ARYAN SCHOOL OF ENGINEERING & TECHNOLOGY

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LECTURE NOTE

SUBJECT NAME- MINE SURVEY -II

BRANCH – MINING ENGINEERING

SEMESTER – 4TH SEM

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UNIT-1 : Tacheometry : Date-20, 03, 23

→ Tacheometry is a branch of angular surveying in which the horizontal and vertical distance of points are obtained by optical means are opposed (ବିପରୀତ)

→ To ordinary slower process of measurement.

→ To ordinary process of measurement the tape or chain method is rapplied is very although in accuracy tacheometry in general compass unfavorably with that of chaining

Instrument is used in Tacheometry surveying :

→ ordinary transit theodolite fitted with a stadia diaphragm is generaly used for tacheometry survey.

→ The stadia diaphragm essentially consist of one stadia hair above and another equal distance below, the horizontal crosshair.

→ The stadia hair being mounted in the same ring and in the same vertical plane, as the horizontal and vertical cross hair shows the diff. forms of stadia diaphragm commonly used.

Principle of Tacheometry surveying :-

→ The principle of Tacheometry surveying is based on the properties of isosceles triangle.

→ That is the ratio of the distance of the base from the apex length and the length of the base is always constant.

→ The formula for horizontal distance is determine.

$$H = Ks \cos^2\theta$$

where, H = Height / horizontal distance.

K = Multiplied constant.

S = Staff Intercept = (general taken has 100)
(top reading - bottom reading)

θ = Horizontal angle of tacheometry

→ The formula for vertical distance is determine.

$$V = (KS \sin 2\theta)/2 = H \tan\theta$$

where,

V = vertical distance.

K = Multiplied constant. (generally taken has 100)

S = Staff Intercept.

θ = Vertical angle of tacheometry

→ Thus after computing the vertical distance value the reduced level of the Instrument (RL), The Height of the Instrument (HI), central wire reading (R).

→ The RL of any point under observation can be calculated as,

RL of point = RL of Instrument station + HI of the Instrument ± (V - R)

V → Vertical distance

R → central wire reading

Procedure of Tacheometry surveying :-

→ Set up the Instrument above specified station and perpendicular at with reference of mean sea level.

→ Set the vertical circle vernier to '0' then with the altitude level module up its run, used in a measuring tape measured the Instrument height (The vertical distance from top of the peck).

→ Alternatively, the height may be found keeping the staff in a reed fixed before telescope and reading through object glass.

→ The magnetic meridian or real meridian can be used the reference meridian.

→ When the reference meridian is magnetic meridian, set one of the vernier to 0° and rotated the telescope around vertical axis. Relaxing the bottom clamp until the compass needle points north.

→ The correct bearing of the reference point or another station of the traverse with the reference the first station must be known in order to orient the instrument with reference to real meridian.

→ Take bearing, vertical angle, and the top, bottom and axial hair reading while holding the staff bench mark. (The line of site may be horizontal and Inclined).

→ If there is no local bench mark fly level from the nearby accessible bench mark and temporary bench mark concentrated near the reason.

→ The bearing, the vertical angle, staff reading are used to fixed all representative location under the Instrument station, command Observation.

→ The second station when the all the representative spots have been identified by the first station record the vertical angle and staff reading relative top, bottom and axial hairs.

→ Change the station of Instrument to the second as before, to set up, centre and level the Instrument and measured its height.

→ Take a back site of the first station also pay attention to the bearing, vertical angle and the staff reading, the top, bottom and axial hairs.

→ Since each station sighted with to value for station distance and altitude produced which must be with in the legal limit, other wise the operation must be redone.

* Stadia and Its principle :-

→ A surveying method here determination distance and diff. elevation. by means of telescope Instrument having to horizontal lines through which is the match graduated rod are observed.

Its principle :-

→ The stadia technique of tacheometry is a popular method adopted for calculating horizontal distance and vertical elevation.

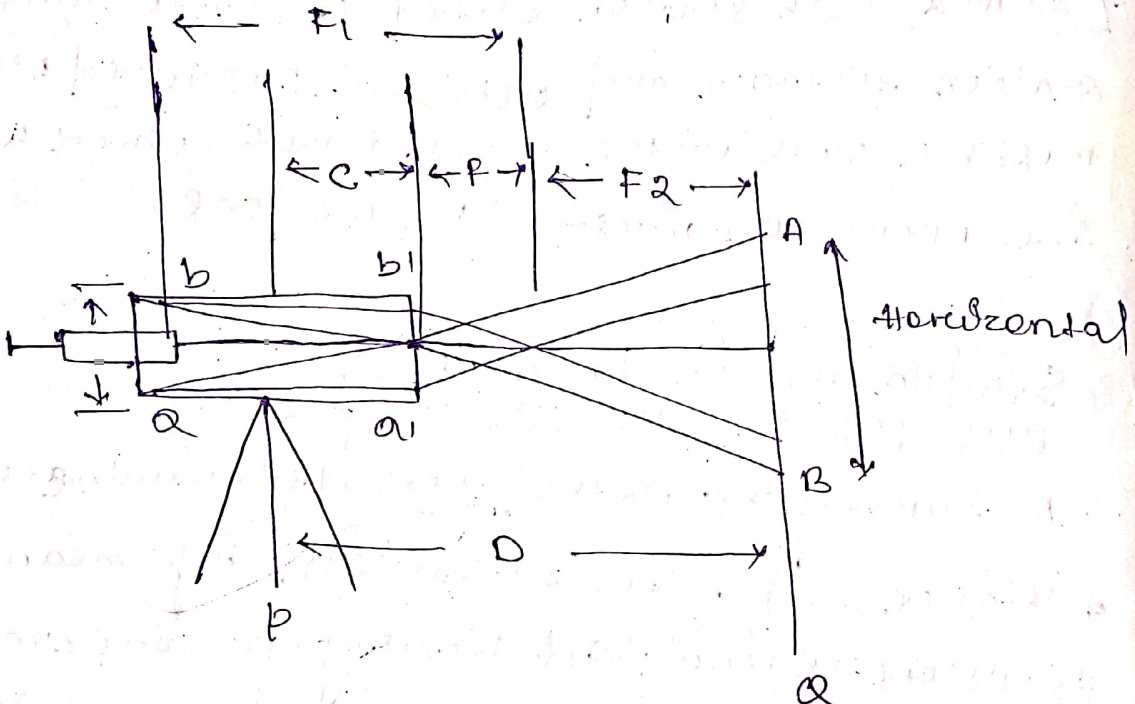
→ The horizontal distance between the staff station and the instrument station and the distance between staff station along the instrument line is computed using in the approach we know one observation, from the instrument station.

→ It is for there divided into two types.

(i) Fixed hair Method.

(ii) Movable hair Method.

(i) Fixed Hair Method :-

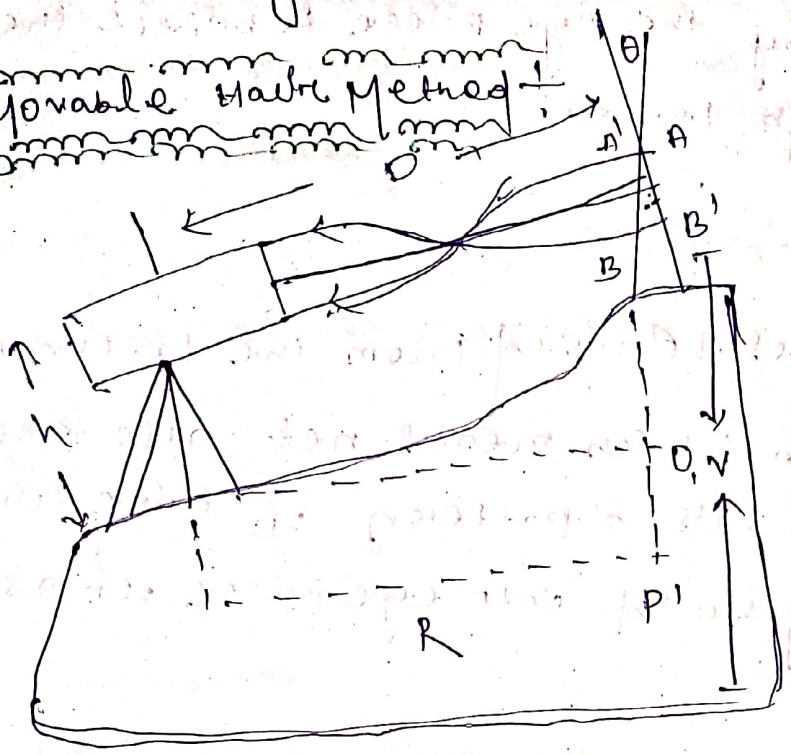


→ The device used for taking observation in this form of surveying at the instrument is two extra cross hair, one above and one below the centre hair.

→ Thus the stadia hair are three that are equal spaced.

→ Where observed by the telescope the stadia hairs are since intersects a specific length staff. This is the most often used tacheometry surveying approached.

(ii) Movable Hairs Method :-



→ In contrast to the stadia technic the telescope connected to the instrument in the movable hairs method comprise movable cross hairs.

→ The centre hairs can be also will be fixed movable cross hairs.

→ The stadia interval is calculable by this manner perpendicular staff position the horizontal distance calculated. Gradge is used the fixed distance target.

*Define diaphragm :-

diaphragm is provided in front of eyepiece. It contains cross hair made of dark metal w are arranged perpendicular position to each other hair used by the eye piece to bisect the Ob -tive through lense

*Reticule :-

A reticule derived from the latin word reticulum which means net also known graticules. is a pattern of fine lines, or marking build into eye piece of a sighting device.

*Tacheometry :-

→ A tacheometry is essentially nothing more than a theodolite fitted with stadia hairs is generally used metric surveying.

→ The stadia diaphragm consists of one stadia hair above and the other at equal distance below the horizontal cross hair. The stadia of hair are kept in same vertical plane at the horizontal and vertical cross hairs.

*Instrument constant :- (electronic distance (edm) measurement)

The Instrument constant is the extra distance measurement the from the Instrument axis

to the measuring device.

Unit-2 Date-25.05.23

Triangulation and Trilateration

The horizontal position of point in a network developed provided accurate control for subsidiary survey can be obtained by three method.

(i) Triangulation.
(ii) Trilateration.
(iii) Traversing.

(i) Triangulation

Triangulation is process of determine the location of point by measuring only angle to it from known point at either end of a fixed base line by using trigonometry.

Operation in triangulation survey

- The field work is carried out in following operation.

→ Reconnaissance / Reconnaissation. (Before preparation of a plane)
→ Station preparation.
→ Base line measurement.
→ Measurement of angle.

Purpose

→ Establishing accurate located control points for the plane and geodetic survey of large area.

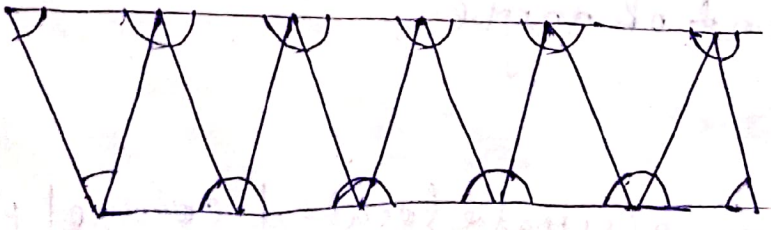
→ Extablished accurately control point in connection with area surveying.
→ accurate location of engg. project such as centerline, terminal points and shaft & long tunnel or long bridges.

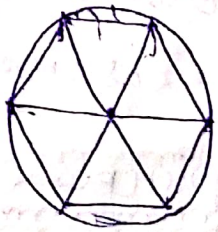
Principle :-

→ A system consisting of triangulation stations connected by a chain of triangle,
→ The complete figure is called triangulation system.
→ The common type figure are used in triangulation.
(i) Triangle (ii) quadrilaterals.
(iii) polygon.

(i) Triangle :-

→ The sum of internal angle should be (2n-4)x
n = no. of side of figure.
→ If all the angle are measured at a station there are sum should be 360°.
→ The length of the side should be measured through more than one routs.





advantage :-

→ This is simple and rapid method.
→ economically cost method.

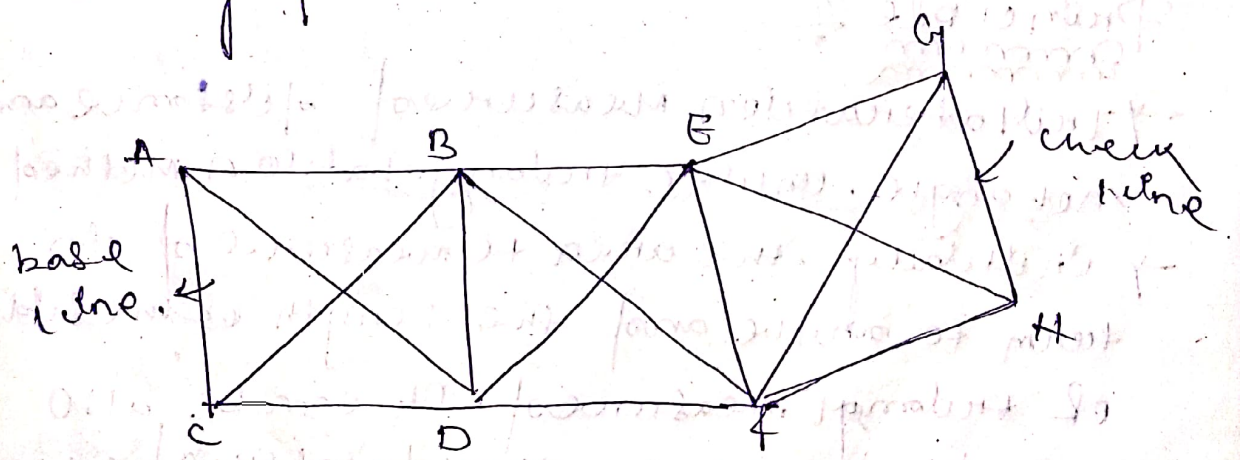
Disadvantage :-

→ since it is used to survey along narrow strip, A no. of base line must be introduced frequently to required the accumulation of errors, therefore a single chain or triangle is never permitted in high order triangulation.

Quadrilateral method :-

→ This efficient and exact system since the various combination of side and angle can be used to compute the length of remaining side and check can be made frequently.

→ The best quadrilateral is square, quadrilateral with both diagonals having no station at there intersection is usually employed.

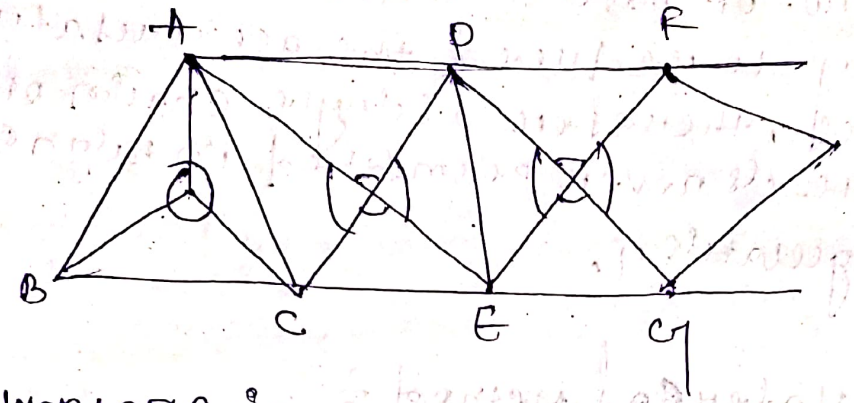


Advantage :-

→ Most accurate method as no. of check are more.

Polygon :-

→ When area that are very wide in proportion to there length are to be surveyed then pentagonal and hexagonal figure may be considered.



Advantage :-

→ This is more accurate as the offsets are more shorter.

* Trilateration :-

→ It is a surveying method used to determine the horizontal position. In addition to other method like triangulation, intersection, resection.

Principle :-

→ Trilateration measured distance and not angle. unlike triangulation method.

→ In this, the area to measured in term to angle and the length of the side of triangle measured. It can be also called polygon. or closed traverse or any combine them.

→ The distance are measurement using electronic instrument or a suitable instrument.

→ The angle of triangle or co-ordinate of vertise are determining using trigonometric comparation. sin rule and cos in rule are used to determine the triangle

→ This means the method doesn't involves the measurement of angles.

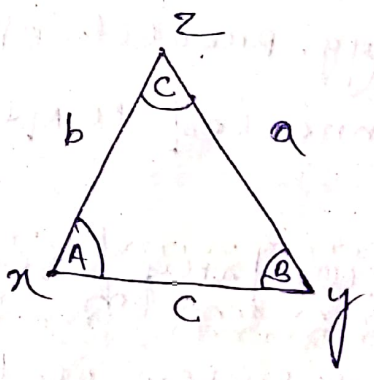
→ In order to the check the accurate of angle from the trigonometric observation horizontal angles are some time measured.

→ once the angles of a triangl are computed the trilateration is adjusted the co-ordinate of the station are determine,

→ When trilateration used for navigation astronomic, engg. or mapping, azmeth is an angular measurement in a spherical co-ordinate system that is measurement in degree

Formula :-

$$\cos x = \frac{(b^2+c^2-a^2)}{2bc}$$



$$\cos y = \frac{(a^2+c^2-b^2)}{2ac}$$

$$\cos z = \frac{(a^2+b^2-c^2)}{2ab}$$

$$\sin x = \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin c}$$

Q. Method of Triangulation Survey ?

(i) primary or first order triangulation method survey.

(ii) secondary or second order triangulation method survey.

(iii) Tertiary or third order triangulation method survey.

(i) primary / First Method survey :-

→ This system of triangulation survey is highest form and it provides the framework for nation control network for sub sidiary triangulation stations.

→ primary triangulation survey is generally connected for determination of shape and size of earth.

→ For earth crustal movement study in areas of seismic activities for engg. project of high precision and survey connected to metered urban areas.

(ii) Secondary / Second Method :-

→ This system of triangulation survey is of the grade slightly lower than that the primary triangulation survey system.

→ General a second triangulation survey is provided within a primary

triangulation system.

- It provides control points closer than those of the primary triangulation sur-
- -veysystem.
- The secondary triangulation survey are connected to the primary triangulation system are various points.
- This are used for detail survey the area where great accuracy is not required.
- It is used to extablished control for inter
- -state and inland subdivision.

(iii) Tertiary / third method :

- The system of triangulation survey each of the grad is lower than secondary triangulation system.
- It is used to provide control points bet
- -ween station of primary and secondary triang
- -ulation survey system.
- Tertiary triangulation system are used to extablished control for real development topographic survey : hydrographic survey and other such project where lower accuracy can be accepted.
- It is also known as Topotriangulation

as it is normally used to for providing control in topographic survey.

2marks

* Reconnaissance survey :-

The Reconnaissance survey is an extensive study in entire (total) area that might be used for a road or air field.

Develop / Designed Concept of Reconnaissance survey :-

→ Designed and Military characteristics should be considered during the Reconnaissance survey keep it mind that future operation may required and expanded area net.

→ A study of relief plane and specifications is necessary, if this are unavailable.

→ To cate portion of new road along or over existing road, rail road, trails whenable to possible.

→ locate a road along ridged and stream line, keeping ~~dangerd~~ of hinged system to a minimum, keep the grand when above the high water line in as them.

→ select a route as near to sources of material as practical and locate a road along contour line to avoid unnecessary to earth way.

→ locate the road on side of hills and canyons on that side of canyon wall where the in situation strata tends to support the road rather than cause to the road side to canyon.

→ select location where conservive engg. accept. avoiding rock work are excessive clearing.

Date-06.04.23

Types of theodolite used in triangulation surveying ?

There are Mainly Four type of theodolite is used in triangulation surveying.

(i) Repetating theodolite.
(ii) Directional theodolite.
(iii) Electrical digital theodolite.
(iv) Total station.

(i) Repetating theodolite ?

→ The desired facilated horizontal angle to be made any no. of times and added directly to the instrumental circle.

→ This type of instrument are restricted for location where.

(i) The support is not steady.

(ii) area for using other such instrument is limited.

(ii) Directional theodolite :-

→ angle are obtained by deducting the first direction reading from the second direction reading this reads direction rather than angle. non repeating instruments are has no other motion.

(iii) Electrical digital theodolite :-

→ Naturally (auto) interprets and record horizontally and vertically angles.

→ eliminents the standard reading of scales on graduated circle.

(iv) Total station :-

→ The total station accepted the term of theodolite for measuring angles, and "EDM" for measuring gaps. Digital data and information and documentation are done in total station theodolite.

Ex :- Nikol DTM 801, TOPKON and Geodimeter 400 series.

* Describe the Method of Base line Measurement using E.D.M ?

Base line :-

→ The line on which the Ream one of the survey is built it is known as Base line.

→ The Base line is most essential line of the survey and It is usually the longest of the main survey line and lies Fairly in the middle of the ground contributed angles as a reference line.

→ This line should be chosen on very level ground and measured very carefully and pressed.

Selection of Base line :-

→ The location is chosen in such away that the main surveying principal are strictly followed.

→ The station point on site is inter visible

→ The terrain is sum what flat consistently slope softly undulating.

→ The site is selected that well conditioned triangle is formed.

→ The longest of main survey line is the base line.

→ The main survey line run near the boundary line of area survey.

How to measured the Base line?

→ In surveying process such as triangulation, trilateration and setting out base line measurement is critical.

→ The invention of electromagnetic distance measuring Instrument, base line measurement where equipments such as tape, chain and EDM.

→ There are mainly two method are used in measuring base line.

(i) Conventional method.

(ii) EDM (electronic distance method)

(i)* Conventional method is divided two types!

(i) wheeled method

(ii) taping method.

(ii) EDM:-

Determination of EDM 'o' correction:-

→ The approach for determining the zero correction of EDM is divided into long straight line into parts.

→ To approach for determining zero correction of an EDM is divided into long straight line into parts.

→ The angle for each section measured as well as the length line and the zero correction is computed.

(2) Setting out OR Base line :-

→ A theodolite and ranging rods are used to set out the base line, set of theodolite on the starting point after a pillar has been placed.

→ The direction is define by pointing the theodolite in the predetermine the direction.

→ Used the EDM work in conjection with the theodolite and battary fixed it has to be then set over pillar and level to the reflectors too.

→ The hight of EMD instrument and reflectors hight are measured with line tape and record in the field book.

EMD Measurement :-

→ To measured any distance simple compared to be known calibrated (ക്രമീകരിച്ച) distance for example by using scale or tape to measured the length of object in EDM the same comparision principle is used the calibrated distance in this case the wave length of the modulation and carrier wave.

→ Moreden EDM used the precession of a quartz crystal oxylator and the measurement of the shift fit. to determine distance.

→ The EDM is set up an one end of distance to be measured and a reflector at the other end.

→ The EDM generated and intricate continuous wave carrier beam which is modulated by an electronic shutter, (ఎలక్ట్రానిక్ షట్టర్)

→ The reflector return the beam to the receiver optics where the incoming light is converted into an electrical signal along a phase compared both transmitted and Received signals.

→ The amount by which the transmitted and received wave length about of phase can be measured electronically and Results on a meter to within a millimeter or within two Millimeters.

(V.V.I)

* Tape Correction :- (tape - synthetic rubber)

In surveying tape correction refers to correcting measurement for the effect of slope angle and expansion or contraction due to temp^n and tape sag which varies with the applied tension.

Tape Sag :- (టేప్ కుంగడం)

When tapping both the points, the tape upon ends suspension above the ground due to the weight of the marked

Tape correction is used in surveying :-

- Correction for standardization.
- correction for slope.
- correction for pull.
- correction for temp^n.
- correction for sag.
- normal tension.
- correction for misalignment.
- reduction of length to means sea level.

* Correction for standardization :-

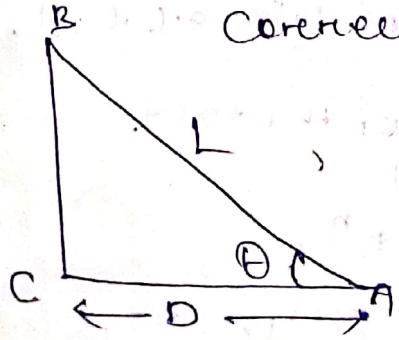
Correction (C_s) = $l' - l$

where, l = nominal length of the tape

l' = actual length of the tape.

Correction is +ve when the actual length is greater than the nominal length, and the correction is -ve when the actual length is smaller than the nominal length.

* Correction for slope :- (always -ve)



Correction for slope (C_s) = $L - D$

$= L(1 - \cos\theta)$

$= \frac{2L \sin^2\theta}{2}$

Where,

O = Horizontal equivalent.

L = Slope distance

θ = angle of slope.

* Correction for pull :-

→ If the pull is applied the applied of tape at end of the tape during measurement the field is of the same as the standard tension at which the tape was calibrate of a correct pull is required.

$$C_p = \frac{(P - P_0)L}{AE}$$

where, P = pull applied during measure

P_0 = pull applied standard pull.

L = measured length,

A = cross sectional area of tape,

E = Young's modulus of material in the tape

* Correction of temp^n :- (±)

$$C_t = \alpha (T_m - T_0) L$$

where, α = co-efficient of linear exp,

T_m = mean temp^h of the tape (during)

T_0 = standard temp^n.

L = measured length.

→ A tape is supported at two ends. It takes the shape of the catenary, the correction sag should be applied as the horizontal cut, length is always shutter than curve length.

→ when end of the tape are at insame level the sag correction is giving.

$$C_{sg} = \frac{l_1 (W l^2)}{24 P^2} = \boxed{\frac{W^2 l_1 l^3}{24 P^2}}$$

where, W = weight of the tape per unit length

l = length of the tape suspended between the support.

P = applied pull.

* Normal tension :-

$$C_N = \frac{(P_n - P_0) l_1}{AE} = \frac{l_1 W^2}{24 P_n^2}$$

$$24 P_n^2 (P_n - P_0) = W^2 AE$$

$$\boxed{P_n = \frac{0.204 W \sqrt{AE}}{\sqrt{P_n - P_0}}}$$

* Tape correction for Misalignment :-

$$C_M = \left[L_1 (1 - \cos\theta) + L_2 (1 - \cos\theta_2) \right]$$

$$= \boxed{\left(\frac{d^2}{2 L_1} + \frac{d^2}{2 L_2} \right)}$$

If $L_1 = L_2$ then $C_m = d^2/L$ (-ve)

* Reduction or length to measure of ment Mea
Sea level :-

$$C_{M.S.L} = \frac{Lh}{R+h}$$

$$\boxed{C_h = \frac{Lh}{R}} \quad (\text{'R' value} = 6370)$$

Date: 13/04/23

* State Construction of triangulation stat
-on of Permanent Nature :-

The following points should be consider
fixing triangulation station.

→ Carefully study of all available surface plan
the area,

→ The station point should be show clearly
the station of each triangle are Inter visible

→ All station should be easily accessable.

→ they should be fixed on Foundation
(Rock surface).

→ They should be from well conditions triang
e.

→ station should not be located in an area
under extraction.

→ After traversing all above Followed by Consolation, the station should be permanent mark.

→ For permanently marking of station cement board, sand, cement, brick may be used and the height of pillar should be 2 to 2.5 M.

→ Correlation of surface and U/G survey :-

Co-relation of surveying is method of surveying by which the surface survey and U/G survey are connected to the same baseline

Purpose of Co-relation survey :-

→ To determine the high degree of accuracy

→ The relation position of U/G road and roads may be correctly left down on the working plane

→ To fixed the boundary line, for limiting of extained or can U/G working.

→ To fixed the position of the railways, road and Important building and structure on mine plane so that the statutary restriction Imposed may stop Focused during working under them.

→ During the march river, lake, road or mine plane so as to taken precaution Ingress when suddenly flow the water in mine).

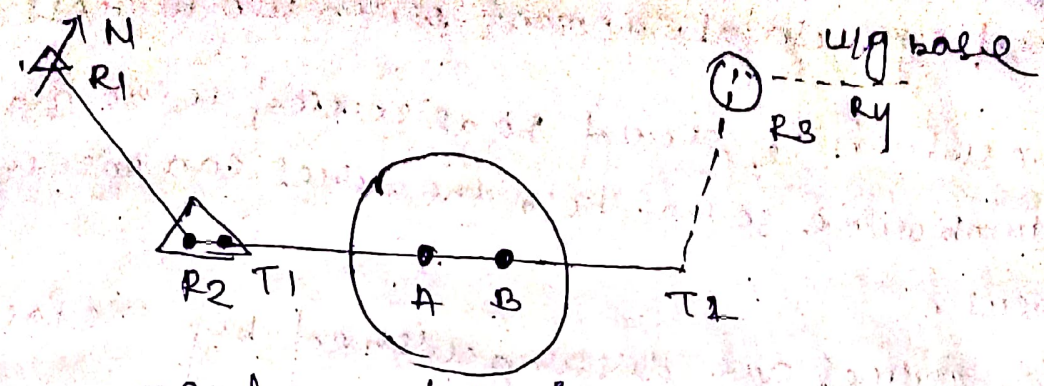
→ To select suitable site for purpose. prepare & drift or benches to connect with u/g work-ing.

* Classification of co-relation survey

- Direct traversing via mine entry
- Precise magnetic method
- Optical transfer
- Shaft plumbing
  - One wire in each two shaft
  - Two wire or more in a single shaft
    - Co-planning or exact alignment
    - Weisbach or approach alignment method
    - Weiss quadrilateral method
- Gyro-theodolite method

Co-planning or exact alignment method :

The co-planning or direct traversing alignment method consist of setting of theodolite in the plane of two plumb lines in a one shaft at the surface and u/g, and thus transforming the bearing.



Instrument Required :-

- Two hard piano wires each 0.1 cm diameter having breaking strength of 1500 kg and of sufficient strength to cover the shaft.
- Two small drums fitted with brake or ratchet
- Two biconical wooden plummet weighing 8 kg each.
- Two symmetrically shaped lead plumb bob weighing 25 kg each and fitted with vanes to dampen the oscillating motion when immersed in water
- Two small pulley, T-washers, bucket of water.
- A theodolite preferably micrometer type with telescope & level.
- Steel tape, thermometer, spring balance.
- Scale for determining mean position of wires.
- Field book, pencil, drawing paper, safety lamp, oil, nail, paints etc.

Procedure :-

- From the surface traverse two stations R_1 and R_2 are fixed at surface, base
- The theodolite is set at station T_1 marked on the surface near to the shaft, Judge by

named eyes in alignment with the wires.

→ The station T_2 should be as close to the near plumb wire so that both the wires can easily focus.

→ The wires are distinguished by the fact that the near wire is thicker.

→ Do all the temporary adjustment at the station T_1 and set the vernier zero.

→ The angle $\angle AT_1R_2$ is measured and take the angle $\angle R_1R_2T_1$. Distance R_2T_1, T_1A and AB are measured very precisely.

→ The assuming of the plumb plane AB and the coordinates of A and B with the surface base line R_1R_2 are calculated.

Precautions :-

→ The two wires in a shaft should be at convenient distance

→ Lead or brass plumb bob must be used in plumbing a shaft to eliminate magnetic attraction.

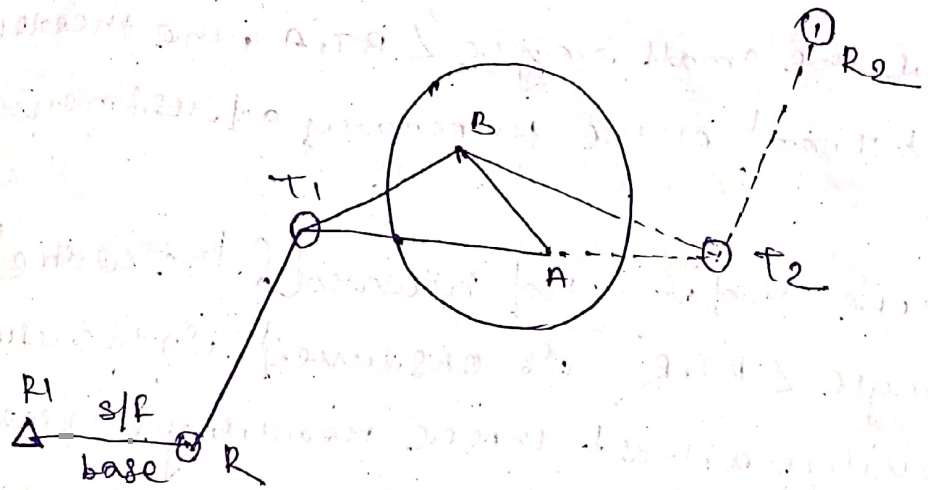
→ The plumbob must hang freely and must be free from ~~twist~~ twist.

→ Air current should be minimised by stopping the fan during an atleast one hour before the observation.

→ The wire must not stick against the sides of bucket of water.

- The permanent adjustment of the theodolite must be checked before the survey work.
- It is possible of observation from both sides of the shaft.
- All angle should be measured correctly by reiteration Method.
- All sides should be using both using face of the instrument.

We use Weissbach triangle Method ⇒



- When traversing ground level across under-ground by succession two wires down a shaft it is difficult to set the theodolite exactly on line with them in addition are wire being nearer obstruct the wire beyond, leading to an inaccurate by setting.
- In Weissbach Method the need arise set up out of line forming a small triangle with the two wires. this triangle between and Weissbach triangle, and the azimuth on the line joining the wire is found by use of triangle solutions.

Procedure :-

→ From the surface traverse station R, angle fixed at the surface base whose azimuth is very carefully determined.

→ The theodolite is set at T_1 at the surface as close to the near vertical B as possible and almost in line with the plumb plane AB. Pressure connecting to the surface base.

→ The small ang $\angle BT_1A$ should be only few minutes and the ΔABT_1 is known as well base triangle.

→ To measure the small angle $\angle BT_1A$, the theodolite is set up at T_1 and all the temporary adjustments are made.

→ The telescope is directed towards the vertical and the angle $\angle BT_1R$ is observed in the usual manner taking at least three readings spread all the face of the instrument.

→ In a similar manner the value of angle $\angle AT_1R$ is obtained and the difference between the two angle thus obtained is the correct angle of $\angle BT_1A$.

→ To calculate the azimuth of the plumb plane AB, the small angle $\angle T_1AB$ must be calculated.

$$\frac{BT_1}{\sin A} = \frac{AB}{\sin T_1}$$

→ The angle ∠AT2R2 and ∠BT2R2 are also being measured and the azimuth of the line T2R2 can be calculated.

Precautions →

→ The plumb line must be vertical and must be free from any obstacles.

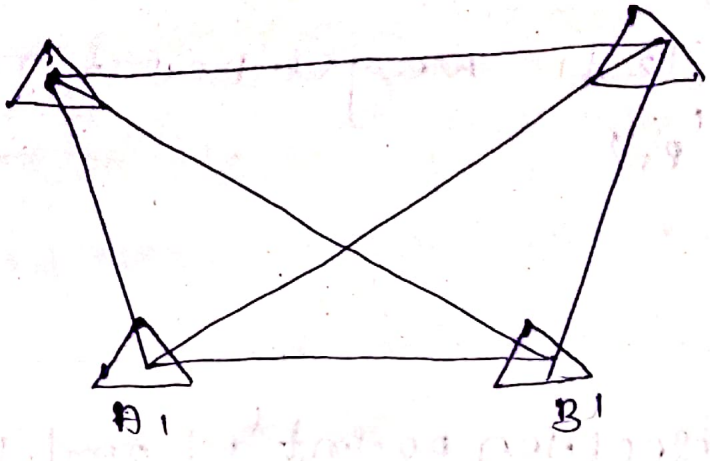
→ The plumb lines must be as much distanced apart as possible.

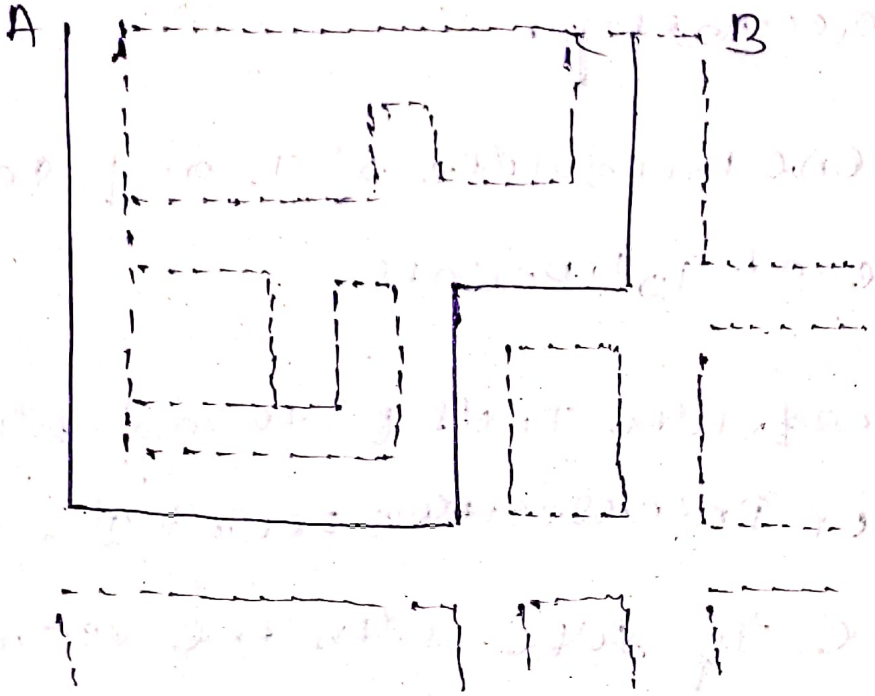
→ The Weisbach triangle must not exceed 30° when to avoid great precision in the measurement of sides.

→ To ensure accuracy 2 or more positions of the plumb wire may be observed.

the closer one ()

* Describe Orientation between two shafts.





→ When two shaft are available for surveying cause one of the most suitable for co-ordinate ~~one of the most~~ and ug survey is to hang an plumb line both shaft. The plumb line is the terminal station on the surface and ug survey and confidence when the survey has been completed there relative position may be determine the the calculation.

Procedure :-

→ To make a triangulation survey at the s/f to for accurate framework for the details survey of surface.

→ To be established by two wire shaft.

→ To locate the position of wire accurately the surface by connecting them to the surface triangulation sheet that the length and bearing of the line joining the two wire at the co-ordinate of the wire may be computed.

→ To make and accurate ug traverse between wires

(1) Let 'A' and 'B' represent the plumb line in the two shaft near triangulation system.
'A', and 'B' are established when are connected to main triangulation system.

(2) measured the angle and distance precisely and calculate the co-ordinate of plumb point

'A' and 'B' are also the length and bearing of 'AB'.

(c) A traverse is made by theodolite traverse along the roadways connecting the two shafts using any assumed directional base.

(d) The co-ordinate of second station 'B' relative to the first station 'A' once again calculating the from the Ug traverse and also the bearing and length of plumb line 'AB' is computed.

(e) The bearing of plumb line as calculated the S/F co-ordinate of the station taken from its true value and its contrary of the bearing of the plumb length calculate the co-ordinates on the U/g traverse.

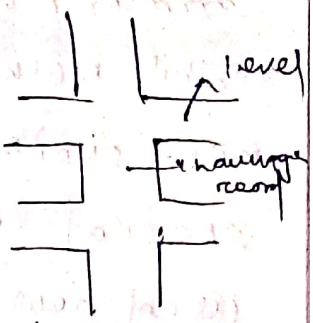
(f) The length 'AB' as computed from Ug traverse should be agree closely with that obtaining of that S/F.

(g) If any difference in bearing found then hole of the Ug traverse as to be shown through the triangle between the S/F and Ug plumb plane is considered.

Stated direct Correlation by traversing & Optical Method ?

* Direct traversing via mines entry ?

When entry to mine by level or drift, the method of co-relation is carried out by moving precise theodolite traversing Direct into the mine starting from surface one line known bearing In the surface triangulation & making a return traverse so that the area should be closed polygonally.



In the time co-relation survey one or two U/g base should be made for future reference when the survey at plotted on plane the U/g working should be shown accurately with there true position relating to the S/f features.

The traverse must be carried out with grade precision all the temporary adjustments are done,

(1) Setting Initial station.

(2) Levelling

(3) measuring the length of each drifts.

The angle between each point of the shaft should be measured at least 8 times. with face left and face right by method of repetition.

The length of each shaft should be measured several times so, that no sag will occurs.

Optical Method :-

This method involves either up and down the mine shaft the transit. Installation of some special form of telescope although not is used now, but this method has used in Rail in shallow.

Procedure :-

→ Set up the base line at plt bottom connect to the u/g survey in the position the point 'A' to 'B' across the shaft bottom.

→ put a theodolite over a line of a site where the baseline and transit upto to target 'P' to 'Q'.

→ Repeat the position of 2 & 3rd with the theodolite.

→ The line joining position of 'P' & 'Q' on the shaft top is then produced either by line wire or extension or co-planning in both of direction.

The optical method of co-relation involves the use of special theodolite having auxiliary lens - cone for treversing signal down words, does not give correct result because short base bet^n the two reference point sites at the bottom of the shaft with the Instrument set up the shaft top. The optical method of co-relation not suitable for shaft exceeding 50 cm.

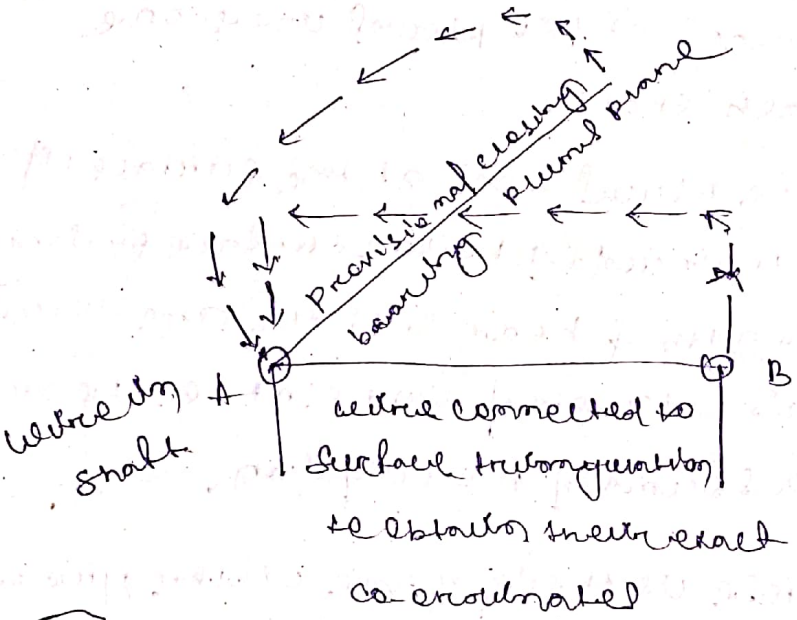
Single wire in two vertical shaft :-

- If both shafts are vertical, co-relation is carried out by means of two plumb lines one suspended in each shaft.
- The position of the plumb lines at the surface is incorporated (to include) to the surface traverse - lation of the length & bearing of the one joining the two wires is calculated in relation to ord - ance, or an assumed meridian.

A traverse is then made under ground between the two wire of the co-ordinated and calculated by reference to an assumed meridian. The bearing of the plumb plane as calculated from the ~~of~~ co-ordinates of the is taken as its true value & compare with the bearing of the plumb plane calculated from the co ordinates of the other through

The difference in bearing is taken to be the error and correction of the assumed UG meridian of the whole of the UG traverse has to be swung through this angle to bring the surface & UG plane into.

If the surface co-ordinates is known as the point of origin for the traverse calculation the co-ordinates of the other wire as obtained from the UG traverse will not normally agree with the GPS values.



Direct method

1) O- planning or Exact Alignment Method

→ In this method the object is to place the axis of the theodolite exactly in line with the plumb plane.

→ The theodolite on the GPS will be exactly aligned & by observing angle between

the plumb plane of nearest station, the azimuth of the plumb plane can be determined.

→ The theodolite must be set up close to one wire about 3 to 3.5 m away aligned roughly by eye, after aligning the tripod by eye.

→ The instrument is attached of accurately levelled.

→ The two wires will be observed, the telescope is pointed ~~towards~~ towards the first wire, the nearest wire is then brought into focus if the telescope is out of line.

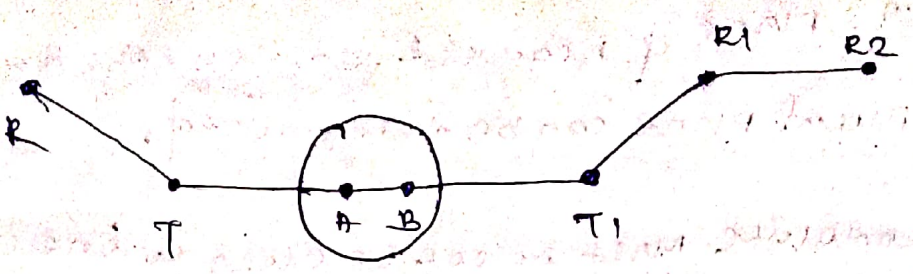
→ A scale can be placed behind the wire the apparent small amount of movement of the ~~the~~ theodolite can be calculated.

→ When both wires are like view through the telescope which meant that the line of sight lies in the plumb plane. This must be treated to zero - of to the W/I.

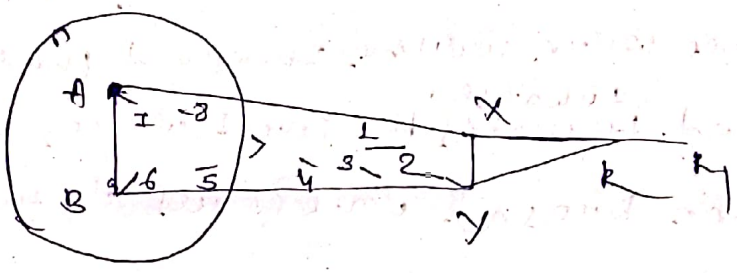
→ This can be done by measuring the horizontal angle BT, R. ~~from~~ from the co-planned station below the ground.

→ The plumb plane azimuth is determined on the surface of the azimuth of W/I lines can be determined.

→ The length of the line can be measured of the co-ordinates of the stations are determined.



Weissbach Quadrilateral Method :-



- The Weissbach quadrilateral is fixed by the two wires & the two instrument stations.
- The side lines are set at stations X & Y and the angles 1, 2 & YXR are measured at X and the angles 3, 4 & XYR are measured very carefully by constant repetitions.
- The length of the sides of the quadrilateral & the diagonals are measured as a check on the angles although all the calculations concerned the angular measurements.
- The angles at R, YRX, XRR, & YRR are measured.
- Subsidiary or intermediate have now been obtained to calculate the azimuth of the sides

plane of the slf or the azimuth of R1R2 b.w.
ground.

→ Thus the azimuths of the lines are determined & even tually the co-ord. of the station observations may be made from both ends of the staff. It possible several rums round may also be used.

Prewise magnetic Correlation :-

→ In this method the mag. bearing of slf of the base lines are determined and then a traverse is carried out from each to assigned rums while suspended in the stat.

→ The magnetic azimuth of each lines determined and the difference applied to the grid bearings of the surface base will give the grid azimuth of the U/g base.

→ The traverse will give the co-ordinates of the U/g stations.

→ The method uses the tubular compass attached to the theodolite to determine the mag. bearing of the lines.

→ Two theodolites will be used, one on the surface and the other in U/g.

→ The location of the slf baseline of the U/g base line have to be chosen with great care

→ It is easier to find out local attraction on the surface but it is very difficult to find out free from local attraction due to pipe lines, power cables, steel supports etc.

Stope surveying

Date 10/05/23

Define stope surveying ?

→ Stope surveying operation carried out during a few days before the end of the month to find out the exact amount of ground removed in order that the stoper etc may received correct payment where payment of stopper is based on unit of work accomplish and bonuses are awarded for high driving efficiency and low explosive consumption.

Purpose of stope surveying ?

→ To accurate amount of ground removed during given period.

→ To determine the position of stope faces relative to each other, with shaft pillar and the boundary and features.

→ To calculated the ore reserved.

→ To comply with of requirement of the mining regulation.

Factors affecting of stope surveying ?

→ Dip of the ore body.

→ Size and shape of orebody.

→ Method of stoping

→ Degree of accuracy

→ Time available to carry out the survey is more
→ Increase for which the survey is made
whether for payment by area stopped or
tunnel broken or the calculation of reserves

Classification of store surveying :-

Store surveying are mainly two types

(i) Flat areabody

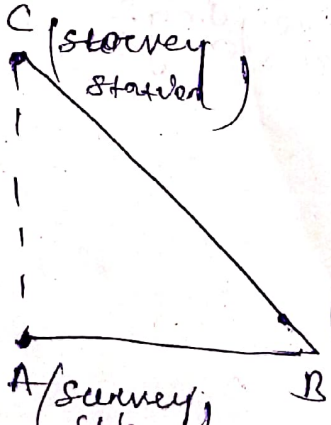
(ii) Inclined areabody.

Tape Triangulation :-

→ As the face advance a new stations are established
near the face to facilitate observing.

→ Suitable ~~possible~~ positions are selected near the
face from which at least two stations by
connection are visible.

→ Direct tape measurement between the survey
pegs (Points) are selected to the stations the method
is followed when face way from which survey
station.



→ When store face have
advanced a distance of
50 m to 60 m and Instrument
Survey mark recent store
station should be carried
out.

① Instruments Survey:

→ It is sum what tedious but rapid for check survey.

→ Specially when the ore body discipline is deriving -lar, the co-ordinate ~~traverse~~ stations of the theodolite traverse are calculated & their positions are plotted on a horizontal position which are after ward converted to the plane of the ore body.

→ Peg to peg distance are measure are steel tape by horizontal & vertical angle by theodolite.

Determine Stope Face:

→ The 30m tape held betn the two stope station. Its zero at stable station near the face and right angle offset from the tape to the successive points at the face and are measured and booked. (point fixed means)

→ If the offsets are less than 1.2m the graduated may be used instead of the 15m depth.

→ The tape line should be closer to face. It may be sometimes necessary to conveniently tie the here with its zero at a point or station peg.

& mark on the face then to the place betn successive station ;

→ The station pegs omitted may be obtained by measurements from any (formed) or wide base triangle with its offsets at the station and clearly the right angle measurement may be addition.

→ The mark made on the face is used at zero for the next station.

→ In order to obtained on a survey so the stope with accuracy of measurement of the hanging wall to the footwall at taken into survey.

→ This measurements are based made from 1.5m to 3m away from the face. and made at right angle to the plane of stope.

Date - 11/05/23

Preparation of stope plane :

→ All measurement in stope are made in the plane of the stope, for plotting is measure, horizontal projection will be incorrect & therefore a correction is applied to the position of peg s on the horizontal projection. in order to extends the distance betn them & along the dip line to there correct inclined layout

→ The co-ordinates of survey station gives their relative position when plotted to scale of the given scale.

→ The two position stations on the store plane will be on the line of the connection as given by the horizontal position i.e. at distances from each other. On the line co-responding to the measured distance measured between them in the horizontal survey or obtained by the plotting but the horizontal & vertical distances that right angle triangles and scaling of the measured distances.

→ The offset of measured from a tape held between the two stations during face measurements are plotted direct on the store plane.

→ The points given by offsets are joined together to formed out line measure of face.

→ The area is enclosed between the current face and previous one.

→ Measured by planning meter. which represent the amount of excavated the ground during the between period of measurement.

→ position of the survey station from the STORE plane are transport the reduced scale. Mine plane are regular interval transport to reduced

to bring mine plan. upto date

V.V.I

Find out area of excavation by planimeter (undulating area means)

→ Planimeter is most used to determine the area by plotted to scale, specially when the boundary are irregular or curve such as reverse boundary etc.

→ It is consist of two arms hinged at a point one of the two arms is called anchor arm and is fixed of length.

→ It is carried a needle point called anchor point. which is fixed on the paper & held in position by small act.

→ Which is also attachable. the other arm is show adjustable length & carried tracing point which is moved around the boundary of area to be measured.

→ The total normal displacement measure by a wheel which excess in parallel to tracing arm.

→ The wheel may be between the tracing point or pole point by and the pole point away from the tracing points.

→ When the wheel carried graduated from divided into 100 parts, the 10th of the parts of vernier scale.

→ The complete revolution of the wheel corresponds of the arc head on counting here.

→ The counting there are divided into 10th parts and advanced one line and every turn of wheel and proper one revolution every 10 turn of the wheel.

→ The planimeter rest on 3 point i.e the anchor point, tracing point, periphery of the wheel.

→ There are mainly two type planimeter are used,

(i) Amsler polar planimeter

(ii) rolling planimeter (it's commonly used in mines)

unit-4 ∴ Setting out Curves ∴ Date 02/05/25

→ Gradually and smooth change of direction from one straight to another straight is known as curve.

→ The mine surveyour is frequently called upon to set out curve on surface or underground Haulage road ways so as to over come any obstacle intermediate a straight path or in order to avoid of encroachment of train.

(curve)

* Classification of curve ∴

There are mainly three types of curve.

(i) simple curve
(ii) compound curve
(iii) Reverse curve.

(i) Simple curve ∴

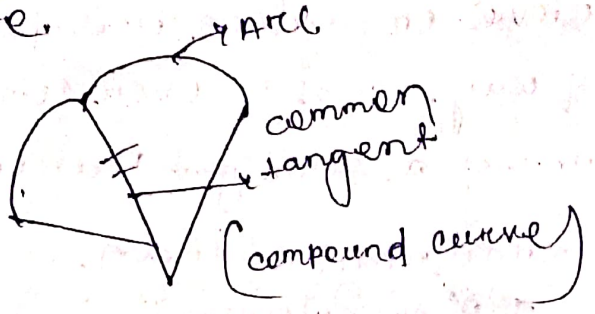
→ simple curve may be defined as single circular curve, united two tangents meeting at an angle.

tangent

(simple curve)

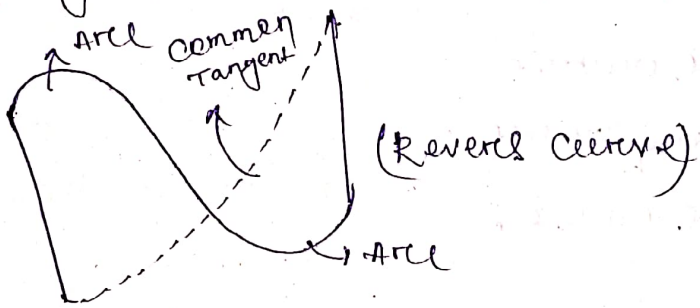
(ii) Compound curve :-

A compound curve is one in which a curve of one radius runs into another of the different radius bending in same direction with a common tangent and with the center in same side.

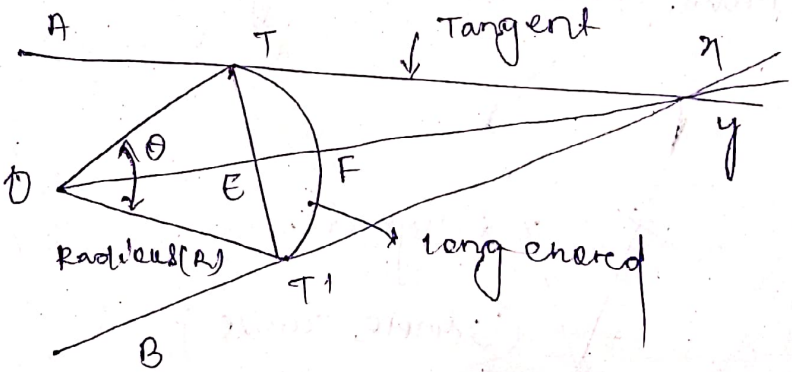


(iii) Revers curve :-

A revers curve consists of two arcs bending in opposite direction. Their centres lie on opposite sides of the curve. Their radii may be either equal or different and they have one common tangent.



* Elements of simple circular curve :-



(i) Straights :-

The two straight portions of railway line or road way which are to be connected by a curve of radius 'R' are the straight here, AT and BT, are the two straights.

(ii) Tangent point :-

These are the ends of the curve where the alignment changes from a curve to a tangent. These are the beginning and end points of the curve. Here. T and T_1 are the tangent points,

(iii) Back tangent :-

The tangent AT previous to the curve is called the back tangent or first tangent.

(iv) Forward tangent :-

The tangent T'B following the curve is called the forward tangent or second tangent.

(v) Point of Intersection :-

If the tangent AT and BT' are produced then they will meet at a point called the point of Intersection or vertex.

Here, n is the point of Intersection,

(vi) Long chord :-

The chord joint the two tangent point is called long chord. i.e TT_1,

(vii) Intersection angle / Angle of deflection :-

The angle $\angle YXT' = \theta$ betn the tangent AX produced and XT' is called the intersection angle or the external angles of deflection betn the two tangent. This angle θ is equal to the angle $\angle T O T_1$ centre of curvature θ by the arc of the curvature TFT'.

(viii) Apex angle :-

It is the angle at the apex of the curve made by two straight. The angles $\angle TXT_1 = \phi = 180^\circ - \theta$.

(ix) Tangent distance :-

It is the distance from the tangent point T or T' to the point of intersection Here TX and T_1X are tangent distance.

(x) Apex distance :-

The distance FX from the mid point of the curves to the point of intersection is the apex distance.

(xi) Rise :-

The distance ER betn the mid point of the long chord to the mid point of the curve is the rise of the curve. It is also known as mid ordinate or versed sign of the curve.

Formula :-

(1) To find the length of the chord.

$$\frac{ET}{OT} = \frac{\frac{1}{2}\,\text{chord}}{R} \quad \therefore \sin\frac{\theta}{2}$$

$$\boxed{\text{so, chord} = 2R \sin\frac{\theta}{2}}$$

(2) tangent distance $= \boxed{R \times \tan\frac{\theta}{2}}$

(3) Rise of curve $= \boxed{R \times \left(1 - \cos\frac{\theta}{2}\right)}$

(4) Apex distance $= \boxed{R \times \left(\sec\frac{\theta}{2} - 1\right)}$

(5) length of curve $= \boxed{\frac{\theta}{360} \times 2\pi R}$

* Designation of curve :-

The sharpness or curve is designation either by its radius by its degree of curvature. The degree of curvature are usually different definition.

(1) According to the arc definition which is used in highway practice. The degree of curve defin & the centre angle of curve that subtended that at 30 m length.

(3) According to the chord definition which used in railway practice, the degree of curve is defined as the central angle of curve that subtended by its chord of 30m length. for 30m of length $R = \frac{1719}{D}$ (approx.)

* Define super elevation ?

→ To avoid the danger of outer rail is raised is higher level than the inner rail and the amount by which it is raised is called the super elevation.

* super elevation in cm = Track gauge in cm $\times \frac{V^2}{gR}$

where, V = speed of vehicle in meter/s

$g = 9.81$ m/s

R = Radius of curve in meter

* Transition Curve ?

→ A transition curve or easement curve used for gradual introduced between a straight or a circular curve for the purpose of giving is changes the direction of a road.

→ It may be introduced between two branched compound curve or reverse curve.

Necessity of providing transition ?

→ To accomodate gradually the transition form of tangent free the circular curve are from the circular curve to the tangent so that the curve are increase.

gradually from zero to specified value and vice versa;

→ To provide medium gradually increase of super elevation from the zero on the tangent to the specified value on the main circular curve.

Advantage ?

→ It provide comfort to the passenger at the turning and.

→ It allow the higher speed at the turning and same is not possible in other ways.

* Setting out of a simple curve ?

→ curve may be set out in various ways depending on the location of curve, It length, the degree of accuracy required the instrument available, the presents of obstruction and shew on,

→ depending upon the instrument used the method of set out the curve may be devided into following method,

Advantages :-

→ Approved

(i) Linear Method :-

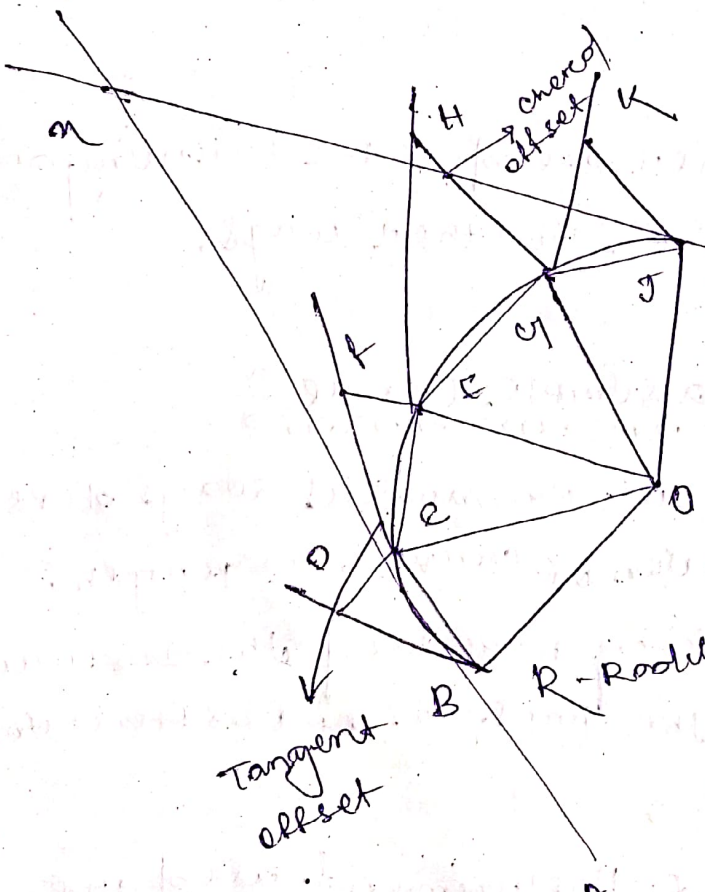
→ In this method only chain and tape are used.

→ Linear method are used when only degree of accuracy is not required and curve is short.

(ii) Angular method :-

→ In this method an instrument such as theodolite is used with or without a chain or tape.

* Setting out by chord of an offset :-



→ In this method the curve is set out by measuring offset construction of a straight AB and successive chords are BC, CE, EG, GI. No angular instrument used.

→ The method consist of dividing the area in equal areas BC, CE, etc.

is subtending an angle α at the centre each subtending at the angle of centre and calculate the chord length by using formula

$$\text{chord} = 2R \sin\frac{\alpha}{2}$$

Procedure :-

- To find out the first point C, tapes A and B are placed at range the OC is to be set out the right angle to the BO so that tangent of an off-set $BC = \frac{ct^2}{2R}$

If the radius of the curve is 300m and the chord is 30m. then the tangent offset.

$$\frac{(30)^2}{2\times 300} = \frac{30\times 30}{2\times 30} = \frac{90}{60} = \frac{3}{2} = 1.5$$

$$\text{chord}\ \frac{30^2}{300} = 3\text{m}$$

- Note that all the chord offset are possible are tangent offset.
- To set out the curve. The zero of the tape are the tangent B and an assistant pull pull along the tangent line and at point D show that in the triangle ABD the length of BC is 90 m

The length of tangent DC = 1.5 m and BC is at right angle to the CD.

→ The pack know forward and its zero end has the pack at the point 'c' and its front end is ranged in line 'CB' and arrows is put near point of at the the tape is moved towards the point 'B'. making the distance 'FE' so the touching text place are set out in like manner and until the other end of curve is ruled.

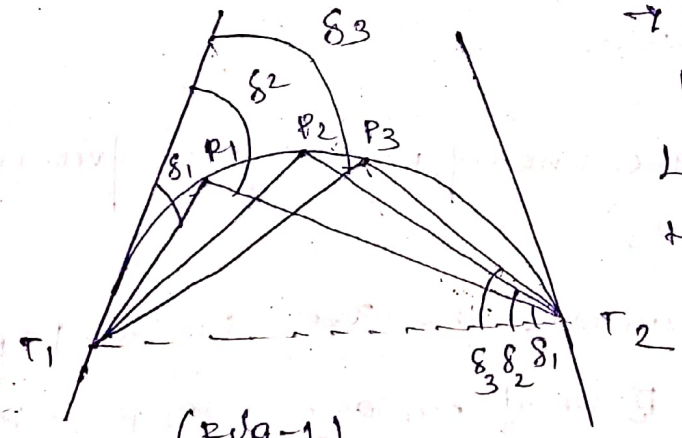
* Two threading method :-

Date- 03/05/23

→ In the two threading method measuring distance with a chain or tape is not required.

→ This method is particularly used in rough ground where chaining is impossible or difficult.

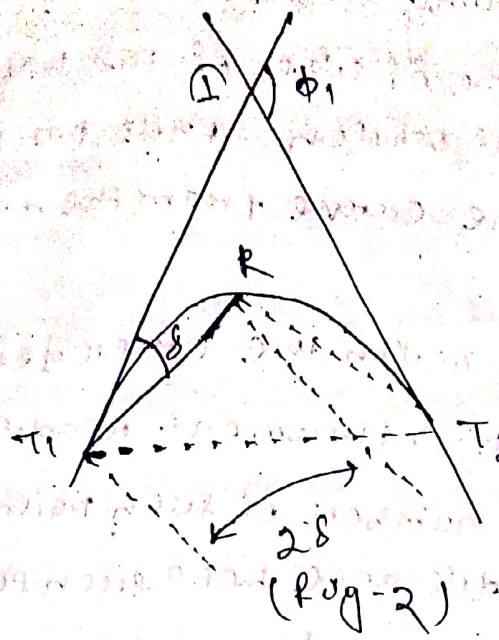
→ The method required two threading and two people hand & them thus making method is more expensive.



(Fig-1)

→ Referring to the Figure -1 and 2 Let T1 and T2 at the two tangent

Consider any point P1 on the curve T'P1 is chord and distance and angle to δ1 at the centre for the



Properties of circle.

The angle betn the tangent and chord is δ (Delta) half the angle subtained at the centre a chord only be also subtained at the centre and another point of curve then and $\angle T_1 T_2 P_1$ is also 'δ'

then, if you say $\angle \delta$ from $T_1 I$ angle and the same angle of 'δ' $\angle T_1 T_2 I = \delta$ and the same angle 'δ' from $T_2 T_1$ we get point T_1 at there Intersection 'P_1'

Procedure

- Fixed the Intersection point 'I' and tangent point T_1 and T_2 accurately.
- Set up the one theodolite at T_1 and second one theodolite at 'T_2' points.
- Set the theodolite T_1 is '0' to and site the signal at point of Intersection point 'I'. Once the the theodolite T_2 site with the vernicere set zero.
- Turn of the theodolite clockwise to the deflection angle is accurately.

→ have a person is reading reef move such that person come in the line of site of the both therefore the point at which this person start in a point on the curve from the defle -tion angle said.

→ repete the procedure with the other deflec -tion angle with both the instrument reading the same angle locate a number of such point of the curve the smaller distance between point, the closer one gets to the actual profile of curve

Date-24/04/23 G.P.S and Total station

G.P.S - Global positioning system.

Total station :-

→ A total station is an electronic transit theodolite that measures angles both vertical and horizontal and distance both the point.

→ It is the most advancing surveying Instrument with integrated EDM.

→ Some companies are :- Hexagon AB, Nikon, Topcon Ltd Corporation.

* Function of total station :-

→ angle measurement.
→ distance measurement.
→ co-ordinate measurement.
→ Data-processing.

* Angle measurement :-

→ Most total station Instruments measure angle by means of electro optical scanning of extremely precise digital barcodes rotation etched on rotating glass cylinder or disc within the Instrument.

* Distance measurement :-

→ Measurement of distance is a combined with a modulated Infrared carrier signal, generated by a small solid state emitter within the Instrument's optical path and

and reflected
under survey.

→ The modulation pattern in the returning signal is read and interpreted by the computer in the total station.

→ The distance is determine by emitting and receiving multiplied frequencies and the determined by the integer no. of wavelength to the target for each frequency.

(#) Co-ordinate measurement (or) (mid-point)

→ The co-ordinate of unknown point relative to known co-ordinate can be determined using the total station as long as a direct line of sight can be established between the point.

→ Angles and distance are measured from the total station to points under survey and the co-ordinate (x, y and z or eastings - northing and elevation) of survey points relative to the total station position are ~~calculated~~ calculated using trigonometry and triangulation.

(#) Data processing

→ Some models include internal electronic data storage to record distance, horizontal angle and vertical angle measured, while other models are equipment to record these measurements to external data collector, such as hand held computer.

- When data is downloaded from a total station onto a computer, application software combined to compute results and generate a map of the surveyed area.
- The newest generation of total stations is capable of showing the map on their screen of the instrument immediately after measuring the points.

* Application of total station :-

- Total station are used by land surveyors and civil engineers. either record features as in topographic survey in order to set out such as roads, buildings or boundaries.
- It is also used by archaeologists to record excavations and by police, crime scene investigation.
- Total station are also used in mining industry -ries to record, the absolute location of the tunnel walls, ceilings and floor as the drill of an underground mine are driven.
- It is used in mechanical and electrical construction industries in to the foundation, both floor of a structure and roofing penetration because more commercial and industrial construction jobs have become centered around building information modeling (BIM)
- It is also used in metrology department to track weather balloon for determining upper level winds.

* GPS :- (Global positioning system)

→ GPS is also known as global positioning system.

→ It is a system of satellite designed to help navigate on the earth in the air and on water.

→ A GPS receiver should know where it is and to track moving.

Principle of GPS

→ A GPS unit takes radio signal from the satellites in the space in orbit around the earth.

→ The radio signals contain information about the time and position of satellite.

→ GPS is nothing but a satellite navigation system that is used to provide us with information about the current location and current time.

→ The satellite navigation system used by GPS includes approximate 24-33 satellites.

→ GPS works on the principle of exchange of radio waves, between the ground stations, satellites and the receivers.

→ This transmission and reception of data follows a trilateration mechanism of operation. The trilateral mechanism states that estimate the precise location of an object on earth.

→ There, at least 4 GPS that transmits and receive data to and from the object is usually preferred to the accuracy of the information processed by GPS.

→ This means if you increase the no. of satellites that are able to communication with the device the accuracy to estimate the location of the device improved phenomenally.

→ The trilateration mechanism can be verified in both 2-dimensional and 3-dimensional views.

→ The two dimensional trilateration mechanism makes use of longitude and latitudes to determine the location of a particular place.

→ On the other hand the 3-dimensional trilateration mechanism makes use of long, latitude and altitude values.

* DGPS ⇒ (Differential global positioning system)

→ Differential global positioning system. It supplement and enhance the positional data available from global navigation satellite sys.

→ DGPS consists of network of fixed position ground based reference station.

→ Each reference station calculate the difference between its highly accurate known position and its less accurate satellite derived position.