GOVERNMENT POLYTECHNIC JAJPUR

LECTURE NOTE
OF
MINE SURVEY-II

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{ Lecture In Mining }

DEPARTMENT OF MINING ENGINEERING

Tacheometry Surveying

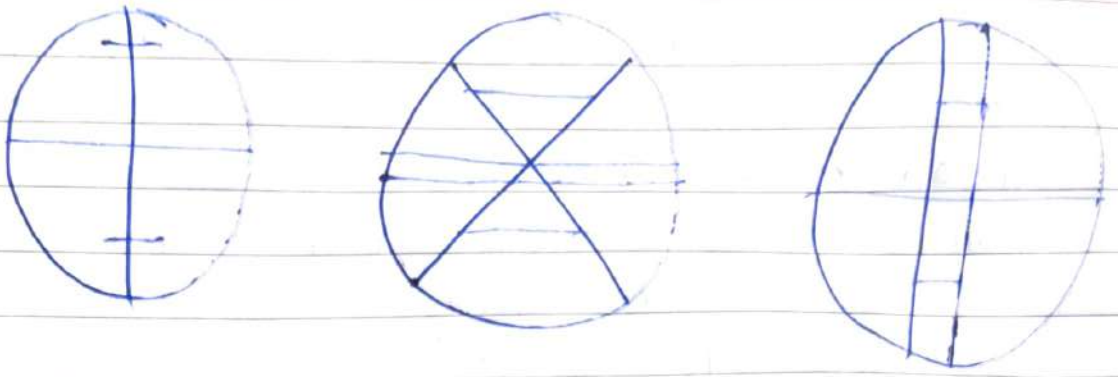
Tacheometry is a branch of angular surveying in which the horizontal & vertical distances of points are obtained by instrumental observations, chaining being thus entirely coupled/eliminated. The method is most rapid though less accurate. The accuracy of Tacheometry is less than that of chaining, but it is far more rapid in rush & difficult country where ordinary levelling is tedious & chaining is inaccurate, difficult & low.

The primary objective of tacheometry is the prepairation of contour plan or maps. It is extensively used on hydrographic surveys, location surveys for roads, railways, reservions etc.

The instrument commonly used in Tacheometry are

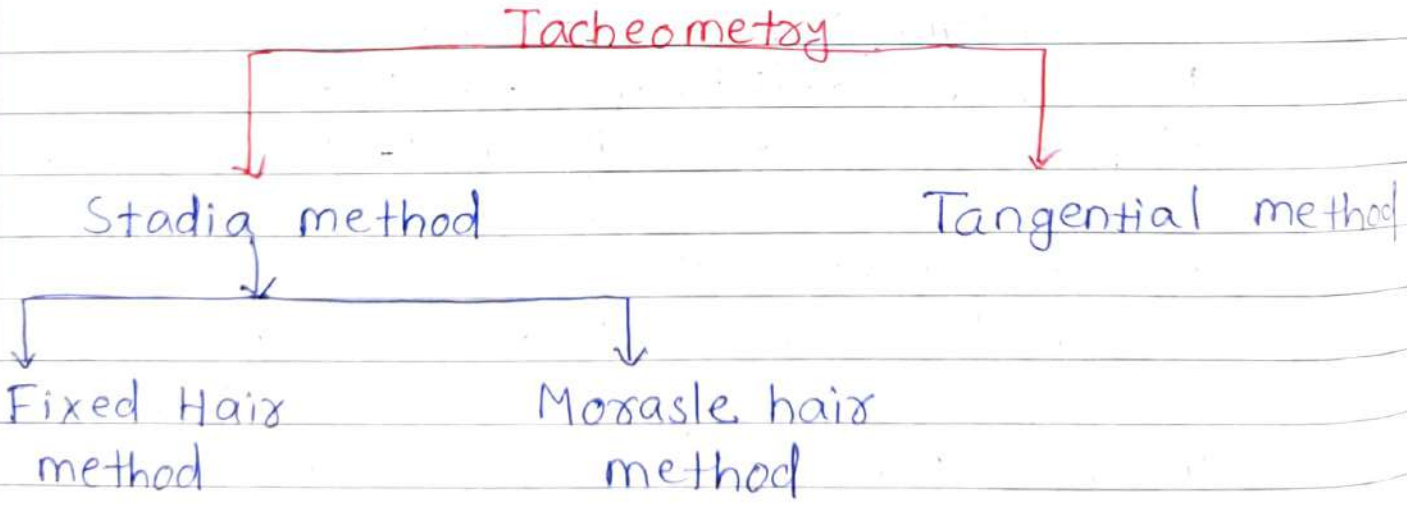
(a) Tacheometer:- An ordinary transit theodolite fitted with additional pairs of station hairs or diaphgram is generally used for Tacheometric survey. The diaphgram essentially consists of one stadia hair above of the other an equal distance below the middle horizontal cross hairs, the stadia hairs being mounted on the same in the same vertical plane as the horizontal & vertical cross hairs.

The kind of telescope used in stadia surveying are (i) External focussing (ii) Internal focussing telescope (iii) External focussing analthetic telescope i.e; telesope fitted with an analletic lens.



(b) Stadia Rod:- For Small sights (upto 100m) ordinary levelling staff is used, but for sights a specially designed levelling staff or graduated rod known as stadia rod is used. A stadia rod is usually of one piece but for ease of transportation it may be of folding or telescopic. It's least count is 5mm or 0.005mm.

Classification of Tacheometry



Stadia Method:-

The principle of Tacheometry is the geometrical theorm that in simmilar triangles same sides are proportional.

It is further subdivided into

a) Fixed hair method

In this method the observation is made with the help of a stadia diaphgram having stadia hairs at fixed distance apart. When the sight is taken to a distance staff, three different readings will obtained. The centre reading will give the true reading. The difference of the readings on the staff corresponding to the top bottom stadia hairs, known as stadia intercept will be directly proportional to the distance of the staff from the instrument station.

b) Movable hair method:

In this method the interval between the stadia hairs being variable. The stadia hairs / lines are not fixed but can be moved by means of a micrometer screw. The staff is provided with two vanes or targets fixed at a known distance apart, usually 3m. The variable stadia interval is measured from this value the horizontal distance may be computed.

Tangential method:

This method is used when the telescope is not fitted with a stadia diaphgram. The horizontal & vertical distances of the staff station from the instrument station may be computed

from observations taken to the vanes or targets on the staff at a known distance apart usually 3m.

Principle of Stadia method

Let O = Optical centre
A'C'B' = Top, Axial & Bottom hairs.
BCA = Points on the staff cut by three lines
C = Interval between stadia lines
S = Staffs interupt
f = focal length of the object glass.
f_1 = Horizontal distance from the optical centre to the staff.
f_2 = Horizontal distance from the optical centre to the image of the staff.
d = Horizontal distance from the optical centre to the vertical axis of the instrument to the staff.

ΔAOB of $\Delta A'OB'$ are simmilar

$$\frac{AB}{A'B'} = \frac{OC}{OC'} = f_1/f_2$$

$$\Rightarrow \frac{S}{C} = \frac{f_1}{f_2} \quad \text{---------- (i)}$$

By the formula of lenses

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

Multiplying both sides by f_1

$$\frac{f_1}{f} = \frac{f_1}{f_1} + \frac{f_1}{f_2}$$

$$\frac{f_1}{f} = 1 + \frac{f_1}{f_2}$$

Multiplying both sides by t, we get

$$\frac{f_1}{t} \times t = f + \frac{f_1}{f_2} \times t$$

or $$f_1 = f + \frac{f_1}{f_2} \times t$$

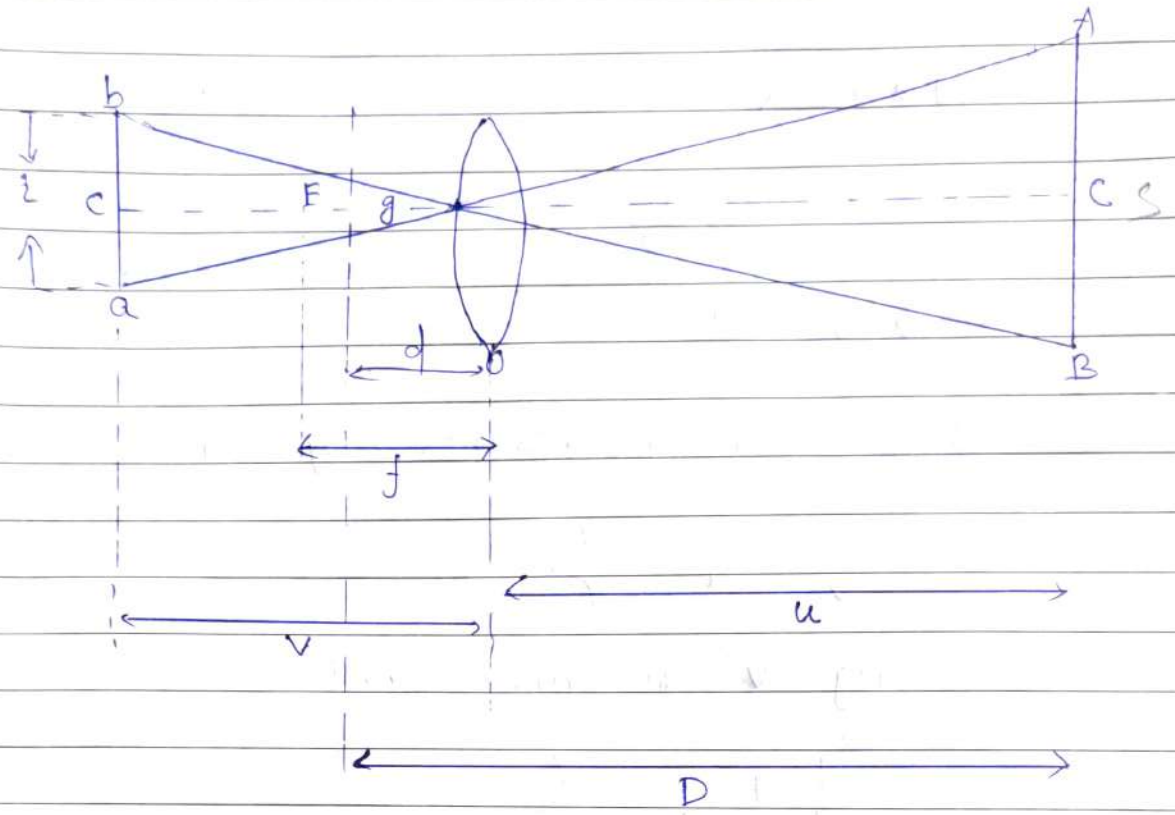
Putting the value of f_1/f_2 from equation (i)

$$f_1 = f + \frac{S}{C} \times t \quad \text{----------}$$

Now $D = f_1 + d$

Putting the value of f_1 from equn (ii)

* General Principle of Stadia Tacheometry:-



Let O = The optical centre of the object glass.

a, b, C = The bottom, top & central c/h at diaphgram

A, B, C = The points on the staff cut by three lines

$\overline{a,b}$ = i = The interval between the stadia lines

AB = S = The staff intercept.

f = focal length of the object i.e; distance between the optical centre 'O' to principal focus of the lense.

u = The horizontal distance from O to staff

v The horizontal distance from O to image

u, v = Conjugate focal length of lens

d = from 'O' to vertical axis
D = from vertical axis to instrument

ΔaOb & ΔAOB are simmilar

$$\frac{i}{s} = \frac{v}{u}$$

$$\Rightarrow v = \frac{ui}{s}$$

Also from properties of lense

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

Putting 'v' in this equation

$$\frac{1}{\frac{ui}{s}} + \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{s}{ui} + \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow u = f\left(\frac{s}{i} + 1\right)$$

$$= \frac{s}{i} f + f$$

We know

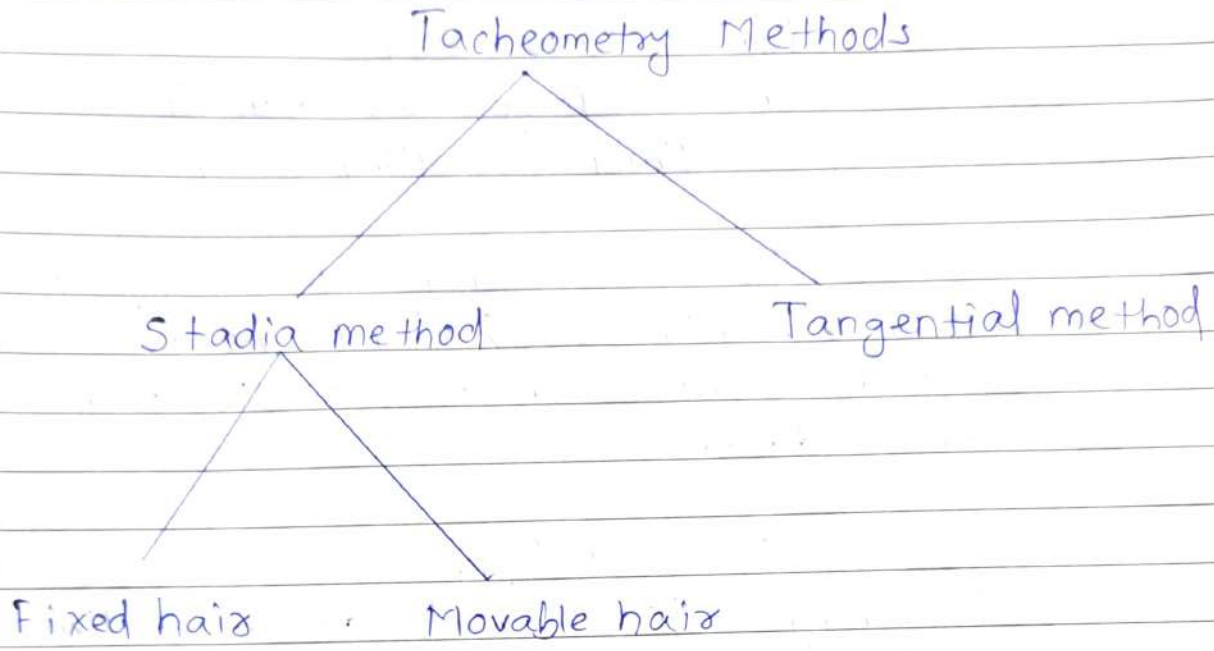
$$D = u + d$$

$$= \frac{s}{i} f + (f + d)$$

$$= \frac{f}{i} s + (f + d)$$

$$\boxed{D = Ks + C}$$

Methods of Tacheometry:-



* Instruments:-

- The instrument used in Tacheometry is a theodolite fitted with a stadia tacheometry diaphgram (on tacheometer

- Tacheometer has some special features
i) The telescope should be truely Anallatic.
ii) The telescope must have a magnification of about 30 diameter to read the staff accurately at large distances.
iii) The aperture of the objective should be 35 to 45 mm diameter to give a bright image.
iv) The multiplying constant should be 100 & additive constant zero.

Staff & Stadia Rod:-

It is 3m to 4m long, 5cm to 15cm wide. The graduation are bold & clear with a least count usually less than the least count of ordinary levelling staff.

Levelling:- It is a branch of surveying, the object of which is to find the elevation of a given point with respect to given or assumed datum.

Surveying:- It is a technique or science of determining terrestrial or three dimentional position of point & the distancer & angles between them.

* **The Stadia System of Tacheometry:-**
(Stadia method)

→ In a stadia system of tacheometry there are two methods of surveying:-
i) Fixed hair method
ii) Movable hair method

i) **Fixed hair method:-**

→ Here the distance between the stadia hairs is fixed. When a stadia rod is sighted through the telescope and its certain length is intercepted by the stadia hair & from this value of staff intercept the distance from the instrument to staff can be determined.

Tangential method:-

In this method the diaphgram of the tacheometer is not provided with stadia hairs, the readings are taken by the single horizontal hair.

central hair req.

→ The staff consists of 2 vanes or tangents at a known distance apart.

→ The angle of elevation or depression are measured and their tangents are used for finding the horizontal distances and elevation.

Movable hair method:- In this method the staff intercept is kept constant but the distance between the stadia is variable.

→ The upper and lower stadia can be moved on adjusted by micrometer screws.

→ The staff is provided with 2 tangles at a known distance apart. During observation, the distance between the stadia hairs is so adjusted that the upper hair bisects the lower tangent.

Advantages of Tacheometry surveying:-

1) It can calculate the horizontal and vertical distances between the stations.

2) In this type of surveying there is no use of tape or chain thus slope correction, sag correction pull correction are rejected.

3) This method is very rapid and convenient.

4. It is useful for prepairing contours maps.
5. It is also widely used by engineers for carrying out survey works for railway, canals, reservers etc.

Errors in Tacheometry:

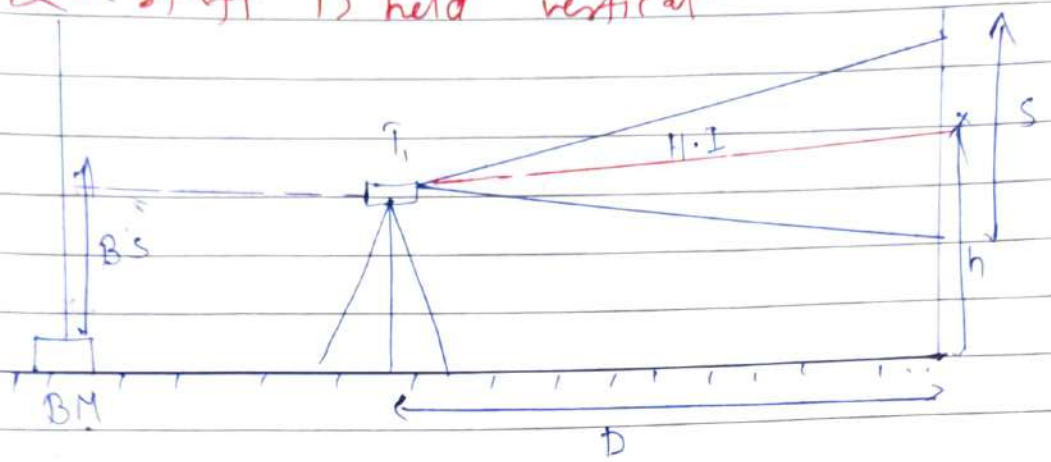
1. Instrumental errors
   (i) Imperfect adjustment
   (ii) Irregular division of stadia rod
   (iii) Incorrect value of the multiplying constant.

2. Error due to Natural Causes
   i) High wind
   ii) Unequal refraction
   iii) Unequal expansion

3) Errors due to Manipulation and sighting:

i) Inaccurate centring and levelling of instrument
ii) Inaccurate estimation of stadia intercept.
iii) Non-vertically of stadia rod
iv) Occurance of parallax.

When the line of sight is horizontal & the staff is held vertical.



$$D = (f/i)\,S + (f+d)$$

RL of staff station P = (H.I − h)

H.I = RL of BM + BS

Where $(f/i) = 100$ = Multiplying ~~addi~~ constant

$(f+d) = 0$ = additive

H.I = height of instrument

BS = back sight

h = central hair reading

S = staff intercept

BM = bench mark

I = instrument station

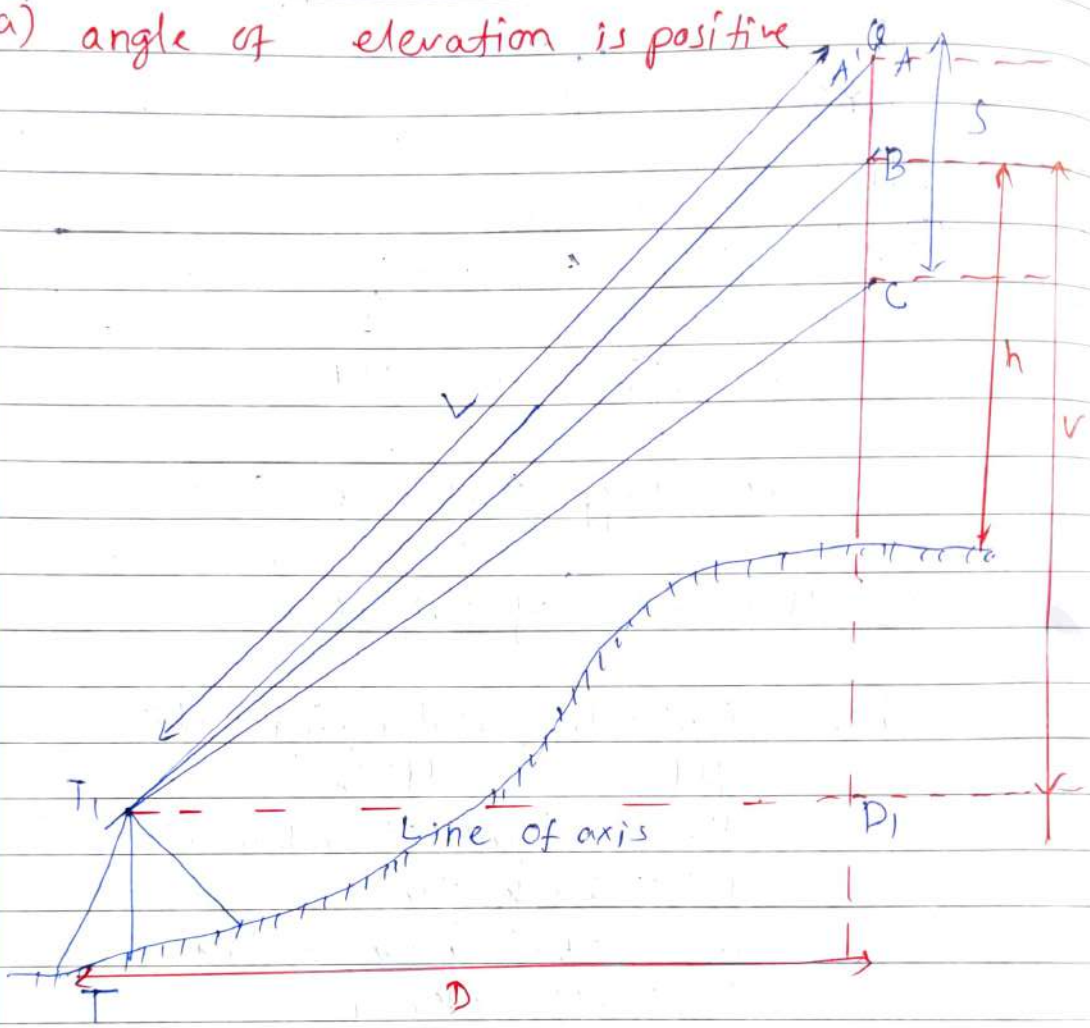
I_1 = axis of instrument

D = horizontal distance between staff and instrument station.

Case II

When the line of sight is inclined both staff is held vertical:-

a) angle of elevation is positive

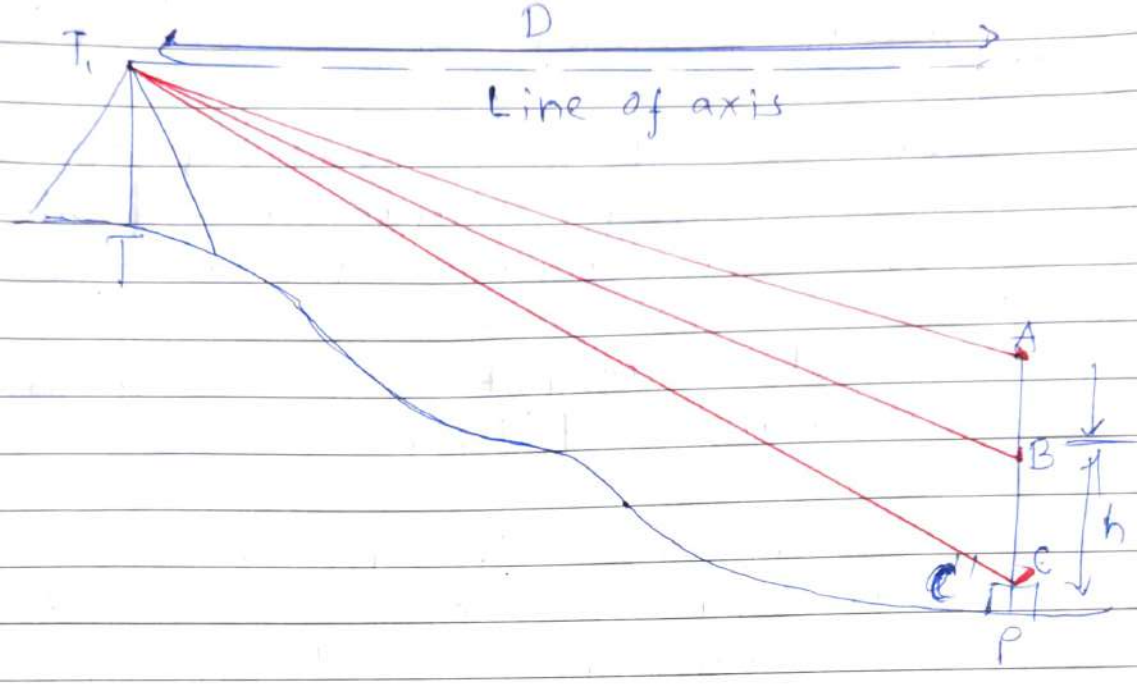


$$D = (f/i)\, s \cos^2\theta + (f+d)\cos\theta$$

$$v = (f/i)\,\frac{s \sin 2\theta}{2} + (f+d)\sin\theta$$

RL of staff station P = RL of Axis of instrument + V - h

(b) Angle of elevation is negative :-



$$D = (f/i) \times S \cos^2\theta + (f+d)\cos\theta$$

$$V = (f/i) \times \frac{S \times \sin 2\theta}{2} + (f+d)\sin\theta$$

RL of staff station P = RL of axis of instrument $-V-h$

Trilateration Traiangulation

It is the process of determining absolute or relative locations of points by measurement of distance using geometry of circle and triangles.

* It doesnot have practical application in surveying, navigation and global positioning system (GPS).

* It also doesnot help in measurement of angle and length.

Triangulation:- The process of measuring the angles of a network of triangles formed by no. of stations marked on the earth surface.

Classification of Traingulation:-

1. Primary / First order triangulation
2. Secondary / Second order tringulation
3. Tertiary / Third order triangulation

Primary triangulation:- It is the highest grade of triangulation system which is carried out for determining the shape and size of earth's surface.

* Its base line length is 8 km to 12 km and the length of sides

vary from 16km to 150km.

Secondary Triangulation:- It helps to connect 2 primary sesies and poovide control points closer than the primary triangulation.

* Its base line length varies from 2km to 5km and the length of side varies from 10km to 25km.

Tertiary triangulation:- It provide control points between stations of primary triangulation & secondary triangulation.

* It is also known as topo triangulation

* It's base line length varies from ~~2km to 10km~~ 100m to 500m. and the length of sides vary from 2km to
* 10km.

Purpose:-

→ To establish accurate control points for plane and geodatic survey.

→ For accurate location of engineering work and fixing the centre lines.

Principle:-

→ If all the three angle and length of one sides of a triangle is known then the length of remaining sides can be found out by trigonometry.

Total station

It is a combination of an electronic theodolite, an electronic distance meter [EDM] and a microprocessor is known as Total station.

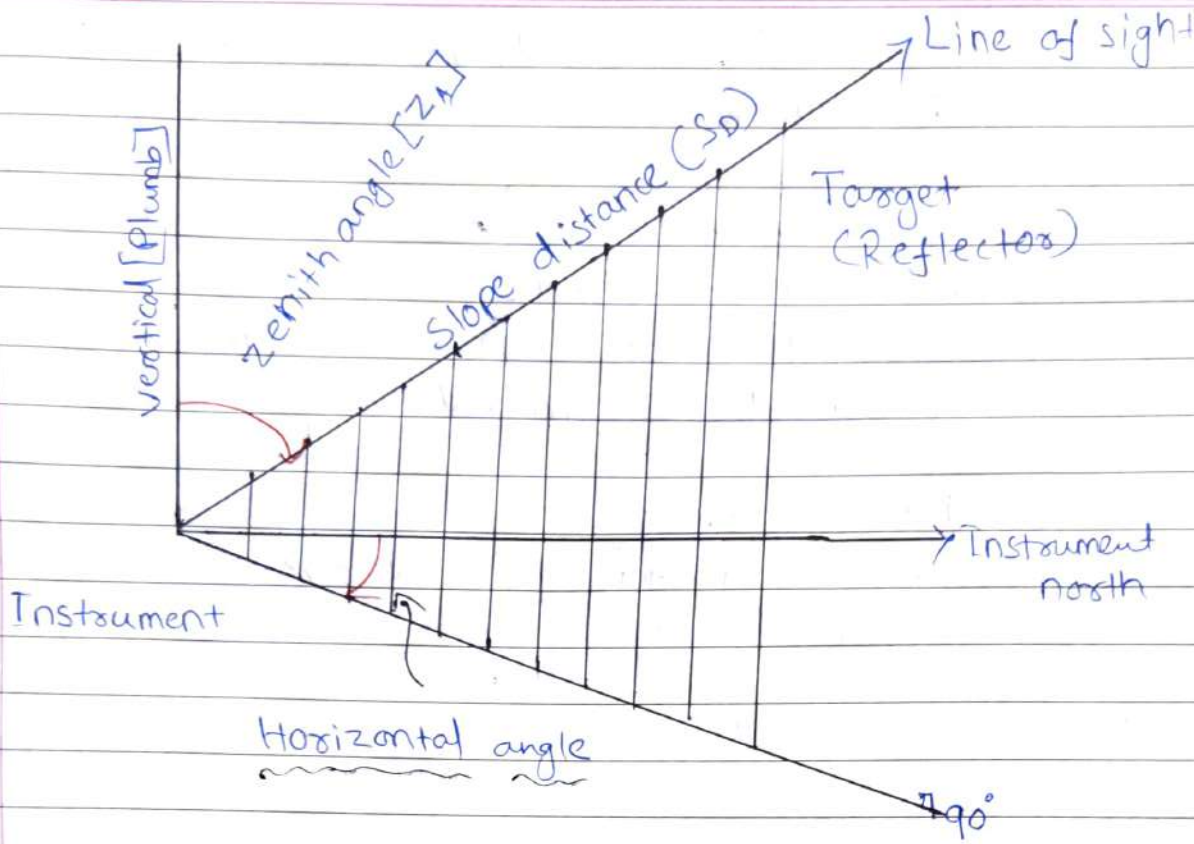
Theodolite and EDM combination determines the coordinates of a reflector by aligning the instrument cross-hairs on the reflector and simultaneously measures the vertical and horizontal angles and slope distances.

Recording, computation of readings will be done by the micro-processor chip in the instrument.

From any computer, the data from the total station can be easily recieved and it can be used to generate maps.

Working Principle: Total station measures 3 parameters when aimed at the object, namely

1. Horizontal angle
2. Vertical angle
3. Slope distance



Measurements made by a total station

Horizontal angle:-

The rotation of the instrument's optical axis from the instrument north in a horizontal plane is known as horizontal angle.

* When the user first setup the instrument the choice of the zero direction should be made. This is called instrument north.

* The zero direction should be set so that it can be recovered if the instrument wants to set up at the same location at same later date.

* This is usually done by sighting to another benchmark. In total station a magnetic compass

is not used to determine the orientation of the instrument as it can be very inaccurate.

* In total station, the instrument is to set a convinient north and carry this through the survey by using backsights when the instrument is moved.

Vertical angle:-

The inclination of the optical axis from the plumb line is known as vertical angle.

* The vertical angle usually measured as a zenith angle [0° vertical upwards, 90° horizontal and 180° vertially downward].

* While measuring vertical angle. The instrument should be truely vertical. Total stations contain an internal sensor [vertical compensator] that can detect small deviation of the instrument from vertical.

* The compensater can only make small adjustment therefore the instrument still has to be well levels in order to get correct vertical angle.

Slope distance:-

The instrument to reflection distance is measured using an electronic distance meter [EDM] is known as slope distance.

EDM uses a Gallium Aresnide diode to emit an infrared light beam The infrared beam is emitted from the total station, and some beam reflected by the reflecter and received and amplified by the total station. The received signal is then compared with a reference signal generated by the instrument and the phase shift is determined. This phase shift is a measure of the travel time and thus the distance between the total station and the reflecter is determined.

Chapter-3 Setting Out Curve.

Curves are usually employed in lines of communication in order that the change of direction at the intersection of the sight line shall be gradual.

⇒ The lines connected by the curves are tangential to it and are called tangents or straights.

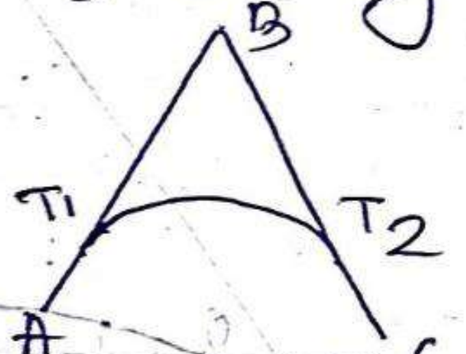
Types of Curve :-

- Types of Curve
  - Horizontal Curve
    - Simple curve
    - Compound curve
    - Reverse curve
    - Transition curve
    - Combined curve
  - Vertical curve
    - Scemmit curve
    - Valley curve

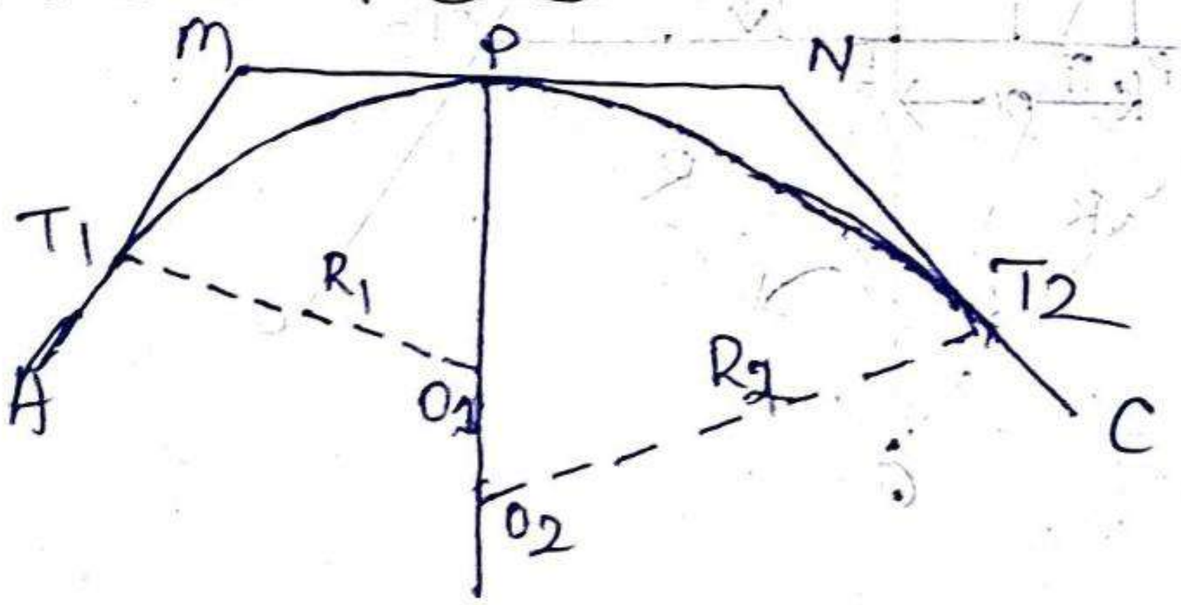
(1) Simple Curve :-

A simple curve consists of a single arc connecting two straights or tangents.

⇒ Simple curve is normally represented by the length of its radius or by the degree of curve.



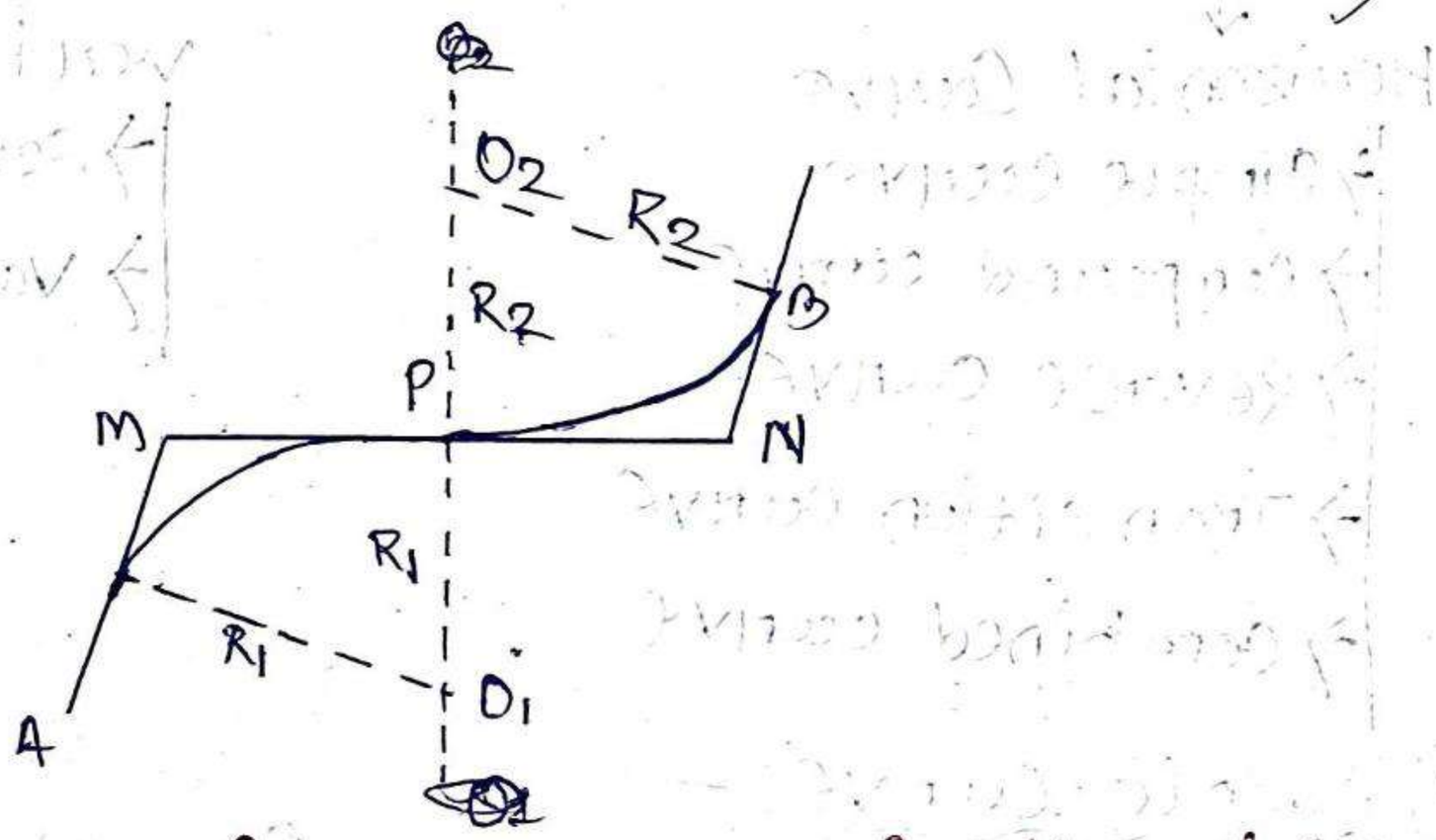
(2) Compocend curve :-



A Compound curve consists of two arcs of different radii curving in the same direction and lying on the same side of their common tangent, their centers being on the same side of the curve.

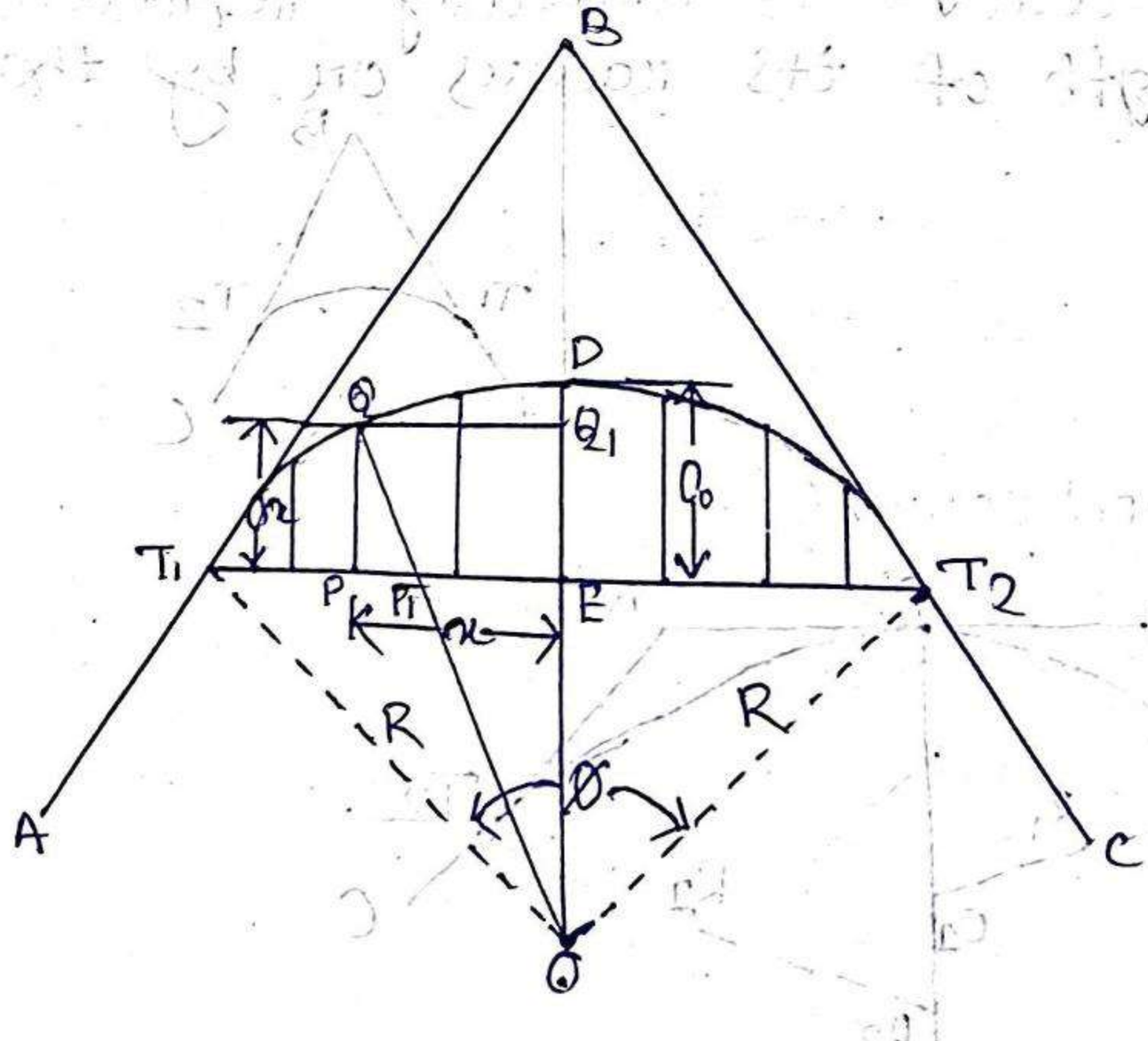
③ Reverse Curve:-

A reverse curve is composed of two arcs of equal or different radii bending or curving in opposite direction with common tangent at their junction, their centers being in opposite side of the curve.



Chain and tape (or linear) method of setting out curves

① By offsets or ordinates from the long chord:-



Let AB and BC = The tangents to the curve T_1DT_2
T_1 and T_2 = tangent points
T_1T_2 = the long chord of length L.
ED = O_o = the offsets at the midpoint of T_1T_2
PQ = O_x = the offsets at a distance x from E so that EP = x.
$OT_1 = OT_2 = OD = R$ = The radius of the curve.

The exact formula for the offset at any point on the long chord may be deduced as follows:-

Draw QQ_1 parallel to T_1T_2 meeting ED at Q_1
Join OQ cutting TT_1 in P_1.

Now in the ΔOT_1E, $OT_1 = R$; $T_1E = (L/2)$

$$DE = OD - ED = R - O_o$$

$$OT_1^2 = T_1E^2 + OE^2 \text{ or } R^2 = (L/2)^2 + (R - O_o)^2$$

$$O_o = R - \sqrt{R^2 - \left(\frac{L}{2}\right)^2} \longrightarrow (1)$$

Of the three quantities O_o, L and R, two quantities L and R or L and O_o are usually known. The remaining unknown may be calculated from the above formula.

From the ΔOQQ_1, $OQ^2 = OQ_1^2 + QQ_1^2$.

But $QQ_1 = OE + EQ_1 = OE + O_x = (R - O_o) + O_x$

$QQ_1 = x$; $OQ = R$.

$$R^2 = x^2 + \{(R - O_o) + O_x\}^2$$

or

$$O_x + (R - O_o) = \sqrt{R^2 - x^2}$$

Hence,

$$O_x = \sqrt{R^2 - x^2} - (R - O_o) \longrightarrow (2)$$

When the radius of curve is large as compared with the length of the long chord, the offsets may be calculated from the approximate formula, which may be deduced as follows,

In this case PQ is very nearly equal to the radial ordinate Q_2P_1 then $Q_2P_1 \times 2R = T_1P \times PT_2$

Now, $T_1P = x$

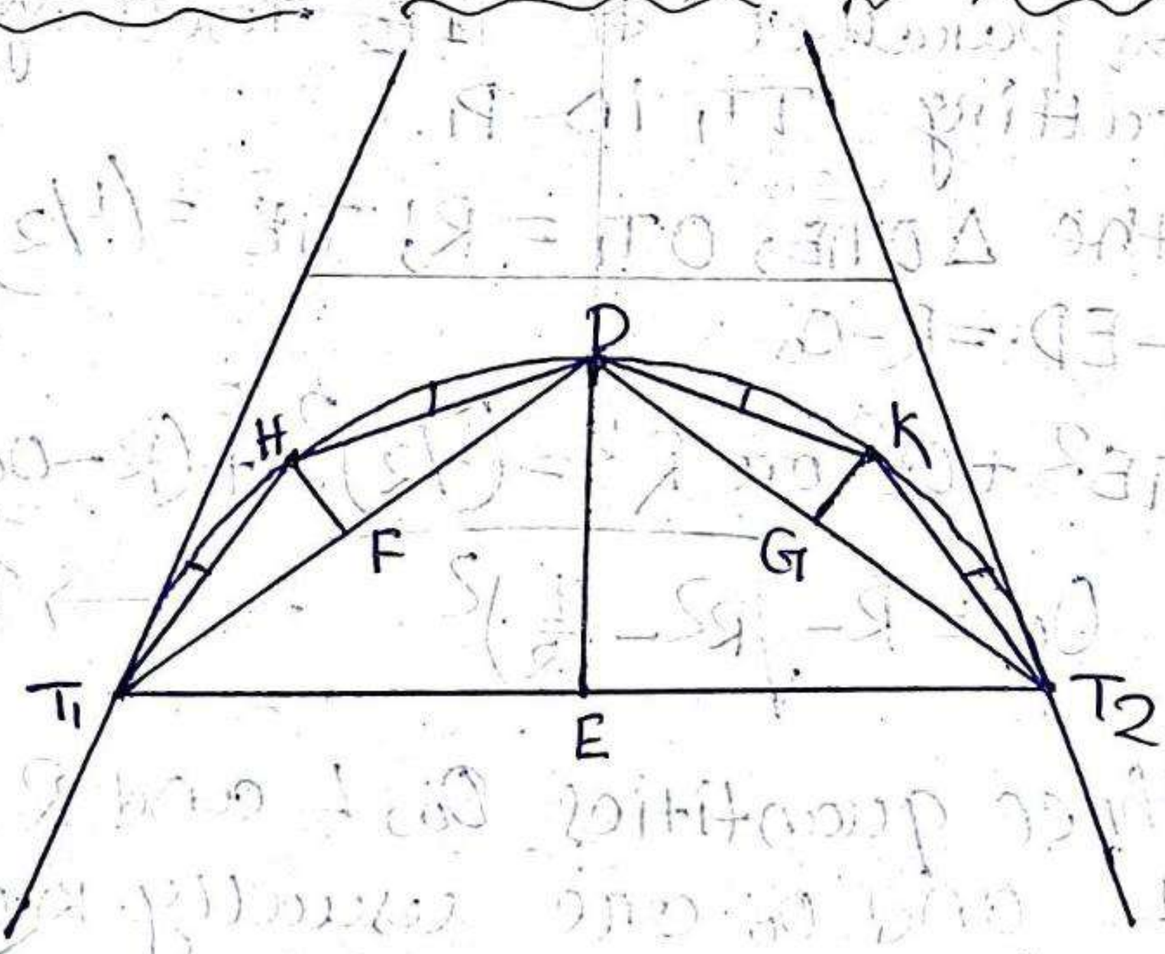
$T_1T_2 = L$

hence $PT_2 = L - x$.

$Q_2P_1 = Ox$

$$Ox = \frac{x(L-x)}{2R} \longrightarrow (8)$$

② By successive bisections of arcs:-



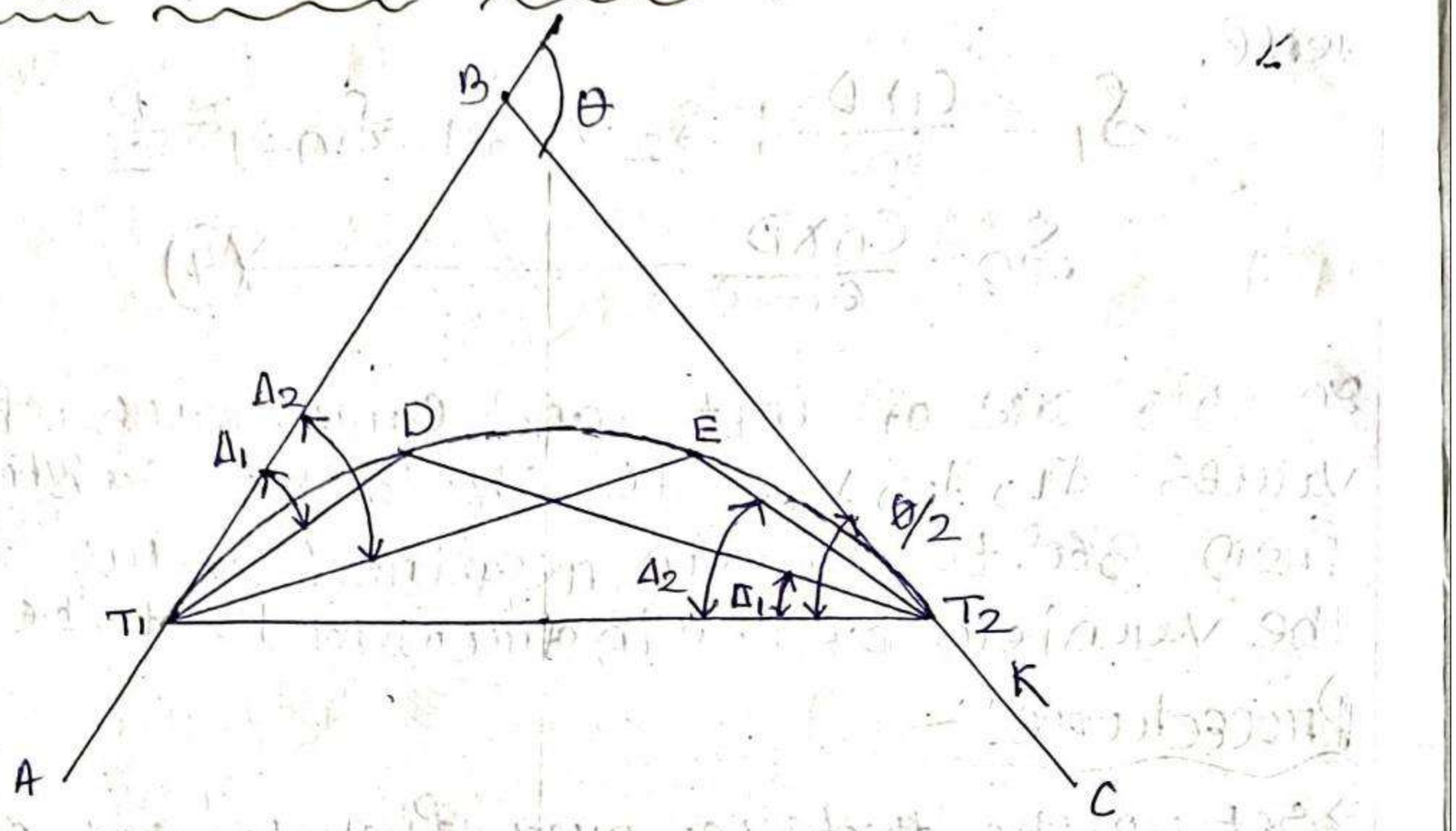
Let T_1 and T_2 be the tangent point. Join T_1 and T_2 and bisect at E.

Set oset the off set $ED = R\left(1 - \cos\frac{\phi}{2}\right) = R \text{ versin } \frac{\phi}{2}$

Thus determining the point D on the curve. Join T_1D and DT_2 and bisect them at F and G respectively.

At F and G set oset the off sets FH and GK each equal to $R[1 - \cos(\phi/4)]$, thus obtaining two more points H and K on the curve, By repeating the process, set oset as many points as required

② Two Theodolite Method :—



This method is used when the ground is not favourable for accurate chaining e.g. rough ground. It is based on the fact that angle bet^n the tangent and the chord is equal to the angle which that chord subtends in the opposite segment.

⇒ Let, D, E etc. be the point on the curve. The angle (A_1) bet^n the tangent T_1B and the chord $T_1D = BT_1D = T_1T_2D$.

Similarly, the angle $DT_1E = A_2 = T_1T_2E$, the total tangential or deflection angle A_1, A_2, A_3 being calculated as in the first method.

Procedure :—

⇒ Set up theodolite over T_1 and another over T_2.
⇒ Set the Vernier of each instrument to Zero
⇒ Direct the instrument at T_1 to the ranging rod at the point of intersection B and bisect it.
⇒ Direct the instrument at T_2 to the first tangent point T_1 and bisect it.
⇒ Set the Vernier of each of the instrument to read the deflection angle A_1. Thus the line of sight of the instrument at T_1 is directed along T_1D and that of the other instrument at T_2

along T_2D. Their point of intersection gives the required point on the curve.

⇒ move the ranging rod until it is bisected by the cross-hairs of both instrument, thus locating the point D, on the curve.

⇒ To obtain the second point on the curve, set the Vernier of each of the instrument to the second deflection angle Δ_2 and proceed as before.

Superelevation:-

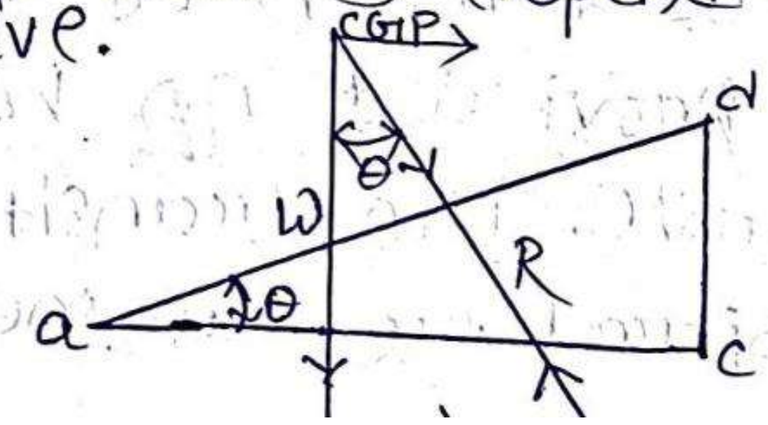
When a vehicle passes from a straight path to curved one, the force acting on it are.

(i) The weight of the vehicle.

(ii) The centrifugal force both acting through the CG of vehicle. Since the centrifugal force is always acts in the direction perpendicular to the axis of rotation which is vertical, its direction is always horizontal. The effect of the centrifugal force is to push the vehicle off the track or rail. In order to counteract the action, the plane of rails or the road surface is made perpendicular to the resultant of centrifugal force and weight of the vehicle.

In other word, outer rail is superelevated or raised above the inner one. Similarly the road should be "banked", i.e. the outer edge of the road should be raised above the inner one, the raising of the outer rail or outer edge above the inner one being called Scepper elevation or Cant.

The amount of Cant is depend on vehicle and radius of curve.



Let
W = weight of the vehicle
P = the Centrifugal force.
V = the speed of vehicle in m/s
g = the acceleration due to gravity = 9.81 m/s
R = the radius of the curve in m.
h = the superelevation in m
b = the width of the road in m.
G = the distance bet^n centers of the rails in m.

Then the equilibrium, the resultant of the weight and the centrifugal force must be equal and opposite to the reaction perpendicular to the road or rail surface.

$$P = \frac{WV^2}{gR} \quad \therefore \frac{P}{W} = \frac{V^2}{gR}$$

If θ be the inclination of the road or rail surface, the inclination of the resultant to the vertical is also θ, therefore we have

$$\tan\theta = \frac{dc}{al} = \frac{P}{W} = \frac{bV^2}{gR}$$

Hence the amount of superelevation h

$h = b\tan\theta = \frac{V^2}{gR}$ on Roads

$h = \frac{GV^2}{gR}$ on railways.

Objects of providing Transition Curves :-

⇒ To accomplish gradually the transition from the tangent to the circular curve, and from the circular curve to the tangent.

⇒ To obtain a gradual increase of curvature from zero at the tangent point to the specified quantity at the junction of the transition curve with the circular curve.

⇒ To provide the scepper elevation gradually from zero at the tangent point to the specified amount on the circular curve.

⇒ To avoid the overteering of the vehicle.

Types :-

The types of transition curve which are in common use are

(i) A cubic parabola.
(ii) A clothoid or Spiral
(iii) A lemniscate.

The first beint used on railways and third one on highways.

Chapter-4 Correlation Of Surface & U/G Survey.

Correlation

The purpose of correlation survey is determined with high degree of accuracy the relative position of the survey & U/G working features, so that the U/G working & the faces may be laid down accurately on the working plan & the statory restriction supposed may be strictly followed in mine workings.

A high degree of accuracy is regd in correlation survey otherwise the safety & elasticity of the mine workers & of the important survey features may be happened or jeopardised because of the distrubances & strata movement caused by mines.

The mine correlation involves the determination of the bearing & azimuth of a line below the ground with respect to a true north & also of the co-ordinates of one of the end station of the line called Reference line or Reference base. The degree of accuracy regd in correlation survey depends upon the purpose & the extend of the survey.

Direct Traversing Via mine Entry :-

When entry to a mine is gained by a level or a drift the method of correlation is carried out by a precise thedolite traversing direct into the working starting from a some one line of known bearing in the surface triangulation & making a return traverse so that the area should be closed polygonally.

In the course of correlation survey one or two U/G bases should be made for future references. When the survey are plotted on plan the U/G workings should be shown accurately with their true position meetings to the surface features.

The traverse must be carried out with great precision & all the temporary adjustment are done.

(a) Centering the instrument above the station.
(b) Levelling.
(c) measuring the length of each drift.

The angle bet' each pair of line should be measured at least 3 times with face left and 3 times with face right by the method of repition. The length of each drift should be measured several times & if need a spiral dead wt may be lifted at both ends of the drift to be measured, so that no sag formation will occurs.

Optical Method:-

This method involves sighters either up both the mine shaft with the transist instrument of some special form of telescope although not in use now bcoz this method was used in past in shallow mines.

(1) set up the base line at the pit bottom connected to the U/G survey & in line position of two points A & B across the shaft bottom.

(2) Plums the theodolite over a line of sight with the base line & transit up to two targets F & G placed across the shaft top.

(3) many pointers on the target are made to obtain the mean position of F & G.

(4) Repeat the operation 2 & 3 with theodolite at point e.

(5) The line joining the mean position of F & G on the shaft top is then produced either by a line wire under tension or by collimation in both direction

The optical method of correlation involves the use of special theodolite having a auxiliary telescope or have a bracket with the central hole for transistive the telescope for sights downwards do not give satisfactory result bcz of the shaft base bet^n the two reference point sighted at the bottom of the shaft with the instrument, set at the shaft top. The optical method of correlation is not suitable for shaft exceeding 500m.

Single wire in two Vertical shaft :-

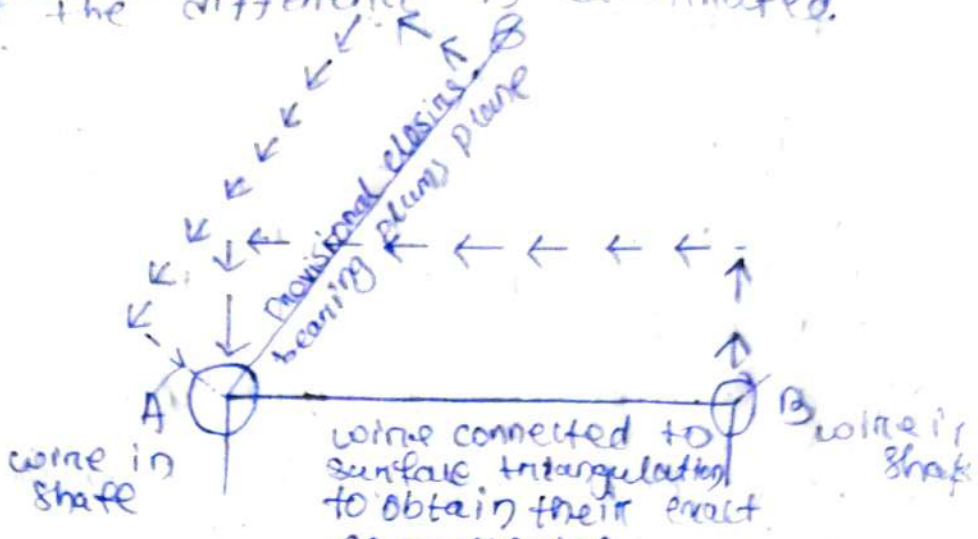
If both shafts are vertical, then correlation is carried out by means of two plums lines one suspended in each shaft. The position of the plums lines at the surface is incorporated to the surface triangulation & the length & bearing of the line joinigs the two wires is calculated in relation to ordinate or an assumed meridian.

A traverse is then made underground bet^n the two wires & their co-ordinates are calculated by reference to an assumed meridian. The bearing of the plums plane as calculated from the surface co-ordinates of the wire is taken as its true value & compare with the bearing of the plums plane calculated from the co-ordinates of the U/G traverse.

The difference in bearing is taken to be error in direction of the assumed U/G meridian & the whole of the U/G traverse has to be swing through this angle to brings the surface & U/G plums plane into coincidence.

If the surface coordinate is taken as the point of origin for the traverse calculation the coordinates of the other wire as obtain from the U/G traverse will not normally

agree with its surface values. The U/G traverse ~~normally agree with~~ therefore must be adjusted ~~so~~ that the difference is eliminated.



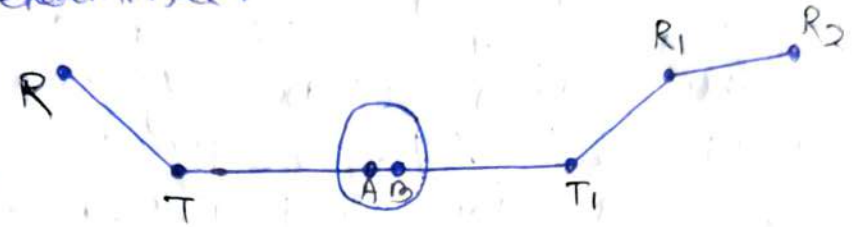
Coplannings or Exact Alignment Method:-

In this method the object is to place the centre of the theodolite exactly in line with the plumb plane. The theodolite on the surface will be exactly aligned & by observing angle between the plumb plane & nearest station the azimuth of the plumb plane can be determined.

The theodolite must be setup close to one wire about 3 to 3.5m away aligned firstly by eye, often alignted the third by eye. The instrument is attach & accurately level. The two wires will be observe the telescope is pointed towards the first & the nearest wire is then brought into focus if the telescope is out of line.

A scale can be placed behind the wire the approximately amount of movement of the theodolite can be calculated. When both wires are in line view through the telescope which means that the line of sight lies in the plumb plane. This must be transferred to the U/G.

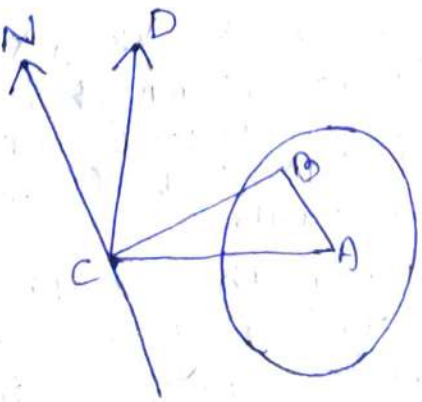
This can be done by measuring the horizontal angle $\angle T_1R$ from the coplanned station below the ground. The plane azimuth is determined on the surface & the azimuth of U/G lines can be determined. The length of the line can be measured & the co-ordinates of the station are determined.



Weissbach triangle Methods:-

The method involves settings up the theodolite to one side of the alignment position, so that its line of collination is almost in line with the plane plane, the angle of derivation being of the order of one or two units.

The arrangement of weisbatch triangle in its relation to the line CD joining two stations in the surface survey has been shown in Fig. The azimuth of CD being known the azimuth of the plane AB may be calculated, provided that the lengths of the sides of the triangle ABC, the angle DCA & also the small angle BCA are accurately measured.



The side of the ΔABC must be measured very carefully with a tested steel tape. When the angle at A & C are very small, the sum of the length of the two short sides of the triangle is virtually equal to the length of longest the difference being so small as to be scarcely almost not increases.

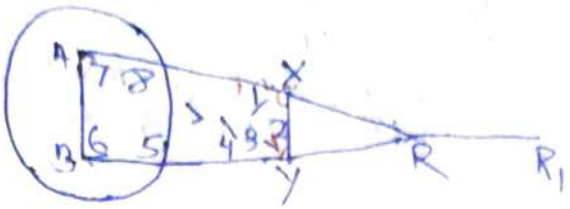
The distance bet) the weis bach station and the heaven wire should be as short as possible which will normally be governed by focussing the telescop. The plans plane BA must be as wide as possible. Although it takes the simplicity of coplanning, this objective is carefully & systematically applied is no less accurate.

Weis-Quadrilateral Method :-

The weisquadrilateral is formed by the two wires & the two instrument stations. Theodolites are set up at station X & Y and the angle 1, 2 & YXR are measured at X and the angles 3, 4 & XYR are measured very carefully by constant repetitions. The lengths of the sides of the quadrilateral and the diagonals are measured as a check on the angles although all the calculation involve the angular measurements.

The angle at R, YRX, XRR & YRR are measured, sufficient information have now been obtained to calculated the azimuth of the plans plane at the surface or the azimuth of RR blow ground.

Thus the azimuths of the lines are determined & eventually the co-ordinates of stations observations may be in from both sides of the staff if possible, several plans plane may also be used.



Precise Magnetic Correlation:-

In this method the magnetic bearing of surface and U/G base line are determined and then a traverse is carried out from each to a single plum wire suspended in the shaft. The magnetic azimuth of each line is determined and the difference applied to the grid bearing of the surface base will give the grid azimuth of the U/G base. The traverse will give the co-ordinate of the U/G.

Procedure:-

The method used the tabular Compass attached to the theodolite to determine the magnetic bearing of the lines. Two theodolites will be used. One on the surface and other U/G. The location of the surface base line and the U/G base line have got to be chosen with great care.

It is all possible the surface base line should be vertically above the U/G base. The station where the observation are to be taken must free from local disturbances. On the surface it is fairly easy to see whether there are disturbing influences very difficult to find around which is free from local attraction due to pipe lines, power cables and use of steel below ground.

The time of observation should be chosen carefully because of the vibration of the magnetic needle.

The two theodolites are set up on the stations and magnetic observation must be taken simultaneously on the surface & U/G

the observation are replaced at fixed intervals graphs are plotted of the observation. The following day the position of the two theodolites is reversed and the observation repeated.

Advantages!-

- The method entails little of no disorganization of the colliery routine.
- If there are several base lines in different levels ~~are~~ ~~or~~ ~~replaced~~ ~~at~~ ~~fixed~~ ~~intervals~~ these can all be oriented with little trouble.
- If sufficient care is taken it gives fairly good result.

Disadvantages!-

- A minor irregularity in the magnetic needle itself after the result serious.
- The results of the correlation are vitiated if the work is carried out magnetically disturbed day
- Besides the irregular variation, the secular & diurnal variation have direct influence over magnetic reading.
- There is possibility of change in the instrument contact during the period of transference from the surface to the U/G base.
- The stations where the magnetic observations are to be made must be free from local attraction.

Chapter-5 Stope Surveying.

Tape Triangulation :-

⇒ As the face advance, new stations are established nearer the face to facilities offsetting.

⇒ Suitable positions are selected near the face from which at least two stations in connection are visible.

⇒ Direct measurement are made bet' survey Pegs and selected stations.

Instrumental Survey! -

⇒ It is same that tedious but required for check survey.

⇒ Specially when the ore body is irregular from the station of the theodolite traverse are calculated and their positions are plotted on a horizontal projection which are conver to the plane of the ore body.

⇒ Peg to peg distance are measured by still tape horizontal & Vertical angle by theodolite

Determine Stope face! -

A 30m tape is held bet' two stope station with its 0 at the starting station near the face & right angle. offset from the tape to the sucessive points at the face are measure and booke. If the offsets are less than 1.2m then the graduated rod may be used instea of the 15m tape.

The tag line should be closer to the face It may some times be necessary for convient to hold the tape with its 0 at the station. peg and a mark on the face. The station thus omitted may be often by measuring and a chec right angle measurement may be made in addition.

In order to often and accurate stope u... a no. of measurement from the hanging w... to the foot wall are taken during the sur...

State preparation of stope plans, plotting the ... station & plotting of stope face to the mi... plan.

In underground ore body mining, the mining met... plays an important role in the stability of ... stope structure and ground pressure contro... However, with the gradual mining of ore bo... the horizontal pillar with a thin plate stru... may cause accidents due to instability. The... fore, the analysis and evaluation of mini... method of ore bodies can provide an impro... reference for this type of mine.

Domestic and foreign researches have cond... numerous studies on mining method and t... stability of stopes. At present, the mining meth... of metal ore bodies include continuous mining ... technology, ~~cond~~ ~~caving~~ ~~mining~~ filling mining technology, VCR (verti... Crater Retreat method) technology, and Cav... mining technology. For example, T.M. Ermekov... kes mine engineering obtains the key para... of pillar instability in the goaf and then ... analyzes the goaf stability. Zhao et al., u... FLAC3D numerical simulation technology ... on the optimization of the mining scheme i... Daijishan Tungsten mine. They obtained th... alternative and one mining schemes, which ... are further conducive to stope stability an... can improve the stope production capacity.

Rock is closely related to the axial loading rates, which is related to the mining method of coal seam, and the more confining pressure large, plastic features are more obvious. The present research selected the middle section (section 4#) of a mine in Jiangxi as the content and combines on-site monitoring, theoretical discussion, and numerical simulation to analyze the stability of the stope structure under different mining methods to provide reference for complex ore body mining.

Find Out the area of extraction by planimeter and calculation of triangle thereof.

The design of the stope structural parameter in room-pillar mining is mainly the size design of the room and pillar. In the design process, numerical simulation is generally used to perform comprehensive analysis, and the appropriate mining model is adopted to analyze the response of the surrounded rock and ore body in the design of different structural parameters, along with the structural and failure characteristics of the rock mass, the distribution of the 3D in-situ stress field, and the characteristics of the dominant structural plane of the stope. The rationality of the structural parameters is evaluated in accordance with the mechanical response of the rock mass.

Chapter 6 G.P.S & total Station.

GPS!

⇒ GPS is a global navigation satelite system they provide location, velocity and time synchronization.

⇒ GPS is every where. you can find GPS system in your car, your smart phone and your watch. GPS helps get where you are going from point A to point B.

⇒ The GPS System consists of three "segments" called the ① Control segment ② space segment and ③ user segment. proper operation of each of these three segments results in accurate reliable operation of the entaire system.

① Control segment!-

⇒ The control segments is composed of the main control center located at Falcon Air force base near Colorado Springs, Colorado, USA, and several monitoring and control stations located around the world.

⇒ These stations monitor the satelites, report the results to the main control center, and relay the control signal generated in Colorado back to the satelites.

⇒ The control segment stations are the only ones which transmit to the satelites.

⇒ The information they send to the satelites provides for positioning the satelites in orbit, provides data to be broadcast in the satelites. navigation messages and generally provides control of the satelite operation.

⇒ Part of the satelite broad cast data includes a health status.

⇒ The control segments is responible for detecting satelites that are not broadcasting properly

are that are not in the proper orbit, and commanding the satellites to identify themselves as unhealthy when circumstances warrant.

→ This allows the control segment to keep results obtained from using the system consistently within operating specification.

② Space Segments :-

→ The space segments is composed of a constellation of satellite orbiting approximately 20,000 km (about 12,500 miles) above the earth.

→ The full constellation is defined as 24 satellite but there may be more or fewer active at any one time.

→ The satellites are arranged in 6 separated orbits, each inclined about 55° with respect to the equator, with 4 slots per orbit designed to hold a satellite.

→ The orbit is traversed about 12 hours.

→ With a full constellation, receivers located on most spots on the earth can see at least 6, and sometimes as many as 12 of the satellites at any one time.

③ User Segments :-

→ The user segments is the term given to all of the receiver, listening to the satellites at any time.

→ There is no organization to the user segments but for any user, it consists of the receiver currently in use and its associated antenna.

→ User segment.

→ User receivers are passive — they need only listen to the space segment and not

broad cast anything, thus making the system accessible to any number of user at one time without user interfering with each other.

While all three segments operate at one time the typical user is basically unaware of the Control segment, and only concerns himself with the operation of his own receiver & the satellite actually visible at his location during his time of use. Further limitations in individual receivers may take the user aware of only some of the satelites visible at his location, since the receiver may only select a few of them to monitor.

Total Station

Total Station are the primary survey instrument used in mining surveying.

A total Station is used to record the absoult location of the tunnel walls ceiling (backs), and floores as the drifts of an underground mine are driven. The recorded data are then downloaded into a CAD program and compared to the designed layout of the tunnel.

The survey party installs Control Stations at regular intervals. These are small steel plugs installed in pairs in holes drilled into walls or the back. For wall Station two plugs are installed in opposite walls, forming a line perpendicular to the drift. For back Station, two plugs are installed in the back, forming a line parallel to the drift.

A set of plugs can be used to located the total Station set up in a drift or tunnel by processing measurements to the plugs by intersection and resection.