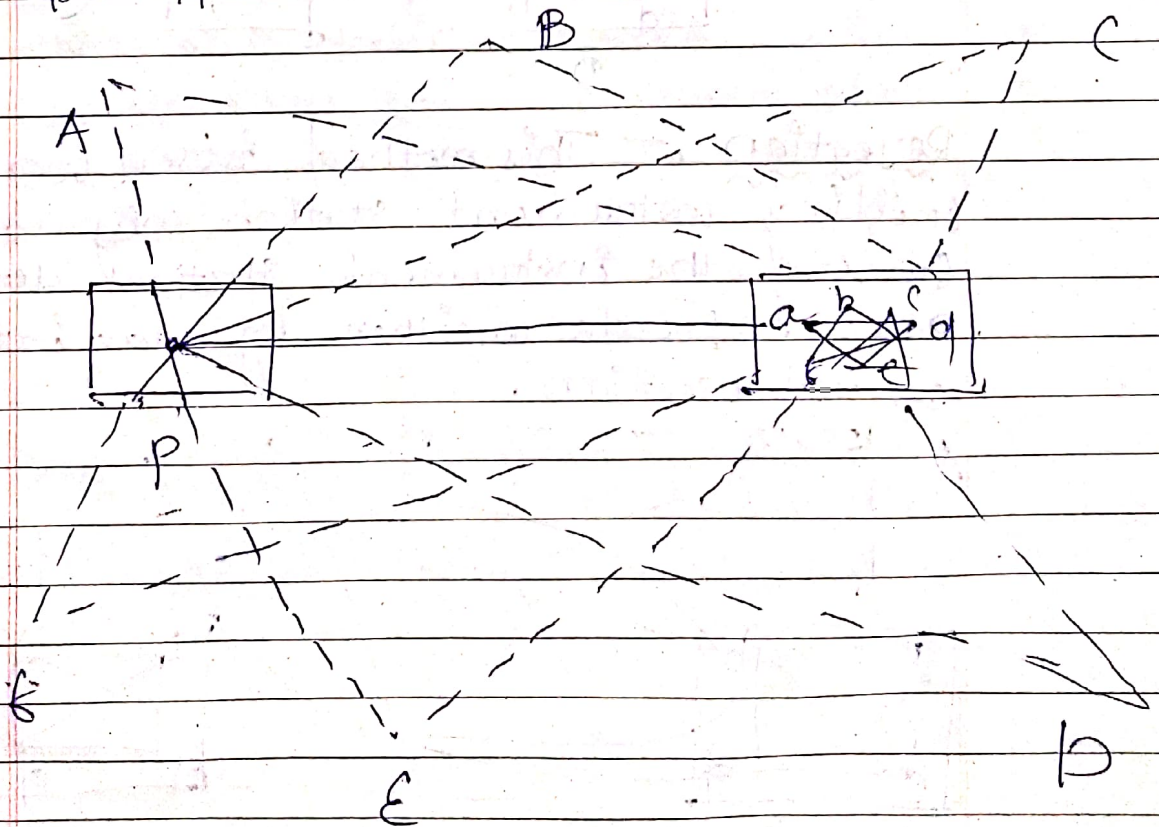
Radiation :-

In this method point is located on the plane table survey to the point and plotting to scale along + by drawing a ranging from the plane table

Survey to the point and plotting to scale along the ray on the distance.

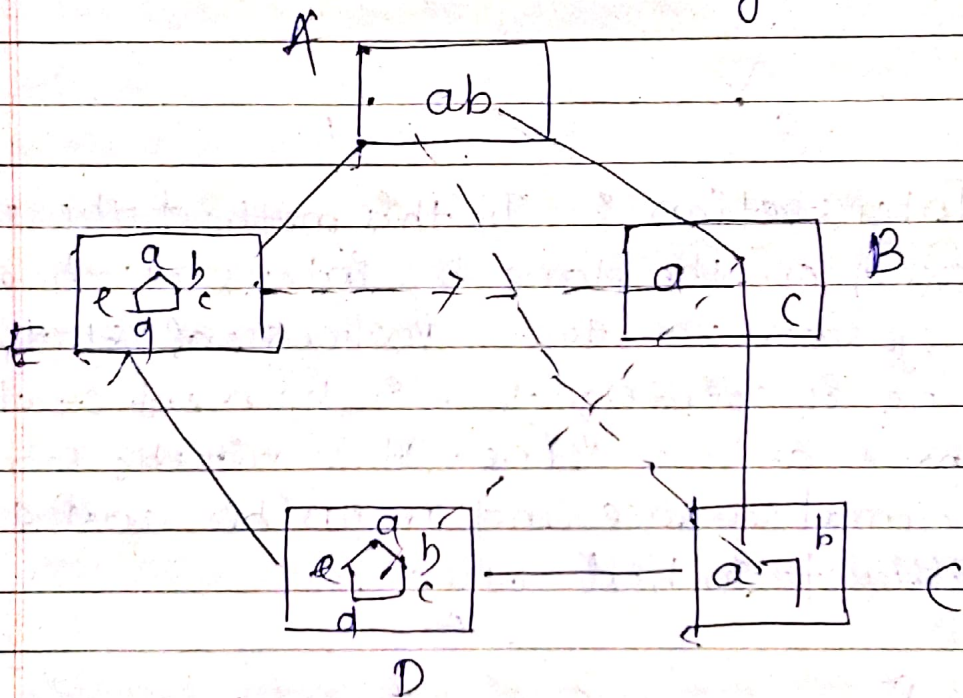


Intersection :- In this method the point is fixed on the plane by intersection of the rays from the two instrument station the line joining two instrument station is known as base line. It is suitable for normal surface and impossible or difficult in hill area.

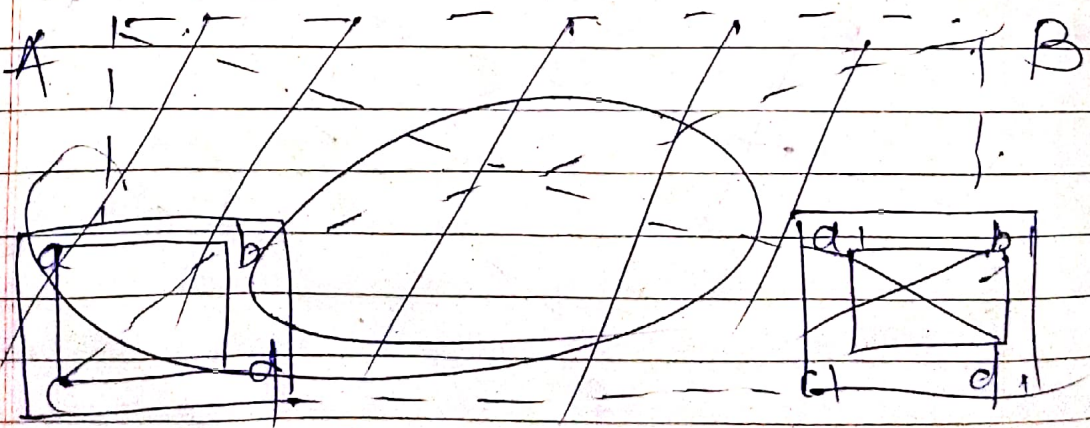


Traversing :-

- This method is similar to that of compass or transit traversing.
- It is used for running survey line betn the instrument station which have been previously fixed by other method of surveying to locate the pagraphical details. It is suitable for the survey of roads, mine

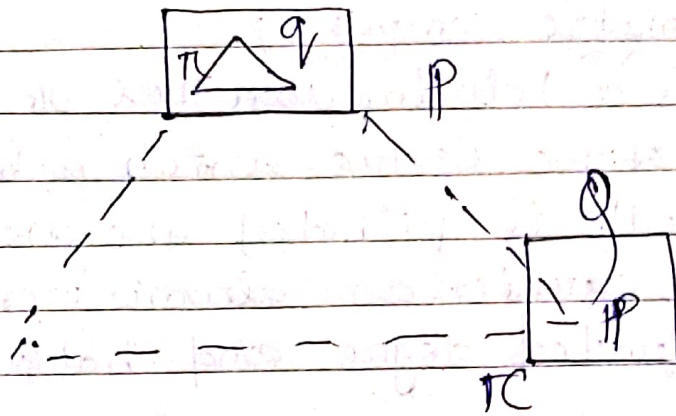


Rejection :- This method is used for finding instrument station only after fixing the instrument station. details are locate either by radiation or intersection.



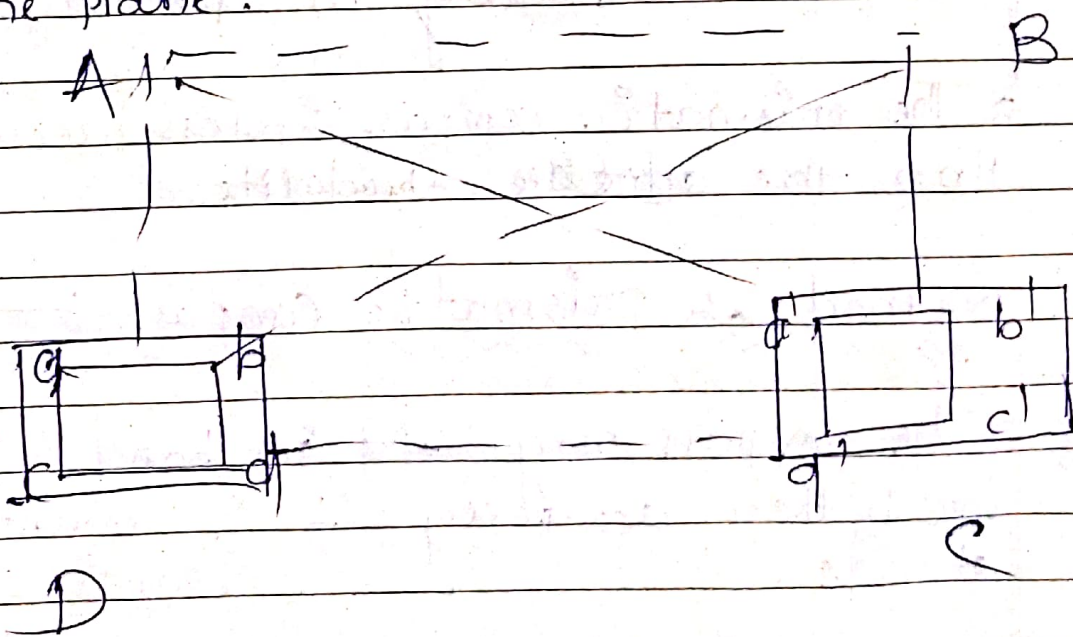
Two point problem :-

The two point problem consisting located on plane occupied by the plane table survey, by means of observation to two well defined point, which are visible from the instrument station and which consisting having already plotted on the plane.



Three point problem :-

The 3 point problem consists in location on the plane by means by observation to three well defined point, which are visible from the instrument plotted on the plane.



Q.1

What is compass survey? —
The compass survey is used in deviation for many country to determine the direction.

Compass are two types —

- (i) prismatic compass
- (ii) surveyor compass

(i) Prismatic compass :-

→ It is a holo-circular box of 85mm into 100mm Dia at the centre which a balance magnetic needle is pivoted the needle is boxed and carries an aluminium ring graduated degree and half degree.

→ The graduation starts from 0 (zero) mag south the needle run clock wise 90° mag north is west 180° at north to 270° at east etc. The prismatic compass is used for survey in wild country. not terminal & fixing in details.

→ The prismatic compass is less accurate than the ~~theodolite~~ theodolite.

Method of Prismatic Compass :-

→ The compass may held in hand but for better accuracy it is mounted stands.

Adjustment :-

adjustment are two types :-

- (i) Permanent adjustment
- (ii) Temporary adjustment

(i) Permanent adjustment :-

The compass are adjusted by the manufacturer company, while selling.

(ii) Temporary adjustments :-

⇒ Temporary adjustments are those which are temporary in nature,

⇒ In this types of adjustment all adjustments which are done before the stands on erect and the end of experiments.

⇒ It is further sub divided into three types -

- (i) Centering
- (ii) Leveling
- (iii) Focusing

(i) Centering :-

It is the process of fixing the instrument exactly over the station point mark.

(ii) Leveling :-

It is the method of marking the instrument properly level.

(3) Focusing :- It is the process of making proper adjustment so that the image appears on the object glass.

(11) Surveyor's compass :- It is much used in land surveying, but now it is little used. It is generally similar to a prismatic compass, except that on another plane side a narrow vertical slit, in a plane of the prism and carries and obeys by needle.

=> It is fixed on a stand up on a single stand called Gault stand.

~~Bearing~~ :- It is a horizontal angle which a line makes with a line of ^{or} reference line or meridian.

~~Meridian~~ :- It is a reference line from where the bearing are taken.

= Meridian are divided three types -

- (i) True meridian
- (ii) Magnetic meridian
- (iii) Arbitrary meridian.

(i) True Meridian :-

→ The point of intersection where the earth axis and surface of earth is known as North and South Geographical pole.

→ True meridian is a line passing through a point on the earth surface, which is the line the plane passing through given to the surface of pole.

(ii) Magnetic Meridian :-

It is a direction is indicated by a properly balanced magnetic needle free from local attraction.

(iii) Orbitary meridian :- or (Sight line)

It is the direction from survey station to some defined point or permanent object. It is also known as Sight line of survey.

Types of bearing :-

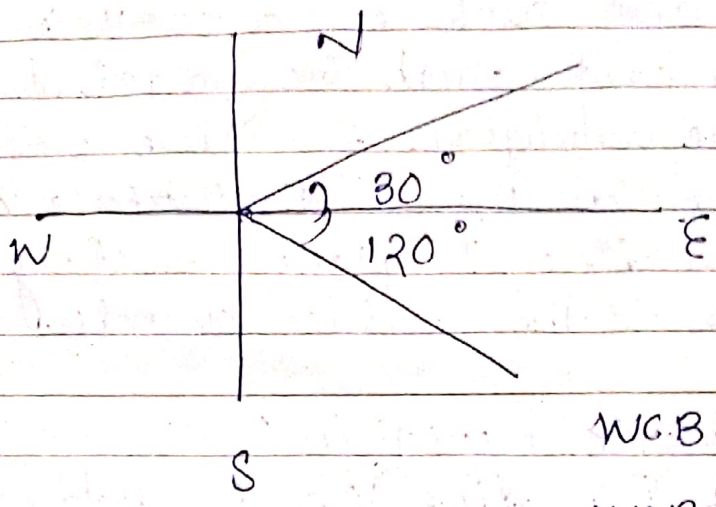
- 3 types of bearing
- (i) whole circular bearing (WCB)
 - (ii) quadrantal bearing (QB)
 - (iii) Reduced bearing (RB)

(P) WCB :-

In this system the bearing line measured 'clock wise direction' in reference to north pole point.

⇒ Value varies $0^\circ - 360^\circ$

⇒ It is used in prismatic compass.



WCB = $N 30^\circ$

WCB = $N 120^\circ$

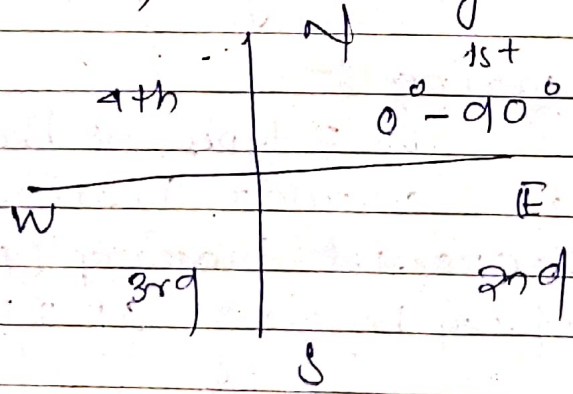
(ii) Q.B. :-

⇒ In this system the bearing line is measured from North end to South end.

⇒ In clock wise direction.

⇒ It is range to $0^\circ - 90^\circ$

⇒ It is used in surveying compass.



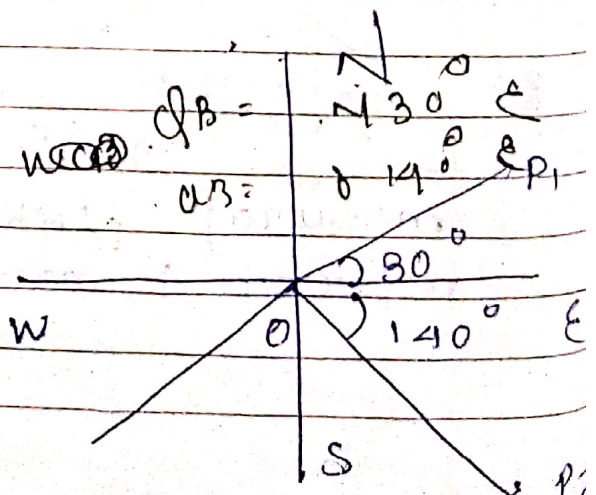
(1) WCB = 30°

(2) WCB = 140°

(3) WCB = 190°

(4) WCB = 290°

(5) WCB = 310°



(11) RB :-

⇒ When the whole circle bearing line axis 90° , those it must be broad for or reduced to a corresponding angle less than 90° without changing of the value of the angle.

forward Bearing / four Bearing :-

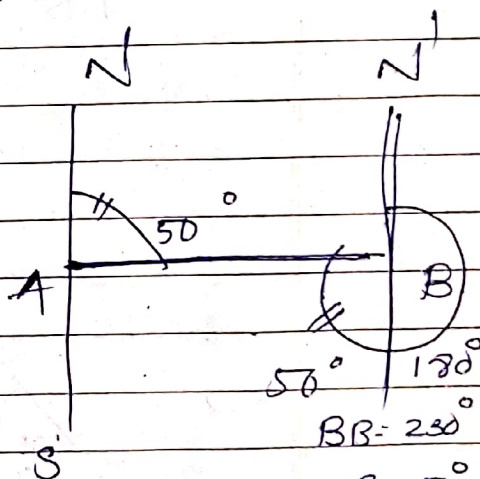
The bearing of a line taken in the forward direction is known as forward Bearing. It is also called four Bearing.

Back bearing :-

The bearing which is taken into back ward direction of a line is called Back bearing.

* Back bearing.

$$F.B \pm 180^\circ$$



If $F.B$ is more than 180° then '-' sign is used if less than 180° then '+' sign is used.

① Define contour :-
 contour is an Imaginary line joining the two point in the same elevation from the mean sea level.

Local attraction :- / alteration
 It the magnetic needle does not point to word the magnetic North under the influence of sum external alteration force - Such external attractive force is known as local Attraction.

Q11

MAGB

Q12

$55^{\circ} 15'$

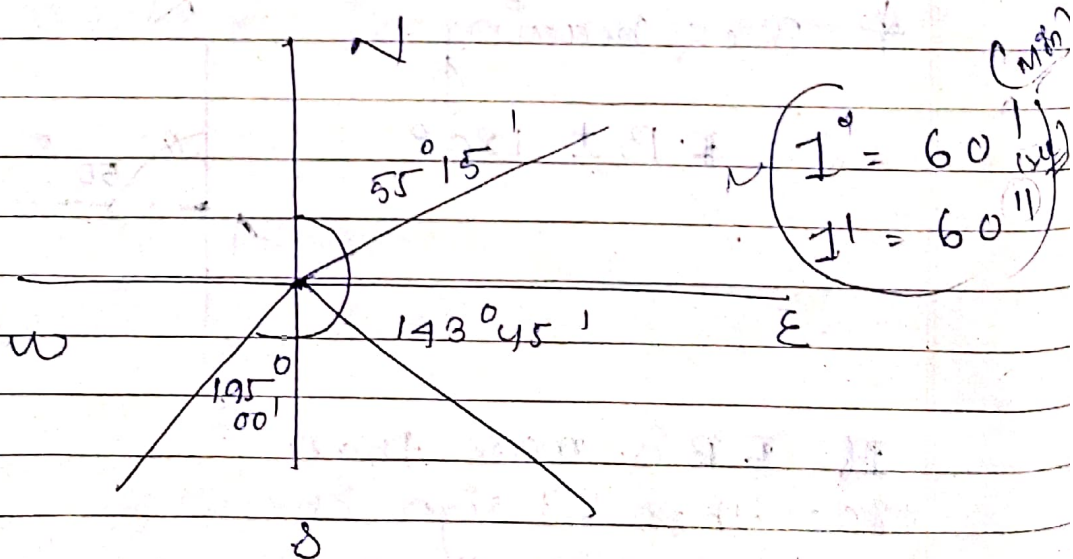
N $55^{\circ} 15'$ E

$143^{\circ} 45'$

S $30^{\circ} 45'$ E

$195^{\circ} 00'$

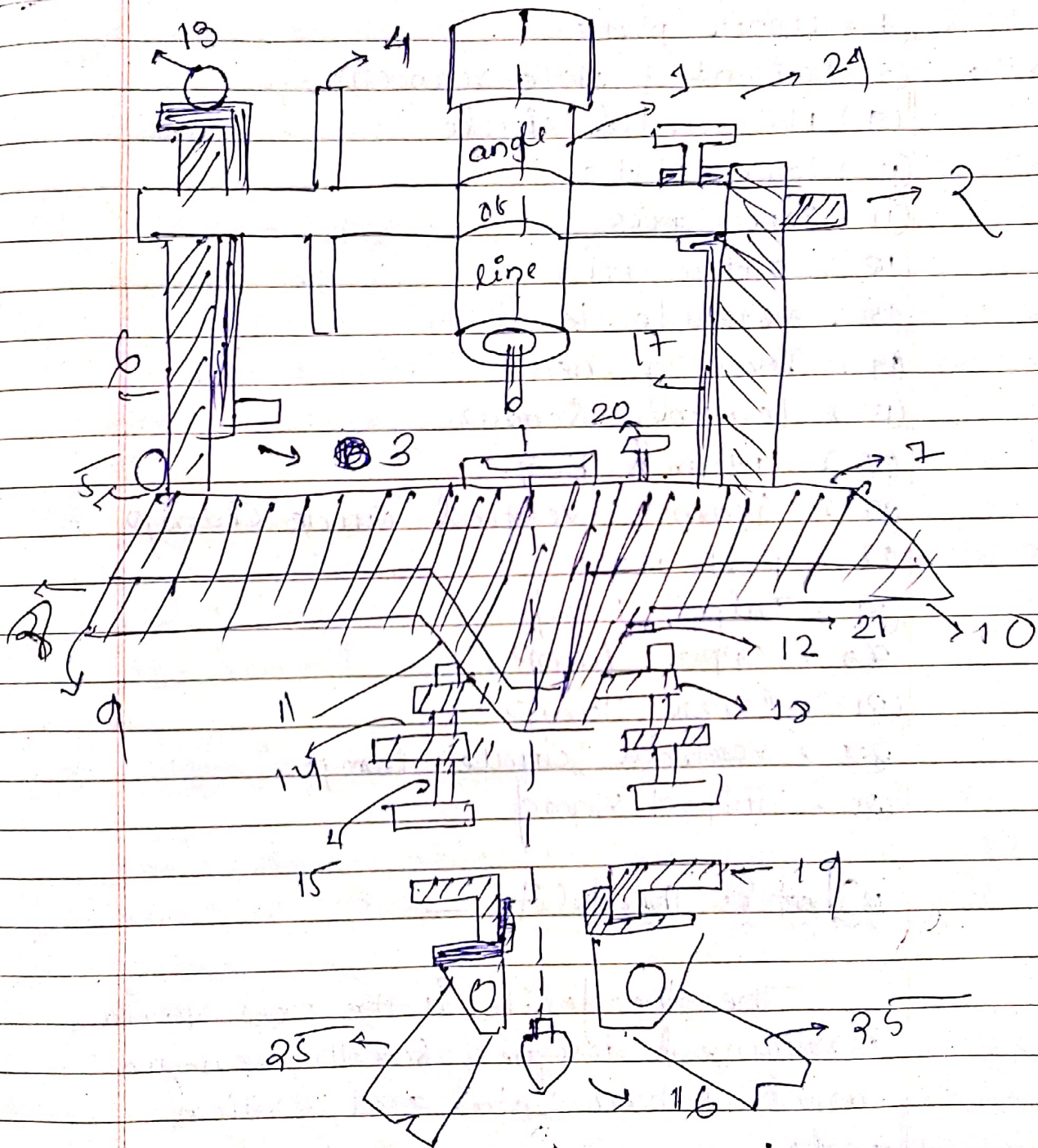
S $15^{\circ} 00'$ W



Ques

Theodolite

What is Theodolite?



- (1) Telescope
- (2) Trunnion axis
- (3) Vernier frame
- (4) Vertical circle
- (5) Plate level
- (6) Standards (FM)
- (7) Upper plate
- (8) Horizontal plate vernier
- (9) Horizontal circle
- (10) Lower plate
- (11) Inner axis
- (12) Outer axis
- (13) Altitude level
- (14) Leveling head
- (15) Leveling screw
- (16) Plum bob
- (17) Animate vertical circle clamp
- (18) Feet plate
- (19) Tripod head
- (20) Upper clamp
- (21) Lower clamp
- (22) Vertical circle clamp
- (23) Tripod stand

What is Theodolite :-

The theodolite is the most special instrument designed for the measurement of horizontal and vertical angle.

- It is most widely used in surveying instrument.
- Theodolite may be classified into two types →

(i) Transit Theodolite

(ii) Non Transit Theodolite.

(i) Transit Theodolite :-

It is one which its line of sight can be reversed by revolving the telescope through 180° in vertical plane.

(ii) Non-transit Theodolite :-

The non transit Theodolite are either plane theodolite or y-theodolite in which the telescope cannot transit.

(*) Vertical axis :-

The vertical axis is the axis about which the instrument are rotated in a horizontal plane.

* Horizontal axis :-

The horizontal axis is the axis about which the telescope and the vertical circle rotating in vertical plane.

* The line of sight or line of collimation :-

It is the line passing through the intersection of horizontal and vertical cross hair and optical centre of object glass and its continuation.

* Axis of level tube :-

The axis of level tube ^{or bubble line} is a straight line horizontal to a longitudinal curve of a level tube at its centre. The axis of the level tube is horizontal when the bubble is in centre.

* Centering :-

The process of setting of theodolite exactly over the station mark is known as centering.

* Swinging of telescope :-

It is the process of turning the telescope to horizontal plane. If the telescope is rotated in clock wise direction then it is known as right swinging. If the telescope is rotated in anti clock wise direction it is known as left swinging.

* Telescope Normal :-

A telescope is said to normal or direct when the face in vertical circle is to left and the bubble of telescope is up.

Theodolite (Permanent adjustment) :-

The permanent adjustment of theodolite are made to establish fixed relation between instrument's fundamental lines.

Permanent adjustments are :-
→ vertical axis.

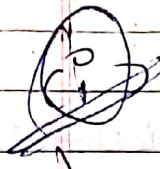
→ horizontal axis
→ axis of plate levels

→ Axis of telescope
→ bubbles water should read zero

Adjustment of theodolite :-

There are mainly two types of theodolite

- (i) Temporary adjustment
- (ii) permanent adjustment

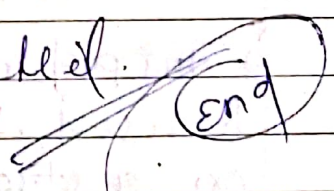


Temporary adjustment :-

→ Temporary adjustment or station adjustment are those which are made once every instrument setting and prepare preparatory or taking observation with the instrument.

→ The temporary adjustments are

- (a) setting over the station
- (b) leveling up
- (c) elimination of parallax



(Imp)

Prismatic compass

Surveyor's compass

→ Graduation circle is fixed to broad type needle hence it will not rotate with the line of sight.

→ Graduation circle is fixed to the box, hence rotates with the line of sight. At viewing end there is no prism. There is only a slit.

→ There is a prism at viewing end.

→ sighting and reading can be done simultaneously.

→ sighting and viewing cannot be done simultaneously.

⇒ The magnetic needle do not act as an index. ⇒ Magnetic needle acts as index while reading.

⇒ The graduation are in whole circle bearing. ⇒ The graduation are quadrantal systems.

⇒ Graduation are marked inverted since its reflection is read through prism. ⇒ Graduation are marked directly they are not inverted.

⇒ The reading is taken through a prism. ⇒ The reading is taken by directly viewing from top glass.

⇒ Tripod may or may not be used. It can be held on a stretched hand also. ⇒ Tripod is essential for using it.

Sources of error in theodolite:

Sources of error about three types

- (i) Personal error
- (ii) Instrumental error
- (iii) Natural error.

(i) Personal error:

(II) Instrumental error :-

- The instrumental errors are due to
- ⇒ In perfect adjustment of instruments.
 - structural defect in the instruments.
 - In perfection due to wear.

(III) Natural error :-

- In equal atmospheric refraction due to high temp.
- ⇒ unequal expansion of parts of telescope and circle due to temp. changes -
- ⇒ unequal settlement in the tripod.
- wind producing vibration.

Traversing of theodolite :-

Compass :-

correction of local Attraction :-

line	FB	BB
AB	45° 45'	226° 10'
BC	96° 55'	277° 5'
CD	29° 45'	209° 10'
DE	324° 48'	144° 48'

line	LA	Error	correction
AB	✓	+25	-25
BC	✓	+10	-10
CD	✓	-35	+35
DE	✗	0	0

observed

line	observed bearing	corrected bearing	Remark
AB	45° 45'	0	25° 45'
BA	226° 10'	-25	235° 45'
BC	96° 55'	-25	96° 30'
CB	277° 5'	-35	276° 30'
CD	29° 45'	-35	29° 10'
DC	209° 10'	-35	209° 10'
DE	324° 48'	0	324° 48'
ED	144° 48'	0	144° 48'

Point
B
and
C
are
local
attraction

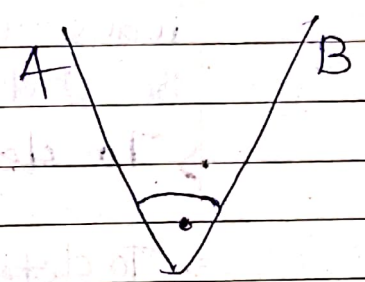
Measurement of horizontal angle by theodolite are mainly two types -

- (i) Repetition method
- (ii) Reiteration method

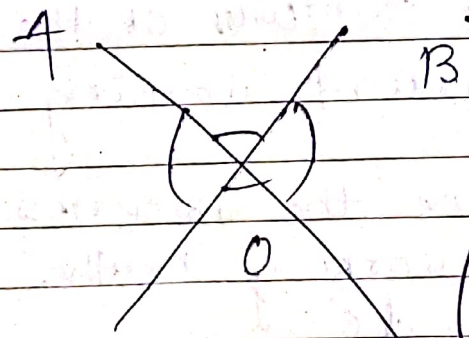
(i) Repetition Method :- (0°-180°)

→ set the instrument at O on level & with the help of upper screw clamp and tangent set a reading of vernious A' and B' vernious reading.

→ Loosen the lower clamp and direct the telescope towards at point A' and clamp the low clamp and bisect the point A' directly by lower tangent screw.



Reiteration method :- (0°-360°)

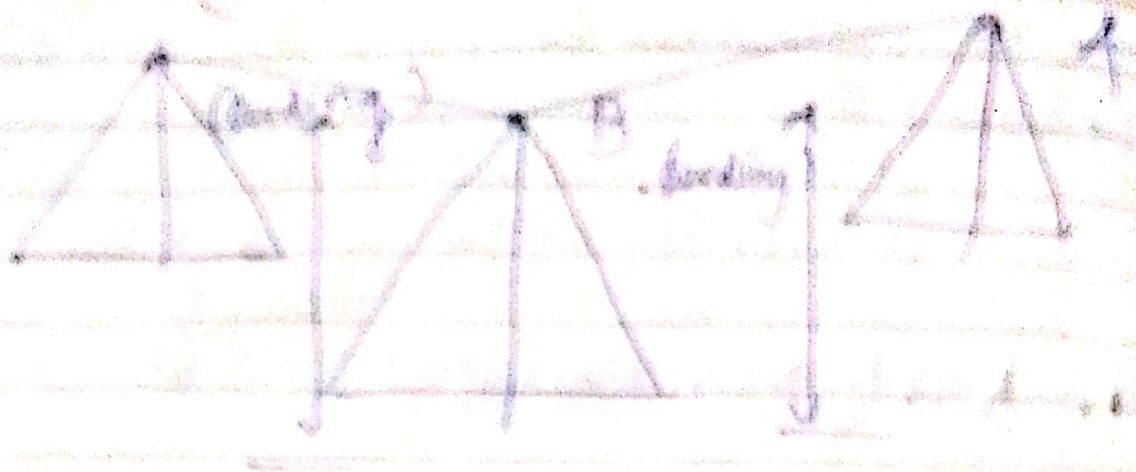


(1) Levelling

(2) Levelling

Defind levelling :-

Levelling is the process of finding the difference in vertical height betn two or more points in the earth surface.



Objective of Levelling :-

- To determine the depth of working below the surface.
- To determine the grade of ways through which mineral may be hald.
- To determine through or belds.
- To determine the height of which water may be hald pumped.
- To fix tables, contours of the surface and underground working.
- To determine the thickness of cover to such ~~work~~ working beneath a railway, river lake etc.
- To establish underground bench marks.
- To measure subsidence caused during or after the underground mining operation.

Method of levelling :-

method of levelling is mainly three type

- ① Barometric levelling
- ② Trigonometric levelling (Indirect)
- ③ Spirit level levelling (direct) - levelling

① Barometric levelling :-

⇒ Barometric levelling makes use of the phenomenon that difference in elevation betⁿ two points is proportional to the difference betⁿ in atmospheric pressure.

⇒ Barometric level are used at both reading observed at different points and elevation of different points.

② Trigonometric levelling (Indirect)

⇒ Trigonometric levelling also known as indirect levelling.

⇒ Is the process of levelling in which the elevation of points computed from the vertical angle and horizontal distances measured in the field.

③ Spirit level levelling or direct levelling

⇒ It is that branch of levelling in which the vertical distance with respect to the horizontal line may be used to determine the relative difference in elevation betⁿ two adjacent point.

What are the instruments used in levelling :-

- ① A Level
- ② A levelling staff
- ③

① A Level :-

The purpose of Level is to provide a horizontal line of a site.

A level is consist of four parts -

- (i) A telescope to provide a line of site ✓
- (ii) a level tube to make the line of site horizontal.
- (iii) A levelling head to bring ^{the} bubbles in its center of π rad.
- (iv) A tripod to support the instruments.

Types of levelling :-

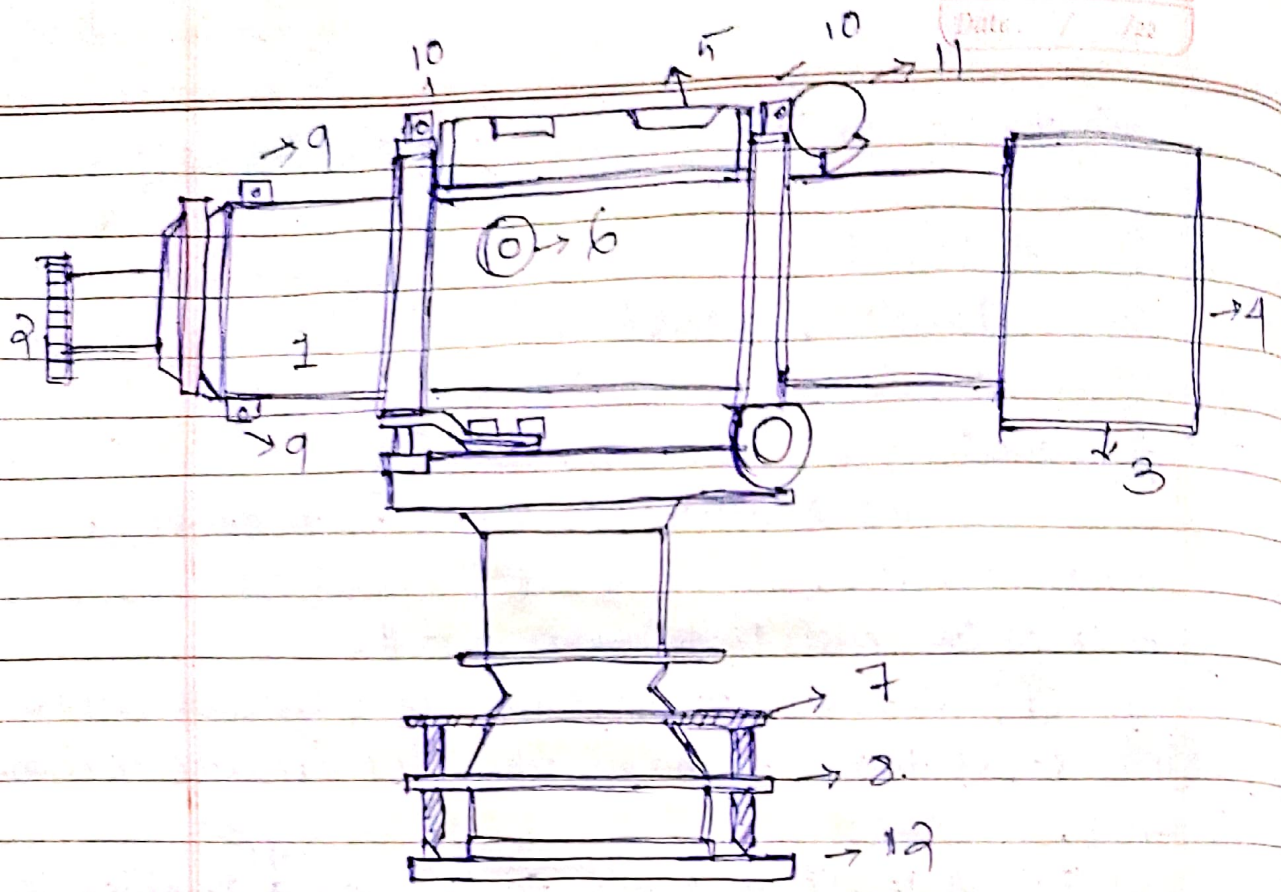
There are four type of levelling :-

- (i) dumpy level
- (ii) wye level
- (iii) reversible level
- (iv) tilting level
- (v) top level
- (vi) Auto level

(Imp)

① Dumpy Level

→ The dumpy level originally designed by Greavatt, consist of telescope tube firmly secured in collar ~~two~~ collar fixed by adjusting screws to the stage carried by the vertical spindle.



((DUMPY LEVEL))

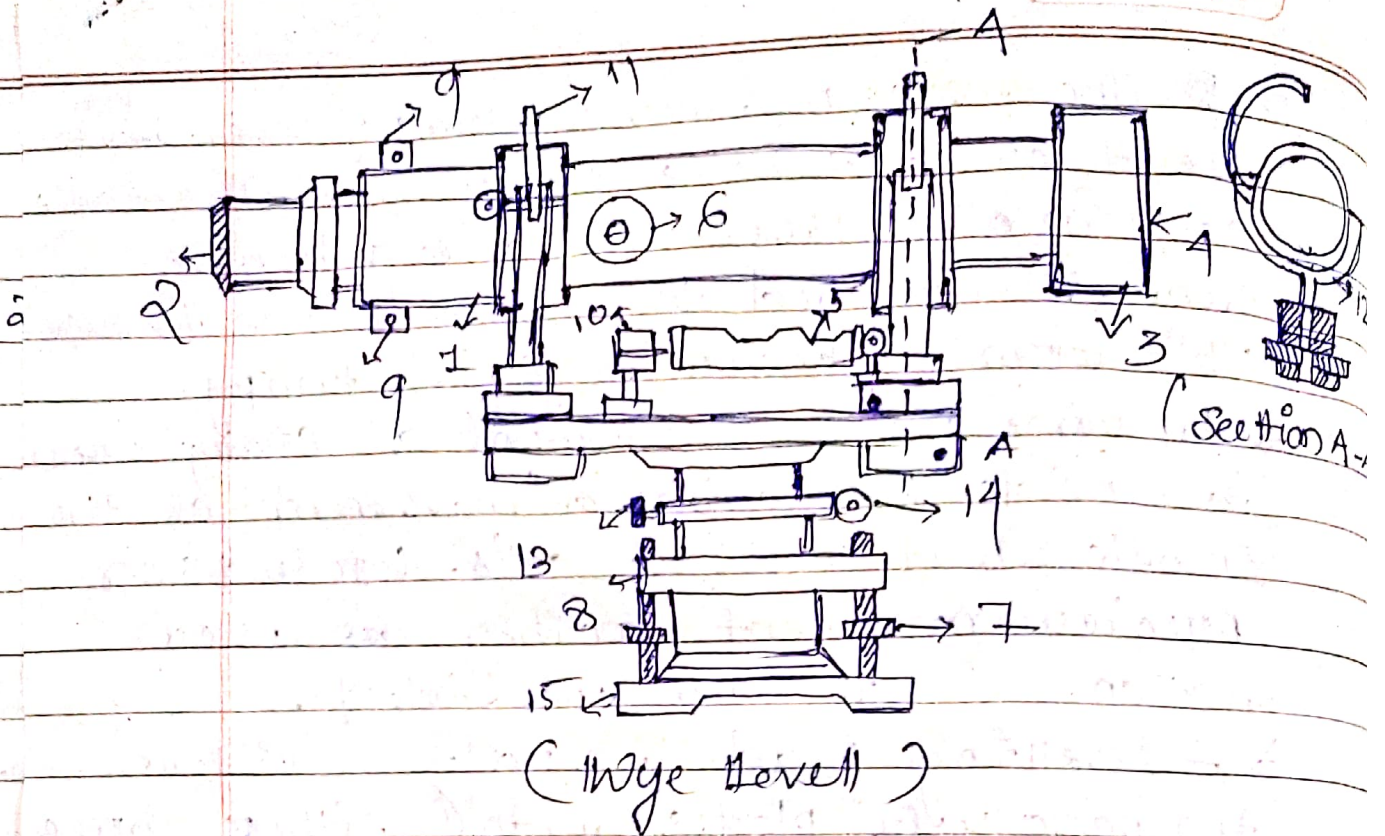
- ① telescope
- ② eye piece
- ③ rays shade
- ④ objective end
- ⑤ longitudinal bubbles
- ⑥ focusing screws
- ⑦ foot screws
- ⑧ upper parallax plate
- ⑨ diaphragm adjustment screws
- ⑩ bubble tube adjusting screw
- ⑪ transverse bubble tube
- ⑫ foot plate

- ⇒ The modern form of dumpy level ^{has} ~~have~~ the telescope tube and the vertically spindle cast in ~~a~~ one piece and a long bubble tube is attached to the top of the telescope. This form is known as solid dumpy.
- ⇒ In some of the instrument a clamp screw is provide the control ^{of} ~~the~~ movement of the spindle about vertical axis. For small or precise movement ~~scarcely~~ ~~and~~ a slow motion is also provided.
- ⇒ A levelling head generally consist of two parallel plates with either three feet screw and four feet screw. The upper plate is known as tribrache and lower plate is known as tribrach.

(short type)

(II) Wye Level :-

- ⇒ The essential betⁿ dumpy level and wye level is that in the former case the telescope is fixed in spindle while in wye level, the telescope is carrying into vertical wye support.
- ⇒ The wye support consist of curved clips if the clips are ~~not~~ raised, telescope can be rotated in the wyes or removed and ~~turned~~ and forward.



- ① Telescope
- ② Eye piece
- ③ Rayshade
- ④ objective end
- ⑤ bubble tube
- ⑥ focusing screw
- ⑦ foot screw
- ⑧ tribach
- ⑨ Diaphragm adjusting screw
- ⑩ bubble tube adjusting
- ⑪ wye clip
- ⑫ clip half upon
- ⑬ clamp screw
- ⑭ tangent screw
- ⑮ trivet stage

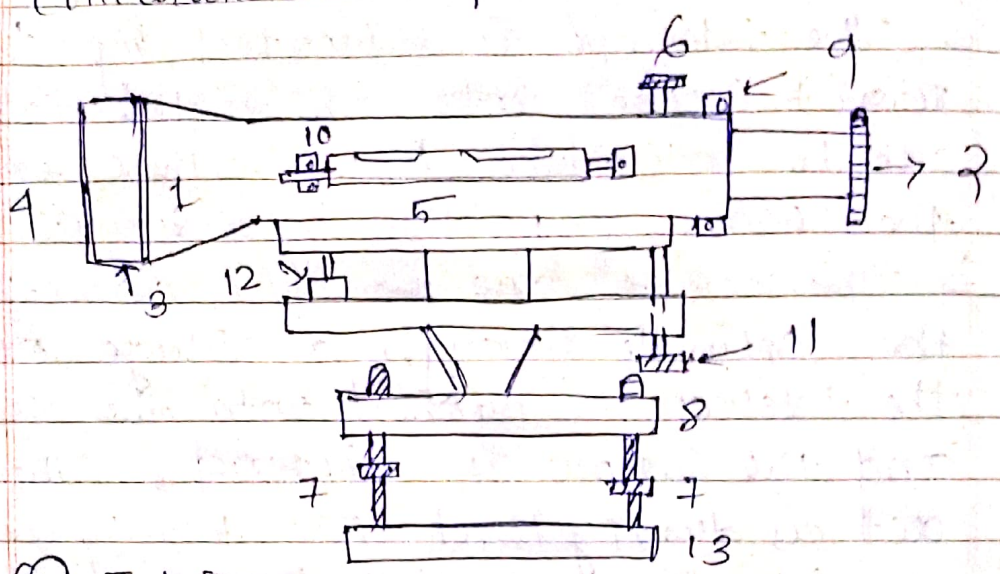
③ Reversible level :-

- ⇒ A reversible level combined the features of both dumpy and wye level.
- ⇒ The telescope is supported by two right socket into which the telescope can be introduced from either end and then fixed position by a screw.
- ⇒ The socket are rigidly connection to the spindle through a stage once the telescope is pushed into the socket and the screw is tightened, the level act as dumpy level for testing and making the adjustment the screw slackening and the telescope can be taken out and reversed and for end.
- ⇒ The telescope can also turned within the socket about the longitudinal axis.

④ Tilting Level :-

- ⇒ In the case of dumpy level and wye level the line of site is perpendicular to the vertical axis.
- ⇒ Once the instrument is leveled, the line of site becomes horizontal and vertical axis truly become vertical.
- ⇒ In the case of tilting level, however line of site can be tilted slightly without tilting the vertical axis. Thus the line of site in the vertical axis need not to be exactly perpendicular to each other.

⇒ The instrument is leveled roughly by the three foot screws with respect either to the bubble tube or to a small circular bubble.



- (1) Telescope
- (2) Eye piece
- (3) Ray shade
- (4) Objective end
- (5) Level tube
- (6) Focusing screws
- (7) Foot screws
- (8) TRIBRACH
- (9) Diaphragm adjusting

ERROR IN LEVELLING

Errors of levelling are mainly three types :-

- (i) Instrumental error
- (ii) Natural error
- (iii) Personal error

(1) ⇒ Again instrumental errors are five types :-

- (1) Error due to imperfect adjustment

- (2) Error due to sluggish bubbles ^{slide}
- (3) Error due to movement objective ~~set~~
- (4) Rod not standard length
- (5) Error due to defective joints.

Natural Error :-

(2) Again Natural errors are five types :-

- (i) Earth curvature
- (ii) atmospheric refraction
- (iii) variation of temperature
- (iv) Settlement of tripod on turning point.
- (v) wind vibration

Personal Error :-

(3) Again personal errors are five types :-

- (i) mistake in manipulation.
- (ii) Rod handling
- (iii) Error in sighting
- (iv) Mistake in reading
- (v) Mistake in recording and computing

Dt - 28, 11, 22

REDUCING

METHODS OF LEVELLING

⇒ Reducing levelling, mainly two types :-

- (i) Height of instrument method
- (ii) Rise and Fall method

(i) Height of instrument method :-

⇒ In this method the height of instrument ^{the} is calculated for each setting of instrument

By adding back sight sight to the elevation of the first point.

→ The elevation of Reduce level of the turning point is then calculated by subtracting from H.I of the fore sight (Minor sight).

→ For the next setting of instrument, the HI is obtained by adding the back sight on total point.

→ If there are some intermediate point, the Reduce level of those points is calculated by subtracting the intermediate sight (Minor sight) from the H.I for that setting.

→ The difference betⁿ the sum of back sight and the sum of fore sight should be equal to the difference betⁿ the last and the first Reduce level are equal to —

$$\sum B.S - \sum F.S = \text{Last Reduce Level} - \text{First Reduce Level}$$

(ii) Rise and Fall method :-

→ In this method the HI is not at all calculated but difference of levelling betⁿ consecutive points is found by comparing the staff reading true level and the self setting instrument.

→ The difference betⁿ staff readings indicate a rise or fall according as the staff reading at the point is smaller or greater than at the preceding point.

→ The figure shows rise and fall work out thus for all the point vertical distance at each point above or below the preceding wall, and if the level of one point is known at the level of the next wall continued by adding within rise or subtracting it from fall at the case may be found at the line of levelling.

RECIPROCAL LEVELLING

→ In ordinary levelling where the sights are comparatively short the effect of refraction is usually ignored and the equalisation of back sight and fore sight with eliminate curvature and refraction error.

→ If the root of levelling is cross a river it may be impossible to equalise back sight and fore sight.

→ In such a case the error of curvature and refraction can only be eliminated by adapting the procedure known as reciprocal levelling.

COMPUTATION OF AREA

Page No. _____

Date: / / 22

~~Computation of Areas~~

~~Mid point ordinate Rule~~

(iii)

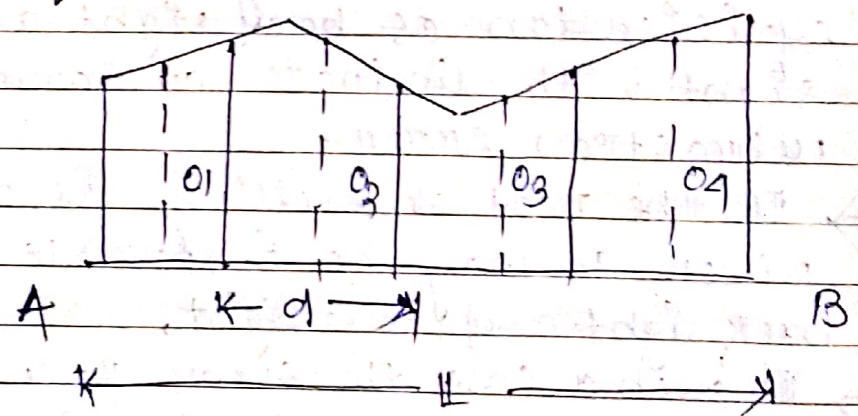
~~The rule~~

* Computation of Areas are mainly determined the following rules :-

- (i) Mid point ordinate rule
- (ii) Average ordinate rule
- (iii) Trapezoidal rule
- (iv) Simpson's rule
- (v) Graphical rule

(i) Mid point ordinate rule :-

→ The rule states that if the sum of all the ordinates taken at mid point of each division multiplied by the length of the base line having the ordinates (line divided by number of equal parts)



→ In this base line AB is divided into equal parts and the ordinates are measured in the mid point of each division

$$\text{Area} = \left[\frac{o_1 + o_2 + o_3 + o_4}{4} \right] \times L$$

Where,

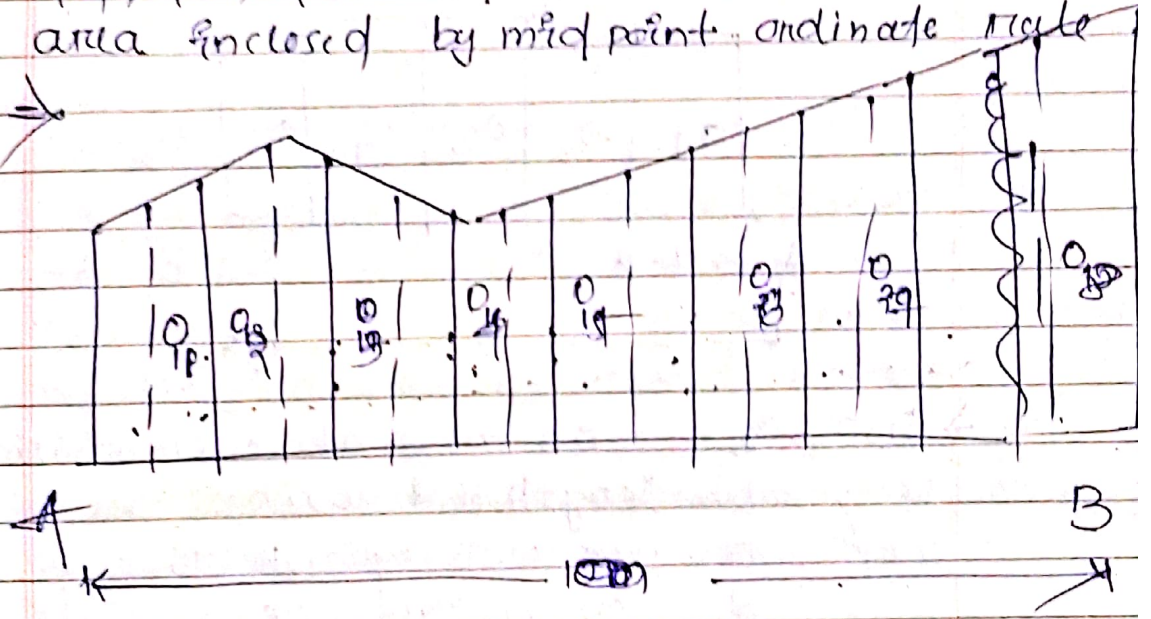
l = length of base line

n = number of equal parts

d = common distance betⁿ the ordinates

Problem - 1

The following perpendicular offset were taken ~~at~~ from interval 10m's survey line to an irregular boundary line, the ordinates are measured at mid point of division are 10, 13, 17, 16, 19, 21, 20 and 18 m. calculate the area enclosed by mid point ordinate rule



$$Area = \left[O_1 + O_2 + O_3 + O_4 + O_5 + O_6 + O_7 + O_8 \right] \times L$$

$$= \left[10 + 13 + 17 + 16 + 19 + 21 + 20 + 18 \right] \times L$$

$$= \left[10 + 13 + 17 + 16 + 19 + 21 + 20 + 18 \right] \times 10$$

~~10~~

$$L = 10, n = 8$$

$$L = 9 \times 10 = 90$$

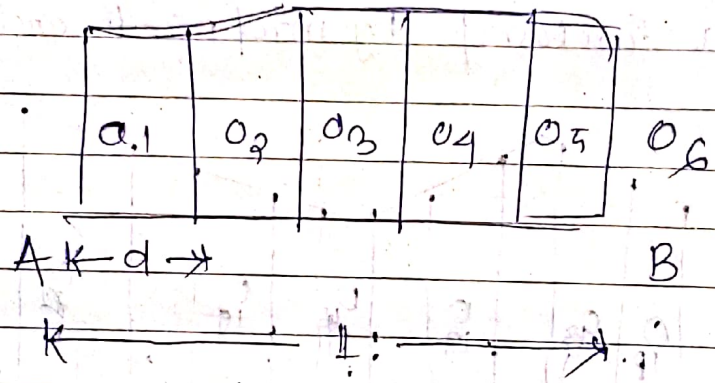
$$= \frac{134 \times 80}{8} = \frac{10720}{8} = 1340$$

(2)

Average ordinate rule :-

The rule state that :- to the average of all the ordinates taken at each division of equal length multiplied by base line length divided number of ordinates.

1340 m² (Ans)



⇒ o₁, o₂, o₃ ... o_n taken at each division,
 L = length of base line
 n = number of equal parts
 d = common distance.

$$\text{Area} = \frac{(o_1 + o_2 + o_3 + \dots + o_n) \times L}{n}$$

① Simpson's Rule / parabolic rule :-

The rule state that sum of first and last ordinate has to be done.

→ Add twice the sum of remaining odd ordinate and four time the sum of remaining even ordinate then multiply the total sum by $\frac{1}{3}$ third of the common distance from the ordinate which gives the required area.

→ where $O_1, O_2, O_3, \dots, O_n$ are the length of the ordinate.

d = common distance

n = number of division,

→ If the number of ordinates are even the area of last division may be calculated separately and added to the result obtained by applying Simpson's rule to remaining ordinates.

→ Even the first and last ordinates happens to be O_1 they are not to be omitted from Simpson's rule.

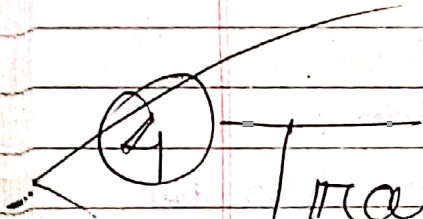
$$\text{Area} = \frac{d}{3} \left[(O_1 + O_n) + 4 \left(\text{Sum of even ordinates} \right) + 2 \left(\text{Sum of odd ordinates} \right) \right]$$

(Problem) :-

0	25	50	75	100	125	150
3.6	5.0	6.5	5.5	7.3	6.0	4.0

where, $d = 25$

$$\begin{aligned} \text{Area} &= \frac{25}{3} [(3.6 + 4.0) + 4(5.0 + 5.5 + 6.0) \\ &\quad + 2(6.5 + 7.3)] \\ &= 242.90 \text{ (m}^2\text{)} \end{aligned}$$



Trapezoidal rule $\frac{a}{c}$

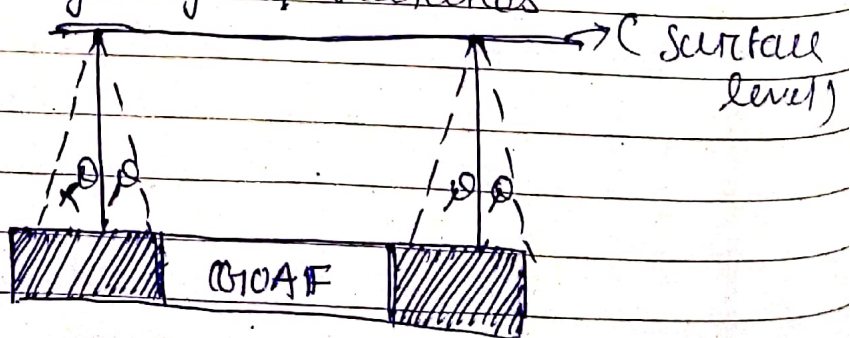
→ In this method boundary betⁿ the end of ordinates are assumed to be straight line thus the area betⁿ these line and the irregular boundary line are consider as a trapezoidal

$$\text{Area} = \frac{d}{2} [(1^{\text{st}} \text{ ordinate} + \text{last ordinate}) + \text{sum of other ordinates}]$$

(Levelling) used
(underground)

Subsidence Levelling :-

- ⇒ The term Subsidence means the lowering of the surface.
- ⇒ When an underground opening is established due to extraction of a coal seam or ore body.
- ⇒ The original equilibrium of strata is disturbed with resultant stress concentration.
- ⇒ It causes effect on the surface where particle ~~sepp~~ suffer vertical and horizontal displacement, creating Subsidence basin or trough which is flattened out to sides until it is level with the existing ground. The area of the surface affected ~~above~~ the goaf depends on the angle of ~~draw~~ ~~trough~~ draw.
- ⇒ which is ^{the} an angle betⁿ ^{the} a vertical line from a edge of the goaf and a line extended to a point at which the subsidence falls out to zero.
- ⇒ The angle of ~~draw~~ ^{trough} varies with dept nature and inclination of the strata and other geological features



AIM OF Subsidence Levelling :-

⇒ Its ground movement observation are carried out in a scientific manner, every observing operation and observation data are kept properly maintained, many valuable information such as amount of subsidence, angle of draw, rate of subsidence etc. etc. can be made available for planning, feature operation under similar ground condition and similar operational parameter.

⇒ The five parameter of subsidence are :-

- (i) vertical subsidence
- (ii) differential change in ground slope

(iii) change in the surface curvature

(iv) horizontal displacement of different surface points.

(v) horizontal strain

Trigonometric Levelling :-

⇒ When inclined distance betⁿ two points is known as relative altitudes and the horizontal displacement of the point may be determined by the reading with the vertical circle of the theodolite the angle of a elevation or depression of the line joining the points.

⇒ This method of finding altitudes is known as trigonometric levelling. This method is suitable in steep gradients where the dumpy level is inconvenient.

to sets and when extreme accuracy is not required only and approximate height difference in level betⁿ two points is urgently required.

Advantages of trigonometric levelling

- ⇒ It is important in under ground work of seam inclined at angle of 10° to 12° \circ up wards, where the use of ordinary level would be inconvenient by reason of the shortness of sides for restricted height.
- ⇒ This method of levelling is suitable for levelling hilly and mountainous region where ~~and~~ and ordinary levelling with dumpy level is difficult and time taking.
- ⇒ It is preferred for levelling for steep gradients and when distance involved are large.
- ⇒ The consumption of with stadia measurement this method is used for contouring in hilly area.
- ⇒ As the inclined length is measured along the slope any error in measurement due to ~~can~~ can be avoided.

Disadvantages :-

- The degree of accuracy attainable by this method is low and comparison to the attainable by leveling with a dumpy level. The permissible error for trigonometric levelling is 1.5 cm per 1 km of run and for ordinary levelling with a dumpy level it is 0.15 cm per 1 km of run.
- Profile of the ground may not be parallel with the inclined line of sight. The linear measurement along the ground in such cases can never be equal to the inclined distance.
- The accuracy is entirely dependent upon the linear measurement, vertical angles and the ground profile.
- The method is preferred only when extremely accuracy is not equal.

(Contour)

Contour :-

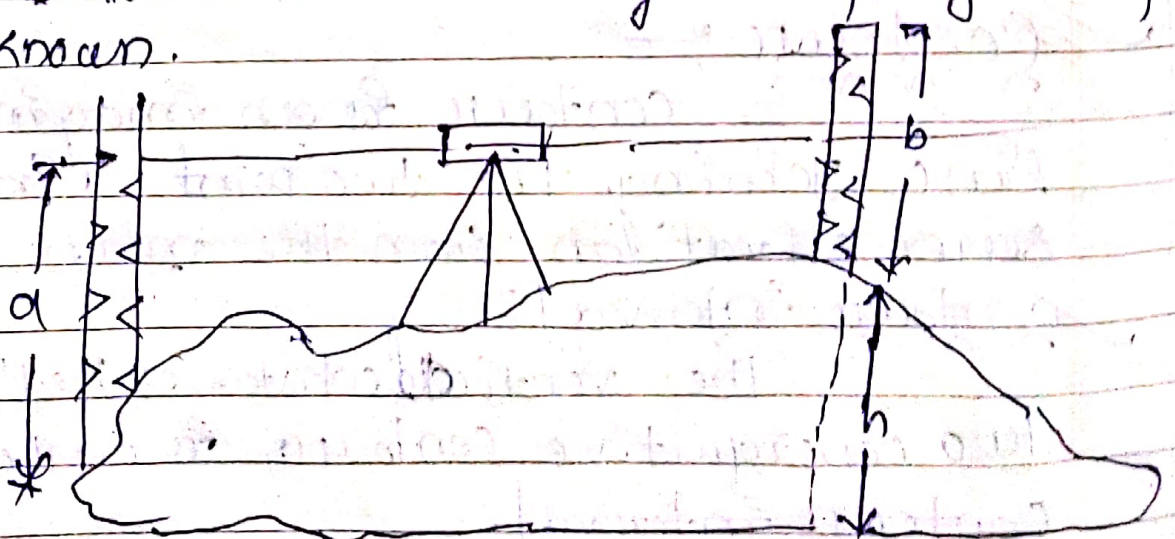
Contour is an imaginary line joining the two points in the same elevation from the mean level.

Contour interval :-

The vertical distance betⁿ any two consecutive contours is called contour interval.

Characteristics of contouring (pt-2, 19, 22)

- Geometric levelling is a set of operating procedure to measure the difference in level betⁿ two points. ~~is~~ the difference
- ⇒ That is the difference height betⁿ two point in the earth surface.
- geometric levelling differs from trigonometric levelling in that taking of the measurement is independent of distance.
- ⇒ Geometric levelling is performed to determine ~~the~~ ^{the} absolute elevation of a point ~~for~~ which only the difference betⁿ ~~the~~ level and that of another point is known.
- It needs to be link to a levelling bench marks point, which absolute position is reference to the ~~geoid~~ ^{geoid} geoid known.



(Imp)

Contour :-

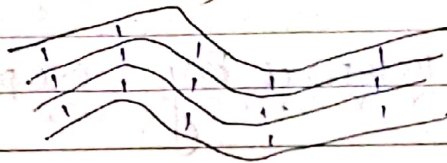
Contour is an imaginary line joining the two points in the same elevation from the mean level.

Contour Interval :-

The vertical distance betⁿ any two consecutive vertical contour is called contour interval.

Characteristics of contour :-

⇒ All points in one contour line have the same reduce level (R.L.)



⇒ Every contour line closes on its self either within or beyond the limit of map.

⇒ Contour lines are equally spaced when the ground is uniformly sloping, and where the ground is plane they are straight and parallel.

⇒ Contour never split nor do contour nor cross each other except in the case of an overhanging cliff.

⇒ Contour lines cross edge line or valley line at right angle.

⇒ A series of closed contour on the map indicates a depression or a summit according as the lower the higher values are inside them.

⇒ The direction of the steepest slope at a point contour is at right angle to the contour.

(CALCULATION OF ORE RESERVE)

Date: / /

Classify ore reserve :-

→ Ore reserve are mainly two types :-

(1) Proved reserve :-

Economical minable part of measured resource is known as proved reserve.

(2) Probable reserve :-

Economical minable part of indicated resource (measured under particular circumstances) is known as probable reserve.

Evaluate reserves By explanatory :-

(Contours)

Methods of contouring :-

→ Methods of contour are mainly two type -

(i) Direct method

(ii) Indirect method

~~(i) Direct method :-~~

→ The method in which contouring at the point of required elevation are directly located on the ground with the help of leveling instrument is called direct method.

→ The position of these point are surveyed by chain and offsets method or by a plane table.

⇒ The contours of required elevation are drawn by joining the respective points. The method is accurate but it's slow and tedious as lot of time is consumed in marking the point of same elevation on the ground.

⇒ contouring by direct method is done by any of the following method :-

- (1) By selecting a long main line and taking cross-section at suitable interval
- (2) By radial line method
- (3) By use of plane table in conjunction with leveling operation

INDIRECT METHOD :-

⇒ The method in which spot level taken on already fixed points over the entire area, the re. respective R.Ls are written against each point on the plane drawn to scale and contour lines are drawn by interpolation is called indirect method of contouring.

⇒ In this method the spot level are taken on points fixed along series of lines laid out over the area to be contour.

⇒ The spot level show taken are not necessarily on the contour line.

⇒ The contour of required elevation are then drawn by interpolation the method is used in all kinds of survey being cheaper, quick and less tedious compared to the direct method of contouring.

⇒ Contouring by indirect method is done by any of the following method :-

- (1) By square method
- (2) By cross-section method
- (3) By tacheometric method

(Shorts note)

- ① What is Datum surface?
- ② Define mean sea level?
- ③ Describe the miner's dial?
- ④ uses of contour map?

(Imp) ⇒ uses of contour map :-

- ⇒ ① To draw longitudinal section & plan of given map.
- ② To determine nature of ground in proposed area.
- ③ To calculate reservoir capacity.
- ④ To measurement of drainage area.
- ⑤ To determine inter-visibility betⁿ two points.
- ⑥ To find intersection of surfaces and measurement of earth work.

(Imp) Datum Surface :-

⇒ It is an imaginary level surface with respect to which the levels of points are measured or referenced.

⇒ In India, Survey of India has adopted mean sea level of Chennai as the datum surface.

(Reduced Level) :- (RL)

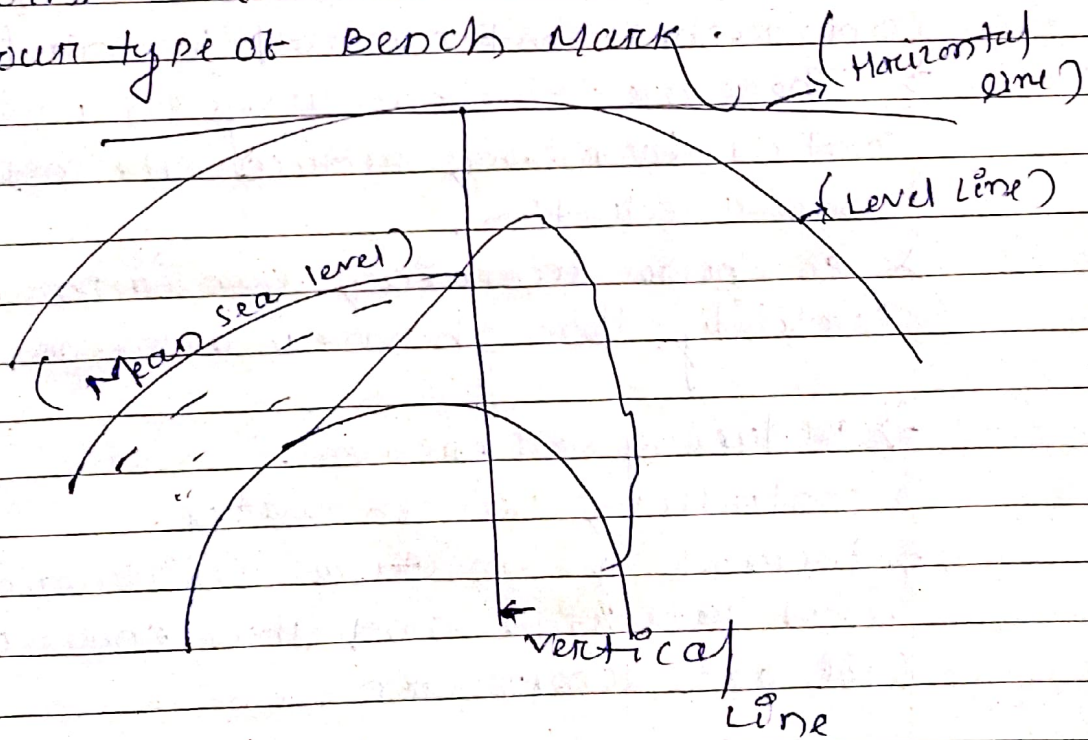
⇒ The vertical distance of a point above or below the datum is known as reduced level or elevation.

⇒ If the point is above the datum surface elevation is taken +ve.

⇒ If the point is below the datum surface elevation is taken -ve.

(Bench Mark) :-

⇒ It is a fixed reference point of known elevation. There are four type of Bench Mark.



Mean Sea Level :-

⇒ Mean sea level is the average height of sea for all stages of tides. It is derived by averaging the hourly tide height over a period of 19 years. Mean sea level (MSL) adopted by a survey of India for reference is located at Mumbai High.

(mp) Advantages and disadvantages of contour :-

Advantages :-

- ⇒ contour farming is one of the simplest and most effective sustainable farming approaches that are used to control erosion.
- ⇒ There are various ways in which contour farming reduces the cost of crop production.
- ⇒ contour farming can improve soil fertility through various means.

⇒ reducing soil erosion :

⇒ controlling runoff water.

⇒ increasing moisture infiltration and retention and thus enhancing soil and composition.

(Advantages) :-

- ⇒ It depicts slope and size of different landforms on map.
- ⇒ By reading contour interval it is easy to determine the different elevation of the landscape.
- ⇒ It provides the basic form coloring method.
- ⇒ It can be used in drawing cross-section of the given features on the mapped area.

(Disadvantages of contour) :-

- ⇒ contour fail to show some of the heights due to limitation of vertical interval.
- ⇒ some of the landforms cannot be shown by using contour for example coral reef, outcrop rock and craters.
- ⇒ contour method is mostly not used to show relief on small scale map as it may obscure some details.

(Dumpy level) Adjustment :-

① Temporary adjustment :-

Setting up :-

As the level is not to be set at any fixed point the setting up of a level is much simpler than compared to other instrument. However, while fixing the position of a levelling instrument.

(a) The instrument is not too low or too high to facilitate reading on a bench mark.

(b) The length of the back sight should preferably not more than about 100m.

→ The process of setting up includes fixing the instrument and approximate levelling by leg adjustment.

✓ It involves some well defined operations which are required to be carried out at every set up of the instrument.

② Setting up level :-

This operation includes the fixing the instrument on the tripod and levelling the instrument approximately by the leg adjustment.

(i) levelling up :- In this step, accurate levelling has been done with the help of foot screws and with reference to the plate levels. The purpose is to make the vertical axis truly vertical or perpendicular to the line of sight.

(ii) parallel :- It can be eliminated in two steps.

(i) By focussing the eye piece to have distinct vision of the cross-hairs.

(ii) By focussing the objective to bring the image of the object on the plane of cross-hairs.

(2) permanent adjustment of dumpy level :-

→ The establishment of a desired relationship between the fundamental lines of a levelling instrument is termed permanent adjustment.

The fundamental lines :-

(i) The line of collimation :-

⇒ The imaginary line joining the centre of the cross-hairs at the diaphragm to the centre of the object glass and its continuation.

Axis of the telescope :-

It is the line joining the centre of the eye piece and centre of the object glass.

Vertical axis :-

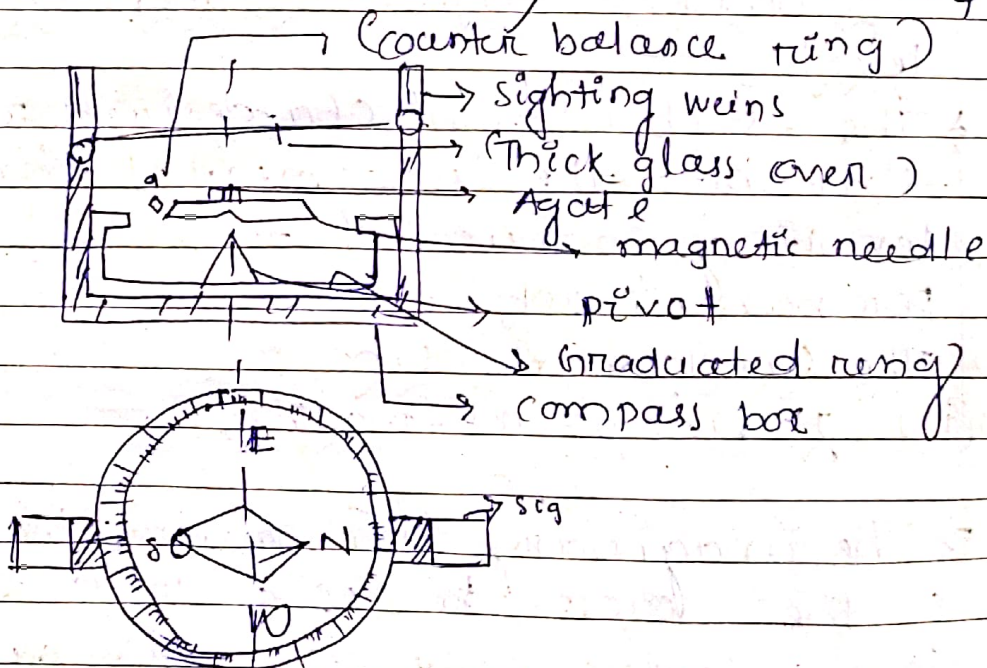
→ It is the axis which is obtained by the rotation of the telescope in a horizontal plane.

The axis of the bubble / level tube :-

→ It is the straight line which is tangential to the longitudinal curvature of the bubble tube at its midpoint.

(Compass) :-

(1) (Surveyor compass / Miner's dial) :-



→ Surveyor's compass which is also known as miner's dial consist of graduated ring made of brass and a magnetic needle supported on pivot at the centre of the ring.

→ The graduated ring is engraved in quadrant system.

→ The needle is provided with a wire ring on its south side which balance the needle by sliding on the needle as required.

→ The ~~needle~~ by ~~s~~ there is a pair of sighting wires are to sight of the point and measuring the bearing of line. Sighting wires are brass tube having slit in its centre along length. The sighting wire is attached with graduated ring, so ring revolves around the needle when sighting wire is rotated.

→ The position of East and West on the graduated ring is transparent because needle is stagnant while dial is moving around it.

→ The sighting wires are attached with dial by hinge joint so that it can be folded on glass cover when dial is not in use.

→ There is a thick glass cover which is used to make the needle dust proof & water proof and shock proof. The surveyor's compass also provided with a needle lighter by which the magnetic needle can be lighted off the pivot when the dial is not in use.

→ If the needle is always kept on pivot it tends to align itself in magnetic north which causes loss of magnetic position of the needle.