SURVEYING – II

CIVIL 4TH SEM.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:-

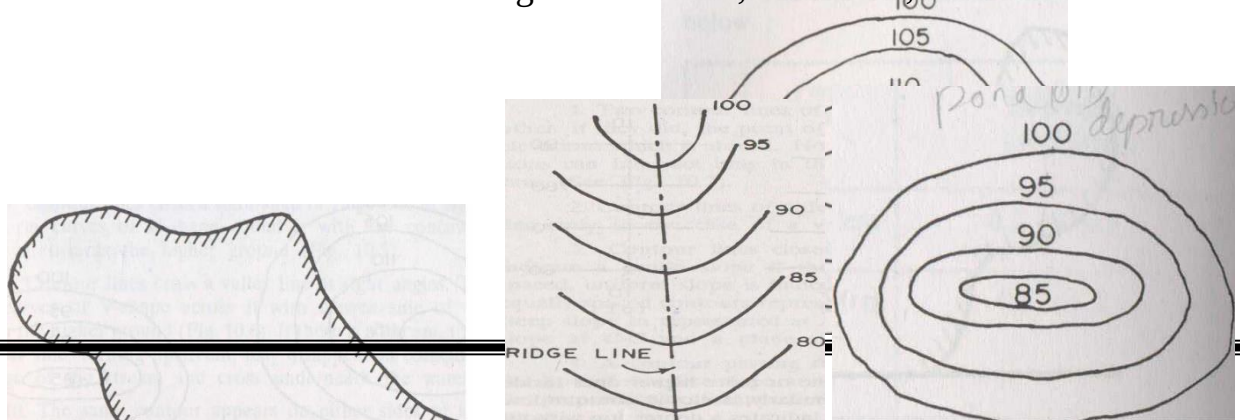
- Interpolate contours on a given sheet of paper
- Align a proposed road
- Draw a contour plan of an area
- Calculate earth work for a road from a contour map
- Prolong a line with theodolite
- Conduct closed traversing
- Measure horizontal and vertical angles
- Set out simple circular curve
- Read Total Station, EDM and Auto level

Contouring & Characteristics of contours

A contour is an imaginary line on the ground joining the points of equal elevation. It is a line in which the surface of ground is intersected by a level surface.

Characteristics of contours

1. Two contour lines of different elevations cannot cross each other. Contour lines of different elevation intersect only in case of overhanging cliff or a cave.
2. Contour lines of different elevations can unite to form one line only in the case of a vertical cliff.
3. Contour lines close together indicate steep slope. They indicate a gentle slope if they are far apart.
4. A contour passing through any point is perpendicular to the line of steepest slope at that point.
5. To contour lines having the same elevation cannot unite and continue as one line. Similarly, a single contour cannot split into two lines. This is evident because the single line would, otherwise, indicate a knife-



edge ridge or depression which does not occur in nature. However, two different contours of the same elevation may approach very near to each other.

7. A contour line must close upon itself, though not necessarily within the limits of the map.

8. Contour lines cross a watershed or ridge line at right angles. They form curves of V-shape round it with the concave side of the curve towards the higher ground

9. Contour lines cross a valley line at right angles. They form sharp curves of V-shape across it with convex side of the curve towards the higher ground If there is a stream, the contour on either side, turning upstream, may disappear in coincidence with the edge of the stream and cross underneath the water surface.

10. The same contour appears on either sides of a ridge or valley, for the highest horizontal plane that intersects the ridge must cut it on both sides. The same is true of the lower horizontal plane that cuts a valley.

Methods of contouring

1. Direct method
2. Indirect method

Direct method:

The field work is of two-fold Vertical control

Horizontal control

Vertical control

- The points on the contours are traced either with the help of a level and staff or with a help of a hand level.
- The staff is kept on the B.M. and the height of the instrument is determined.
- Calculate the staff reading For example if height of the instrument is 101.8m
- means the staff reading will be 1.80m
- Taking one contour at a time the staff man is directed to keep the staff on the point on contour so that readings of 1.80m are obtained every time.

Horizontal control

- After having located the points on various contours, they are to be surveyed with a survey control system.
- For small area chain survey may be used and points may be located by offsets.
- In a work of a larger nature a traverse may be used.

Indirect method

The following are some of the indirect methods:

By square

By cross-section

By tacheometric method

By square

- The method is used when the area to be surveyed is small and the ground is not very much undulating.
- The area is divided into a number of squares.
- The size of the square may vary from 5 to 20 m depending upon the nature of the contour and contour interval.
- The elevations of the corners of the square are then determined by means of a level and a staff.
- The contour lines may then be drawn by interpolation. It is not necessary that the squares may be of, the same size.

- Sometimes, rectangles are also used in place of squares. When there are appreciable breaks in the surface between corners, guide points in addition to those at corners may also be used.
- The squares should be as long as practicable, yet small enough to conform to the inequalities of the ground and to the accuracy required. The method is also known as spot leveillng.

By Cross Section

- In this method, cross-sections are run transverse to the centre line of a road, railway or canal etc.
- The method is most suitable for railway route surveys.
- The cross-sections should be more closely spaced where the contours curve abruptly, as in ravines or on spurs.
- The cross-section and the points can then be plotted and the elevation of each point is marked.
- The contour lines are interpolated on the assumption that there is uniform slope between two points on two adjacent contours.
- Thus, the points marked with dots are the points actually surveyed in the field while the points marked with x on the first cross-section are the points interpolated on contours.

By tacheometric method

- In the case of hilly terrain the tacheometric method may be used with advantage.

- A tacheometer is a theodolite fitted with stadia diaphragm so that staff readings against all the three hairs may be taken.
- The staff intercept s is then obtained by taking the difference between the readings against the top and bottom wires.
- The line of sight can make any inclination with the horizontal the range of instrument observations.
- The horizontal distances need not be measured since the tacheometer provides both horizontal as well as vertical control. Thus if it is the inclination of the line of sight with horizontal the horizontal distance (D) between the instrument axis and the point in which the line of sight against the central wire intersects the staff are given by:

D = K1s cos2 + K2 cos2 V = D tan

K1 & K2 are instrumental constants.

THEODOLITE SURVEYING :

Theodolite – vernier and micro tic – Description and uses – Temporary and permanent adjustment of vernier transite – Horizontal angles – Vertical angle height of distance – Traversing closing error and distribution – cale's table – orient measurement.

TACHOMETRY SURVEY :-

Tachometry is a branch of angular surveying in which A horizontal & vertical distance is of points are obtain by optical means as supposed to ordinary slow process of measure by tape chain. This method is very rapid & convenient. All though the accuracy of tachometry is low it is best adopted in obstructed such as steep & broken ground stretches of water etc which make drawn age difficult. They primary object of tachometry is the preparation of contour maps are plans required with both horizontal & vertical measurements also accuracy improvement it provides at check an distance measure with tape.

At the instruments a normally transit theodolite pitted with stadia diaphragm is generally used for tachometry survey. A stadia diaphragm

essentially consist of one stadia hair above on the other an equal distance below the horizontal cross hair. Telescope is used in stadia surveying are of 3 types :-

(i) Simple external focusing telescope

(ii) External focusing analytic

(iii) Internal focusing telescope

Different system of Tachometry measurements :-

(i) Fixed hair method (or) stadia method

(ii) Movable hair method (or) substance

Fixed hair method :-

In method observation are made with stadia diaphragm having stadia wires at fixed (a) constant distance occur. They reading an the staff corresponding to all three wires are taken. The staff intercept that is the differents of reading corresponding to top & bottom stadia wires will depend on the distance of the staff from the instrument when the staff intercept is more than the length of the staff only ½ interne of real. For inclined said reading may be taken by keeping the staff either vertical a normal to the line of site.

Subtense method :-

This method is similar to fixed hair method except the stadia internal is varying table arrangement is may to --- distance between the stadia hair so as to said them against the two targets on the staff kept at a point and observation this in this case the staff intercept that is the distance between the two forgets is kept fixed while the stadia interval that is the distance between the stadia hair is carrying as is the case of fixed hair method inclined site they out show be taken the tangential method. They stadia being taken against the horizontal hair as against any two point on the staff on their corresponding vertical angles are measured. This measurement of vertical angles tube for one single observation. Staff in theodalite normal mean by perpendicular. Least count of staff 0.005m.

Held staff vertical :-

Horizontal D = MS $\cos^2\theta$ + cos

θ Vertical V = MS $\sin^2\theta / 2$ + C

sin θ H = height of instruct

R = observe staff

reading S = staff

intercept

This is top – bottom hair radia

O = angle made by line of site with

horizontal Reduced level of θ = R.L of p +

h-v-r

RL of p + h + v – r = RL of O

Staff normal to lined site :

Find the elevation & horizontal distance of point Q view from A is than angle of 30° above horizontal with staff intercept with staff held vertically occur 3.855 m & C.H reading 1.930 m elevation of point A is 10m above m.s.l take multiplying as 100 assume h to be 1 m

RL of A = 10.000 m

RL of Q = RL of A + height of instrument +

v – r V = MS $\sin^2\theta / 2$ + c $\sin\theta$

= 100 x 3.855 $\sin^2 30°/ 2$

= 48.19m

reduce level of Q = 10.000 + 1.000 + 48.190 – 1.930

= 57.260m

Horizontal distance :

D = MS $\cos^2\theta$ + $\cos\theta$

= 100 x 3.855 $\cos^2 30°/ 2$

reduce level Q= 57.260m

2. Find vertical & horizontal distance between point A & B. If the instrument located 0.8m above A clip of 22°to a staff held normal to the line of site at B. The staff read 1.650, 2.150, 2.650

Assume m = 100

RL of θ = RL of A + h – v- r cosθ S = 1m

R = 2.150 r cosθ = 1.993

V = (ms + c) sinθ

= (100 x 1) sin 22°= 37.461m

RL of θ = 0 + 0.8 – 37.461 – 1.993

= 38.654m

horizontal distance D

D = (ms + c) cosθ + r sinθ

= (100) cos 22°+ 0.805 D = 93.51m

3. To determine distance between two points with base of one point is axiable and instrument station in the same vertical plane as the elevated object.

$$D = \frac{d \tan^2\theta}{\tan\theta 1 - \tan \theta 2}$$

h = D tanθ1

Instrument with two different Axis :-

$$D = \frac{(d + s \cot \theta_2) \tan\theta_2}{\tan\theta_1 - \tan \theta_2}$$

$$h = \frac{(d + s \cot \theta_2) \sin\theta_1 \sin\theta_2}{\sin (\theta_1 - \theta_2)}$$

$$h_2 = h_1 + s$$

use positive sign with s cot θ2 when instrument a axis a Q is lower & negative sign when it's height the instrument axis at P.

1. An instrument was setup at station P and the angle of elevated to an objective was 9°30' the same object was focus from a point 4m away the first one angle was 11°150' the staff reading s from a B.M having elevation 2650.38m are 1.310m and 1.815m respectively. Find the RL of Q = θ1 = 9°30' θ2 = 11°15'

$$D = \frac{(d - s \cot \theta_2) \tan\theta_2}{\tan\theta_1 - \tan \theta_2}$$

$$= \frac{(4 – 0.535 (d 9°30') \tan 9°30' 0.164}{\tan 11°15' – \tan 9°30' \quad 0.0315}$$

D = 5.21m = -204.13m

$$h_2 = \frac{(4 – 0.505 \times 5.98) \sin 11°15' \sin 9°30'}{\sin (11°15' – 9°30')}$$

= 39.68m

$h2 = h1 + s = 39.68 + 0.505$

$= 39.175$

RL of stadia = R.L of $D^2 + S^2$

$= 2650.38 + 1.310 – 39.175$

$= 2612.52m$

2. An instrument was setup a P and the angle of elevation to a volume 4m above the focus of the staff held at Q was 9°30'. A horizontal distance Pl was know 2000m determine the RL of staff station Q given RL of instrument axis was 2650.38m

$0.0673\ d^2$

0.0673×2000^2

$Ccr = 0.673 \times 2$

$= 0.27m$

$V = D \tan\theta$

$= 2000 \times \tan 9°30' = 334.69m$

RL of Q = RL of instrument axis + Ccr + V – h

$= 2650.38 + 0.27 + 334.69 – 4$

$= 2981.34m$

1. A instrument was setup a P and angle of depression to a plane 2m above the fast of the staff held at Q was 5° 36’ H. d between P & Q was 3000m determine RL of staff station Q given the staff readings as a B.M of elevation 436.050m was 2.865m

Cn = 0.0673 x 3^2 = 0.6057

V = 3000 x tan 5°36’ = 294.15m

RL of Q = BM + cn – V – n + instrument

= 436.050 + 2.865 – 0.6057 – 294.15

= 142.16m

Measurement of horizontal angles :-

(i) Direct method

(ii) Method of Repetition

(iii) Method of Reiteration

Precaution to be taken theodalite observation :-

(i) Turn the theodalite by the standards and not by using telescope ensuring slow & smooth movement.

(ii) Done force the foot screws & tangent screws to heart.

(iii) Clamp vertical axis tightly while observing the horizontal angles.

Sources of errors in theodalite :-

(i) Instrumental Error

(ii) Personal Error

(iii) Natural Error

CURVES:-

Curves are generally used on highways and railways way there is necessary to change direction of motion. It curve classified as

(1) simple curve

(2) compound curve

(3) reverse curve

Uniform radiations curvature is called simple curve.

Two variable radius curvatures are called the compound curve. Two curves in upside and downside curve is called reverse curve.

OTHER TYPES:-

Vertical and horizontal curves

BACK TANGENT:-

The tangent AT1 previous to the curve is called Back tangent or first tangent.

FORWARD TANGENT:-

The tangent T2B following the curve is called second tangent.

POINT OF INTERSECTION:-

If the two tangent AT2 and BT2 are produced they two meet in a point v called the point of intersection.

POINT OF CURVE:-

It is the beginning of curve where the alignment changes from tangent to

curve.

POINT OF TANGENCY:-

It is the end of the curve when the alignment changes from curve too tangent.

INTERSECTION ANGLE:-

The angle between tangent AB, BB is intersection angle at external deflection angle.

DEFLECTION ANGLE TO ANY POINT:-

The deflection angle to any point on the curve the angle BC between the back tangent or they move from BC to the point on the curve.

TANGENT DISTANCE:-

It is the distance between PC to PI then be equal to PI & PT

EXTERNAL DISTANCE:-

It is the distance from the mid point of the curve 2PI.

LENGTH OF CURVE: L

It is the total length of curve from PC to (P.T)

LONG CHORD:-

It is a chord joining from PC to PT.

MID ORDINATE:-

It is the ordinate from midpoint of the long chord to the midpoint of the

curve.

A chord between two successive regular stations on a curve is called normal chord.

SUB CHORD:-

Sub chord is any chord shorter than normal chord.

RIGHT HAND CURVE:-

If the curve is deflective to the right of the direction of progress of survey is called right hand curve.

LEFT HAND CURVE:-

If the curve is deflective to the left of the direction of progress of survey is called left hand curve.

DESIGNATION OF THE CURVE:-

The sharpness of the curve is designated either by radius at by its degree of curvature. The degree of curvature is defined as the central angle of the curve then it subtended by curve 100 ft length. According to the chord definition the degree of curvature is defined as the central angle of the curve that is subtended by a chord of 100 feet length.

SETTING OUT OF SIMPLE CURVES:-

(i) LINEAR METHOD:-

In linear method only a chain or tape is used. These used when the degree of accuracy required is low are when the curve is short.

(ii) ANGULAR METHOD:-

In angular method instrument such as theodolite are used along which chain or tape. It is hardly accumulated and can be used for longer curves.

Before a curve is set out it is a tangent point of intersection. Point of curve and point of tangent.

LOCATION OF TANGENT:-

Before setting out the curve the surveyer is always sub lying with the working plane upon which the general alignment of tangent is known in relation of the transverse controlling the survey of the area.

Know in objects to certain points on both a tangents the tangents can be marked in the ground by tape measure the tangents may be the set out by theodolite by trivalent error

sudden the pass through the mark as really as possible. The total deflection angle (α) and then it is measured by setting theodolite on P.I

LINEAR MEASUREMENTS OF SETTING AT CURVES:-

(i) By ordinates or offset by chart.

(ii) By successive bisection of areas.

(iii) By offset from the tangents.

(iv) By offset from the chords.

ANGULAR METHODS:-

(i) Rankine's method of tangential angle (or) deflection angles.

(ii) Two thedolite method

Rankine's method:-

∫= 1718.9 C/R minute

(i) Thedolite setting on p.c view in P.I or U in setting o°. calculate (c) value.

(ii) Turn in 5°to view using ranging rod coordinate point taken.

(iii) Same form by P.T distance

PROCEDURE:-

Set the thedolite point curve T1 with both clamp to zero.

Direct the thedolite to by sec the point of inter section (v) The line of site is tube in the direction of the rear tangent.

- release the vernear plate and set angle D an the veneer
- The line of site is direct alloy T10

- with the zero an end of the tape potted T1 and an arrow held at a distance T1A = C
- Suring the tape around T1 the arrow is by section by the cross hair thus the first point a is fixed set the second defection angle $\Delta 2 : 2\Delta 1$ on the vernear so that the line of site is directed along T1B
- With the zero end of tape pinot at A and an arrow held at an distance AB = C sue the tape arrow A till the arrow is by sected by the cross hairs thus fixing they point B
- Repeat the last two steps till the point T2 is reached.
- The last point show located must coin side with the point of tangent T2 if the deviation is small last tube may be adjusted. If it's more the whole curve should be resected.
- Incase of left hand curve each of calculated values of defection angle D should be subtracted them 360° the show obtained are to be set on they vernear of the theodalite

Procedure :-

(i) set up one theodalite at T1 with a zero reading facing the point V (P.i) similarly setup another theodalite at T2 (P.T) with zero reading facing T1 (P.C) set the reading of each of transit to the defection angle S1 for the first point A. The line of site of both the theodalites are thus directed towards A along T1A & T2A respectively.

(ii) move a ranging rod in such a way that it by sects symantiously the cross hairs of both instrument thus point A is fixed. To fix the second point B set readings S2 cm both instruments an by sects the ranging rod repeat the last two steps for location of remaining points.

The method is expansion since two instruments & two surveyor are required. How ever the methods is more accrue since each point is fixed independently of the other.

Lenear method of setting out curves:

(i) By ordinate from long chord

L = length of long chord

R = Radius of curvature of the curve

To set out the curve a long chord is divided into even number of equal points offsets are calamite from formula & then set out a each of these points.

(ii) By successive by section of arcs or chords:-

CD = R (1 – cos Δ/2) EF = R (1- cos Δ/4) GH = R (1 –cos Δ/8)

- Joint the tangent T1, T2 & by sect the long chord D, erected DC & make in equal to R (1 – cos Δ/2)

- Joint T1C & T2C by sect them a F & F1 at F1 and F2 set out offsets equal to R (1 – cos Δ/4) to get the point EE1 on the curve by successive by section of these chords more points can be obtain offset from tangents.

Setting out compound curve :-

This curve may be by the method of defection angles. This 1 branch is set out by setting theodalite T1 and second branch is setout by set the at the point D.

(i) For the first curve calculate the tangent angles for set out curve by rankines method.

Set the theodalite at T1 & set out the first branch of curve calculating the chord length C.

Calculate the tangent angles for second branch and set out curve by placing instrument at D mark the curve T2 is reach.

(ii) Set the observation by measure angle T1 D1 T2 with should be equal

to

 T1 DT2 = 180 – (Δ1 + Δ2 /2)

SECTION –A

(Very Short Answer Type Question)

(a) Contour interval
(b) Horizontal equivalent
(c) Saddle
(d) Indirect contouring
(e) Super elevation
(f) Tangent point
(g) Axis of level tube
(h) GPS
(i) GIS
(j) Length of curve
(k) Radius of curve
(l) Summit curve
(m) Simple curve
(n) Apex distance
(o) Degree of curve
(p) Axis of telescope
(q) Face right
(r) Soutin

SECTION- B

(Short Answer Type Questions)

Q. I Explain graphical method of interpolation of contour?

Q-II What are the characteristics of contour?
Q-III Various sources of error in thedolite surveying?
Q-IV Write short on movable hair method ?
Q-V What are the error in the stadia technology?
Q-VI Short note on super elevation provided on the curve?
Q-VII Classify the horizontal curve ?
Q- VIII Discuss in brief vertical curve ?
Q- IX Explain working of abney level ?
Q-X Short note on tangent clinometers ?
Q-XI What are the characteristitics of a transition curves ?
Q-XII Short note on tangent clinometers?
Q-XIII How will you measure magnetic bearing of line using theodolite ?
Q-XIV Discuss the principle of stadia techno meter ?
Q-XV what are the errors in the stadia techno meter?

SECTION-C

(Long Answer Type Questions)

Q-1 Explain temporary adjustment of theodolite ?

Q-2 Explain the different method of contouring. ?

Q-3 Write short note on:-

a. E.D.M
b. Remote sensing
c. Pantagraph
d. Planimeters

Q-4 What are the elements of simple circular ?

Q-5 Describe briefly the method of setting-out a circular curve by offset from the chord produced?