UNIT 1

BASICS OF SURVEYING

closed
open traverse

(local attraction
included angle)

=> Definition
=> principles of surveying
=> classification of surveying.
=> principles of chain surveying.
=> Methods of measuring horizontal & slope distance
=> Ranging
=> Working of prismatic compass
=> Types of bearing.
=> declination.
=> Dip, Local attraction
=> planetable surveying, Errors.

chain survey
prismatic compass

2M **Definition :-**

It is an art of determing relative possition on the Earth surface By means of horizontal and vertical distance, and horizontal and vertical angles.

2M **principle of Surveying :-**

1. Working from whole to part
2. To locate New station by atlest two measurements from fixed referance points.

classification of surveying:-

1. primary classification
a. plane Surveying — without curve <250
b. Geotic Surveying — with curve >250

Elevation - angle base

Secondary classification :-

(a) Based on purpose :-

(i) Geological surveying
(ii) mine surveying
(iii) ~~Archlog~~ Archaeological surveying
(iv) military surveying

(b) Based on field [Nature of field] :-

(i) land survey
(ii) Hydrological survey

(c) Based on methods (theodolite, chain survey, compass)

(i) Triangulation - where the area is to be survey is divided into Network of triangles
(ii) Traversing.

It is in the form of Circute survey lines which may be open (or) closed

(d) Imp Based on instruments :-

(i) chain survey →
(ii) compass survey - angular measurement
(iii) plane table survey → graphical method
(iv) Theodilote Survey → exact angle measurement
   (a) Tacheometry survey [It is an special type where the H, V distance is determined indirectly]
   (b) levelling survey [To determine the elivations]
(v) E D M - Electronic Distance measurement
   (a) T. S - Total Station
   (b) D. G. P. S - Differential global possition system (It is used in mega ...)
   (c) lidar
   (d) photogrammetric survey (prism)

(iii) Plane table Survey :- It is an graphical method By which points are plotted on the paper

Scale :-

It is an fixed ratio that every distance on the plane which corresponding distance on the ground

Type's of Scale's :-

(1) plain scale - linear measurements
(2) diagonal scale - calculation of yards and feets etc △
(3.) vernier scale - least count based on angles
(4) scale of chords - protractor ⌓ → identifying on curve.

principles of chain surveying :-

* The main principle of chain survey is to be provide ~~frame~~ form work which consists of number of well conditioned triangles.
* The triangle is to be well condition which contains no angle smaller then 30° and angle greater then >120°

Types of chains :-

1. metric chain → 30m, 20m
2. Gunter chain
3. Engineering chain → 100 feet → ... at every 1 feet
4. Revenew chain
5. steel chain → for ... 30m

Instruments of chain survey :-

1. chain
2. Tape
3. Ranging rods
4. offset rods
5. pegs
6. cross staff → short offset
7. optical square → more accuracy → long offset
8. Arrows
9. plumbob

Errors in chaining :-

(1) Instrumental errors → Instrument defect

(2) Observational errors

(a) gross errors → careless ness, blunder mistake [without have me]

(b) systematic error → Arithmatic error

(c) accendital error, → due to human defect
(or)
random error

8m Correction to be applied :-

(a) Type's

⇒ length correction

⇒ Temperature correction

⇒ pull correction

⇒ Sag correction

⇒ slope correction

Error :- measured value − true value

correction :- True value − measured value

observed + measured correction

1 length correction :- $\boxed{\text{correct distance} = \left(\frac{L'}{L}\right) \times \text{measured distance}}$

L' = actual incorrect length of chain

L = ~~lengt~~ destinated length of chain

2 Temperature correction :-

changes in temperature

$$\boxed{C_t = \alpha\left(T_m - T_0\right) \times L}$$

α = coefficient of thermal expasion

T_m = mean temperature during the measurement

T_0 = standard temperature

L = measured distance

(3) pull correction :-

$$\boxed{C_P = \left(\frac{P-P_0}{AE}\right) \times L}$$

P = pull applyed during the measurement
P_0 = standard pull
L = measured length
A = cross section area
E = Youngs modulus of elasticity

(4) Sag correction :-

$$\boxed{C_S = \frac{LW^2}{24 n^2 P^2}}$$

L = destinated length
P = pull applyed
W = Total weight of Tape
n = Number of Equal Bays (on span)

(5) slope correction :-

$$\boxed{C_S = \frac{h^2}{2L}}$$

If θ is given then $\boxed{C_S = L(1 - \cos\theta)}$

Problem :- 10M

20m steel tape was standardised on a flat ground at a temperature of 20°c under the pull of 15kg. The tape was used in catenary at the temperature of 30°c under the pull of 10kg. The C/s area of a Tape is 22mm² and total weight is 400gms. the Youngs modulus and coeffecient of thermal expansion for the steel tape is 21000 kg/mm² and 11×10^{-6}/°c respectively find corrected distane

(If H is 5cm then what is the slope correction

Given :—

Length — 20m

$T_0 = 20°C$

$T_m = 30°C$

$P_0 = 15kg$

$P = 10kg$

$A = 22mm^2$

$w = 400grams - 0.4kg$

$\alpha = 11\times10^{-6}$

$E = 21000kg/mm^2$

$h = 5cm = 0.5$

(i) correction for temperature :—

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

$$= 11\times10^{-6}(30-20)\times20$$

$$= 2.2\times10^{-3} \rightarrow$$

$$= \boxed{0.0022}$$

(ii) correction for pull

$$C_P = \left(\frac{P-P_0}{AE}\right)L$$

$$= \left(\frac{10-15}{22\times21000}\right)\times20$$

$$= -0.000216$$

(iii) correction for ~~slope~~ slope

$$C_s = \frac{h^2}{2L}$$

$$= \cancel{\frac{(0.05)^2}{2\times20}}\ \frac{5^2}{2\times20}$$

$$= \cancel{0.625}$$

$$= 6.25\times10^{-5} = 0.000063$$

for sag $= \frac{Lw^2}{24n^2p^2}$

$$= \frac{20\times(0.4)^2}{24\times(1)^2\times10^2}$$

$$= -0.00133M$$

Total correction $= C_t + C_p - C_s + S_i$

$= 0.0022 - 0.000216 - 0.00133 + \overset{0.625}{\cancel{0.00006}}$

$= 0.625\,m$

Total length $= 20 + 0.625$

$= \boxed{20.625\,m}$

(2) A line was measured with a steel tape 30m at 25°c and pull of 15kg the temperature during the measurement was 35°c and pull applyed 25kg. Assuming Tape to be Supported at Every 30m, calculate True length, If c/s Area 0.020 m², co-efficient of thermal expantion 3×10^{-6}, modulus of elasticity 2.1×10^{6} the weight of total material 0.8 kg.

Given :-

length = 30m

$T_0 = 25°C$

$P_0 = 15kg$

$T_m = 35°C$

$P = 25kg$

$A = 0.020m^2$

$\alpha = 3\times10^{-6}$

$E = 2.1\times10^{6}$

$\omega = 0.8kg$

(i) correction for temperature :-

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

$= 3\times10^{-6}(35 - 25°) \times 30$

$= \boxed{0.000900}$

(2) Correction for pull :-

$$C_s = \left(\frac{P - P_0}{AE}\right) \times L$$

$$= \left(\frac{25 - 15}{0.020 \times 2.1 \times 10^6}\right) \times 30$$

$$= \boxed{0.00714m}$$

(3) correction for sag :-

$$= \frac{Lw^2}{24 \times n^2 \times P^2}$$

$$= \frac{30 \times (0.8)^2}{24 \times 1 \times (25)^2}$$

$$= \boxed{0.00128\ m}$$

(4) Total correction :-

$$= 0.000900 + 0.00714 - 0.00128$$

$$= 0.0067$$

Total Length $= 30 + 0.0067$

$$= \boxed{30.006m}$$

(3) A steel tape 20m long standaridised at 55°C with a pull of 10 kg. find correction for Tape length if Temperature at the Time of measurement is 80°C. weight of the tape 0.8kg and area 0.051 cm², coefficient of Expansion 62×10^{-6} Elasticity is 2.109×10^6 kg/cm² pull extracted is 16 kg

Given,

Length = 20

$T_0 = 55°C$

$P_0 = 10\ kg$

$T_m = 80°C$

$P = 16 kg$

$w = 0.8 kg$

$\alpha = 6.2 \times 10^{-6}$

$E = 2.109 \times 10^6$

$A = 0.051 cm^2$

(1) Correction for temperature

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

$$= 6.2 \times 10^{-6} (80 - 55) \times 20$$

$$= \boxed{0.0031 m}$$

(2) Correction for pull :-

$$C_s = \left(\frac{P - P_0}{AE} \right) \times L$$

$$= \left(\frac{16 - 10}{0.051 \times 2.109 \times 10^6} \right) \times 20$$

$$= 0.0011 m$$

(3) Correction for sag :-

$$C_s = \frac{L w^2}{24 n^2 \times P^2}$$

$$= \frac{20 \times (0.8)^2}{24 \times 1^2 \times 16^2}$$

$$= \boxed{0.00208 m}$$

Total correction :-

$$= 0.0031 + 0.0011 - 0.00208$$

$$= \boxed{0.0021}$$

Total length :-

$$= 20 + 0.0021$$

$$= \boxed{20.0021 m}$$

prismatic compass :-

principle of compass surveying :-

The principle of compass surveying is traversing which involves series of connected lines

working of prismatic compass :-

The working of prismatic compass involves the following steps

Centering :- levelling, observing the bearing

Types of bearings :-

Types of meridian :-

meridian is a standard direction from which bearings of survey lines are measured

There are three types of meridians.

1. True meridian
2. magnetic meridian
3. arbitary meridian

[It is convinent direction Assumed as meridian for measuring of bearings]

bearing :-

It is an horizontal angle made by survey lines with referance to meridian

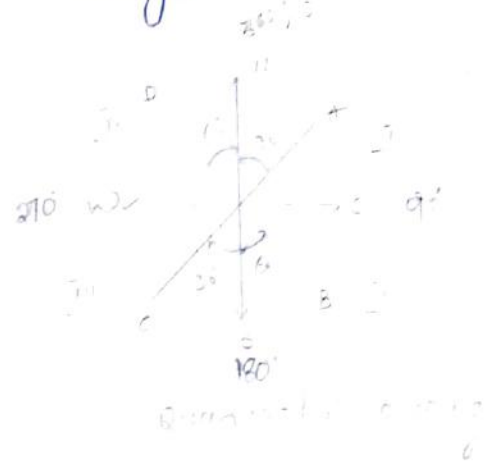
Types

1 True bearing
2 magnetic bearing
3 arbitrary bearing

Representation of bearing :-

1. W.C.B [whole circle bearing]

2. Quadrantal bearing



Conversion of whole circle bearing into Quadrantal bearing :-

S NO	W.C.B	Q.B	Rule
1.	B/w 0° - 90°	NE	QB = WCB
2	B/w 90° - 180°	SE	QB = 180 - WCB
3	B/w 180° - 270°	SW	QB = WCB - 180
4.	B/w 270° - 360°	NW	QB = 360 - WCB

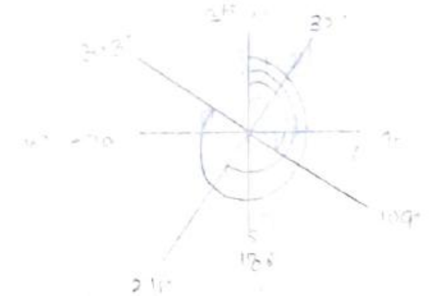
① Convert the following W.C.B lines in to QB.

(a) OA 32°

(b) OB 109°

(c) OC 211°

(d) OD 303°



Solution:- W.C.B. of OA = 32°

(a) QB = WCB

$\boxed{32° = N32°E}$

(b) W.C.B. of OB = 109°

QB = 180 - WCB

= 180° - 109°

$\boxed{= S71E}$

W.C.B of OC = 211°

(c) QB = WCB - 180

= 211 - 180°

$\boxed{= S31W}$

W.C.B of OD = 303°

(d) QB = 360° - WCB

= 360° - 303°

$\boxed{= N57W}$

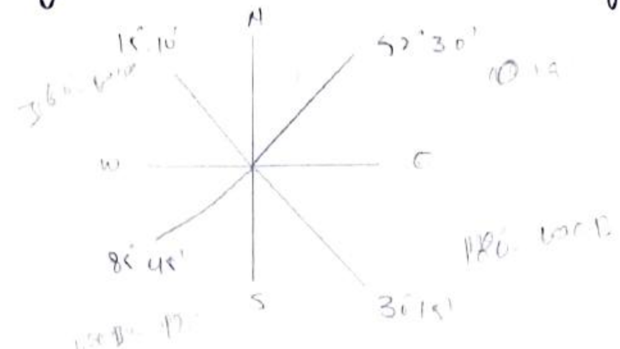
2. Convert Reduced Bearing in to whole circle bearing

(a) N 52°30' E (NE)

(b) S 30° 15' E (SE)

(c) S 85° 45' W (SW)

(d) N 15° 10' W (NW)



(a) WCB = RCB

= N 52° 30'

(b) S 30° 15' E

RB = 180 − WCB

= 180 − 30°15'

= 149°45'

(c) RB = WCB + 180°

= 85°45' + 180°

= 265°45'

(d) RB = 360° − WCB

= 360° − 15°10'

= 344°50'

Local attraction :-

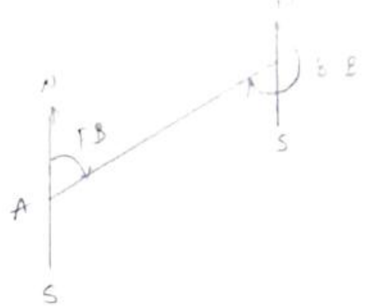
Local attraction is also known as error value. The compass needle is affected by presence of iron and steel such as electric cables, steel girders etc. they will deflect the needle and this disturbance effect is known as local attraction.

Fore bearing and back bearing :-

fore bearing :-

Fore bearing is a line measuring forward direction of survey lines

1



Back Bearing :-

Back Bearing is a line meaning forward backward direction is called Back Bearing

without error

① The followings observed in traversing with compass where local attraction is suspended. find amount of local attraction. at different stations, correct the bearing of lines and inclined angles

Line	FB	BB
AB	59° 00'	239° 0'
BC	139° 30'	317° 0'
CD	215° 15'	36° 30'
DE	208° 0'	29° 0'
EA	318° 30'	138° 45'

Note :- The difference between fore bearing and back bearing of surveylines should be equal to 180°

Solution :-

The line AB

BB of BA - FB of AB

= 239° 0' - 59° 00' [No correction of A]

= 180° 0'

The line EA

B.B of EA − F.B of AE

$= 138°45' - 318°30'$

$= -179°45'$

Adding

The line EA

$=$ FB of EA − BB of EA

$= 318°30' - 138°45'$

$= 179°45'$

$= 180° - 179°45'$

$= 0°15'$

Here 0°15' Correction at "E"

The line DE

$=$ Actual + correction

$= 29°0' + 0°15'$

$= 29°15'$

$=$ F.B of DE − B.B of ED

$= 208°0' - 29°15'$

$= 178°45'$

$= 180° - 178°45'$

$= 1°15'$

Here 1°15' correction at D

The line CD

$=$ Actual + Correction

$= 36°30' + 1°15'$

$= 37°45'$

= F.B of CD − B.B of DC

= 215° 15′ − 37° 45′

= 177° 30′

= 180 − 177° 30′

= $\boxed{2° 30′}$

Here 2° 30′ correction at C

The line BC

local

= Actual + correction

= 317° 0′ + 2° 30′

= 319° 30′

= B.B of BC − F.B of CB

= 319° 30′ − 139° 30′

= ~~177° 30′~~ = $\boxed{180° 0′}$

= ~~180 − 177° 30′~~

~~= 2° 30′~~

~~Here 2° 30′ correction at B~~

~~The line AB~~

~~= Actual~~

Total corrections A = 0, B = 0

C = 2° 30′, D = 1° 15′

E = 0° 15′

= 2° 30′ + 1° 15′ + 0° 15′

= 4° 0′ 0″

∴ local attraction is 4° 0′ 0″   180 − 180

The following bearings where observed while Traversing with compass

A = 0°

B = −25′

Line	F.B	B.B
AB	45° 45′ (A) 0	226° 10′ (B)
BC	96° 55′ (B)	277° 5′ (C)
CD	29° 45′ (C)	209° 10′ (D)
DE	324° 48′	144° 48′

226° 10′ + (−25′)

+ −

determine local attraction and corrected bearing.
~~It is a poen~~ open traversing.

Line	observed bearing	Correction	corrected bearing
AB	45° 45' (A	NO correction at A (Assume) 226° 10' − 45° 45'	45° 48'
BA	226° 10'	−0° 25' 00"	225° 45' 226° 10' − 0° 25'
BC	96° 55'	−0° 25'	96° 30' 277° 5' − 96° 30'
CB	277° 5'	−35'	276 30
CD	29° 45'	−35'	29° 10'
DC	209° 10'	NO correction at D=0	209° 10'
DE	324° 48'	NO correction at D=0	324° 48'
ED	144° 48'	NO correction at E=0	144° 48'

If it is open traverse Assume correction as 0° at A

A = 0°

B completed.

C = −35' error

A = ΦS Assuming a 18 a zero

line	F.B	B.B
AB	44° 40' (A)	223° 20' (B)
BC	96° 20' (B)	274° 18' (C)
CD	30' 40' (C)	212° 21' (D)
DE	320° 12' (D)	140° 12' E

Assuming A is a zero

Line	observed bearing	correction	Corrected bearing
AB	44° 40'	no correction at A (Assume)	44° 40'
BA	223° 20'		
BC	96° 20'		
CB	274° 18'		
CD	30' 40'		
DC	212° 21'	No correction at D = 0	212° 21'
DE	320° 12'	No correction at D = 0	320° 12'
ED	140° 12'	No correction at E = 0	140° 12'

274° 18' - 95° 40'

178° 38'

180 - 178 38

1° 22'

closed Traverse problems

Line	F.B	B.B
AB	75° 5'	254° 20'
BC	115° 20'	296° 35'
CD	165° 35'	345° 35'
DE	224° 50'	44° 5'
EA	304° 50'	125° 5'

interior angle below 180
exterior angle above 180

No Error at C, D = 180 = 180

There is no correction in C and D

Line	observed bearing	Correction	corrected bearing
AB	75° 5'	0° 30'	75° 35' at A
BA	254° 20'	1° 15'	255° 35' at A
BC	115° 20'	1° 15'	116° 35' at B
CB	296° 35'	No correction at 'c'	296° 35'
CD	165° 35'	No correction at 'c'	165° 35'
DC	345° 35'	No correction at D	345° 35'
DE	224° 50'	No correction at D	224° 50'
ED	44° 5'	-0° 45'	44° 50' at E
EA	304° 50'	0° 45'	305° 35' at E
AE	125° 5'	0° 30'	125° 35' at A

296° 35' − 116° 35' = 180° 00'

305° 35' − 125° 5'

① following Bearings are taken at closed traverse

Line	F.B	B.B
AB	86° 10' (A)	259° 0' (B)
BC	120° 20' (B)	301° 50' (C)
CD	170° 50' (C)	350° 50' (D)
DE	230° 10' (D)	49° 30' (E)
EA	310° 20' (E)	130° 15' (A)

compute interior angles and correct them with following Errors.

At angle ∠A = B.B of AE − F.B. of AB

= 130° 15' − 86° 10'

= 50° 5'

At angle ∠B = B.B of BA − F.B of BC

= 259° 0' − 120° 20'

= 138° 40'

At angle ∠C = B.B of − ~~CB~~ − F B of CD

= 301° 50' − 170° 50'

= 131° 0'

At angle ∠D = B.B of DC − F.B of DE

= 350° 50' − 230° 10'

= 120° 40'

At angle ∠E = B.B of ED − F.B of ~~EA~~

= 49° 50' − 310° 20'

= −260° 50'

= 360° − 260° 50'

= 99° 10'

Adding

<u>check :-</u> $(2n-4)\,90^\circ = \angle A + \angle B + \angle C + \angle D + \angle E$

$\Rightarrow (2\times5-4)\,90^\circ = 50^\circ 5' + 138^\circ 40' + 131^\circ 0' + 120^\circ 40' + 99^\circ 10'$

$= 540^\circ$

$= 540^\circ = 539^\circ 35'$

$= 540^\circ - 539^\circ 35'$

$\boxed{\text{Error} = 0^\circ 25'}$

$\angle A = 50^\circ 5' + 5' = 50^\circ 10'$

$\angle B = 138^\circ 40' + 5' = 138^\circ 45'$

$\angle C = 131^\circ 0' + 5' = 131^\circ 5'$

$\angle D = 120^\circ 40' + 5' = 120^\circ 45'$

$\angle E = 99^\circ 10' + 5' = 99^\circ 15'$

$\angle A + \angle B + \angle C + \angle D + \angle E = 540^\circ 0'$

$\therefore (2\times5-4)\,90^\circ = \angle A + \angle B + \angle C + \angle D + \angle E$

$540^\circ = 540^\circ$

(2) The bearings of closed traverse A, B, C, D, E

Line	F.B	B.B
AB	105° 15'	285° 1'
BC	20° 0'	200° 0'
CD	229° 30'	49° 30'
DE	187° 15'	7° 15'
EA	122° 45'	302° 45'

compute the interior angles

$\angle A$ = B.B of ~~AE~~ − F.B of AB

= ~~122°45'~~ − ~~105'~~

= 302° 45' − 105' 15'

$\angle A$ = 197° 30' = 360 − 197° 30' = 162° 30'

$\angle B$ = B. B of BA − F.B of BC

= 285° 15' − 20° 0'

$\angle B$ = 265° 1' − 360° = 94° 45'

$\angle C$ = B. B of CB − F.B of CD

= 200° 0' − 229° 30'

= +29° 30'

$\angle D$ = B. B of DC − F. B of DE

= 49° 30' − 187° 15'

= +137° 45'

$\angle E$ = B. B of ED − F. B of EA

= 7° 15' − 122° 45'

= 115° 30'

check = $(2n-4) 90° = \angle A + \angle B + \angle C + \angle D + \angle E$

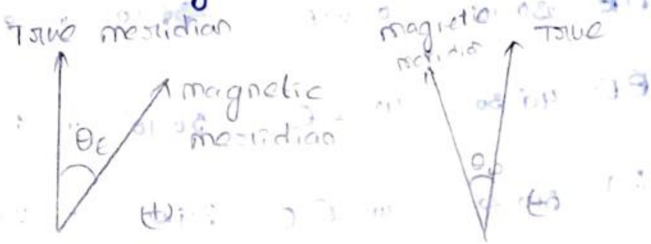
$(2 \times 5 - 4) 90°$ = ~~197°30'~~ 162° 30' + 94° 45' + 29° 30' + 137° 45' + 115° 30'

540°

540° = 540°

Declination:-

1. The Declination at a plane is horizontal angle between true meridian and magnetic meridian It is known as declination
2. If magnetic meridian is at right side [East side of true meridian] Then the declination is said to be positive
3. If It is at (west side) of true meridian that is said to be negative.



problem

① The following bearing is taken on a closed compass traverse.

Line		
AB	80° 10'	259° 0'
BC	120° 20'	301° 50'
CD	170° 50'	350° 50'
DE	230° 10'	49° 30'
EA	310° 20'	130° 15'

at what station do you suspect local attraction. determine correct magnetic bearing if declination was 5° 10' E than what is the true bearing

Line	observed	Correction	Corrected	True Bearing	Remark
AB	80° 10'	45' @A	80° 55' +5'10	86° 5'	
BA	259° 0'	1° 55' @B	260° 55' "	266° 5'	
BC	120° 20'	1° 55' @B	122° 15' "	127° 25'	
CB	301° 50'	0° @ C	301° 50' "	307° 0'	
CD	170° 50'	0° @ C	170° 50' "	176° 0'	
DC	350° 50'	0° @D	350° 50' "	356° 0'	
DE	230° 10'	0° @D	230° 10' "	235° 20'	
ED	49° 30'	40' @E	50° 10' "	55° 20'	
EA	310° 20'	40' @ E	311° 0' "	316° 10'	
AE	130° 15'	45' @A	131° 0' "	136° 10'	

The following F.B and B.B where observed in the traversing with a compass in the place where local attraction is suspected find corrected F.B and B.B and True Bearing of each lines. Given that magnetic direction 10° W.

Line		
AB	38° 30' (A)	219° 15' (B)
BC	100° 45' (B)	278° 30' (C)
CD	25° 45'	207° 15'
DE	325° 15'	145° 10'

Line	observed	Correction	Corrected	True Bearing	Remarks
AB	38° 30'	1° 30' @ A	40° 0' - 10°	30° 0'	
BA	219° 15'	0° 45' @ B	220° 0'	210° 0'	
BC	100° 45'	0° 45' @ B	101° 30'	91° 30'	Remain
CB	278° 30'	1° 30' at C	280° 0'	270°	Station A, B, C
CD	25° 45'	1° 30' at C	27° 15'	17° 15'	Affected
DC	207° 15'	0 @ D	207° 15'	197° 15'	both L.A
DE	325° 15'	0 @ D	325° 15'	315° 15'	
ED	145° 15'	0 @ E	145° 15'	135° 15'	

2M **Dip** :- Dip is also known as magnetic inclination.

2 The magnetic inclination is an angle made with horizontal by Earth magnetic field lines.

3 These lines lies in different points on Earth Surface.

Ranging :-

Ranging is known as method of locating or Establishing intermediate points on a straight line between two fixed points

There are two types of Ranging

1 Direct ranging

2 Indirect ranging

Plane table Surveying

It is an graphical method by which points are plotted on the paper

Apparatus

1. Spirit level

2. Alidade

3. Trough comass

4. plumbing forkman

5. plane table

6. Tape

7. Ranging rods

Errors:-

1. Instrumental Error

2. Sighting Error

3. plotting Errors

methods of plane table:- lab

1. radiation method

2. Intersecting method

3. Traverse method

4. resecting method

(a) Two point resecting problem

(b) Three point problem

UNIT :- 2

LEVELLING CONTOURING AND THEODOLITE SURVEYING

levelling

⇒ Basic Definations

⇒ Types of levels

⇒ Types of levelling staffs

⇒ Temporary adjustment

⇒ Methods of levelling.

(a) Hight of instrument

(b) Rise and fall

(c) Effects of curvacture and Refraction

Levelling :- It deals with determination of elevation of points.

Datum line :- Referance line

Any surface to which elevations are refered is known as datum.

mean sea level :-

The average height of sea at all the stages of tides at several places.

Elevation :-

Elevation is a point by which vertical distance of a point above and below the surface of Earth

Bench mark :- It is an relative permanent point of referance with respective datum line

Types of Bench mars :-

1) GTS [great trigrometric survey]
2) PWD permanent benchmark
3) Temporary benchmark
4) Arbatery bench mark

GTS :- It is Established by survey of India at a interval of 100 km all over the Conuntry

permanent bench mark :-

It is established between GTS bench mark By the central government agencies like PWD [public works department

These points are located at railways stations platform point and kilometer stones, wall of bridges

Temporary bench mark :-

It is a Referance point on which day work is closed and contined for next day.

Arbotary bench mark :-

It is an Assumed bench mark for small levelling

Fore sight :-

It is last sight taken before moving the Instrument.

Back sight :

It is a first sight taken after setting of the Instrument

Types of levels :-

1 Dumphy level
2 wye (or) Y level
3. Tilting level
4. Auto level.

Dumphy level :-
It is an simple and compact instrument, Telescope is rigidly [fixed] To its supports. where no rotations.

Tilting level
Tilting level is also known as Indian office Tilting level is slightly tilted [movement] pattern. In this telescope is slightly tilted

Y level :-
It is a combination of Dumphy level and tilting level. In This telescope is rotated and moved and rised.

Auto level :-
It is a self aligning instrument due to presence of compensation device [prism]
accuracy

Types of levelling staff :-
1. self reading levelling staff (target)
2 Target levelling staff

self reading :-
a. ordinary staff single stick 3m height
b. folding staff 2m
c. stop with telescopic staff 5m
generally used

Temporary Adjustments of Level

1. Setting up the level. leg Adjustment
2. levelling up foot screw Adjustment
3. Elemination of parallax - cross hair

Adjustment in Instrument

Methods of levellings

1. Barometric levelling - when used for Atmospheric pressure
2. Trignometric levelling - indirect level angle and distance form.
3. Sprit levelling - horizontal line on base

Atmospheric pressure $\propto$ to $1/H$

If α and D, values is known basic rules are applyed [sine rule cos rule] and we find the height

(a) Simple levelling

(b) differential levelling.
(c) fly levelling change of instrument
(d) profile levelling
(e) precise levelling - width length
(f) resiprocal levelling In case of rivers water bodyes

accuracy

determination of levelling :-

HI - Hight of Instrument

Rise and fall method

Hight of Instrument:-

$HI = B.S + RL$

$RL = HI - FS$ (or) IS - Intermidiate sight

Hight of instrument is also called collimation

problem:-

The following staff readings where observed Successfully with level of instrument having 0.675, 1.230, 0.750, 2.565, 2.225, 1.935, 1.835, 3.220, 3.115 and 2.875. The first staff reading was taken with staff held on bench mark with reduced level 100m.

The Instrument have been shifted After the second 2nd, 5th and 8th reading Enter the readings in the level book and find R.L of the points

Station	B.S	I.S	F.S	HI	RL
	0.675			100.675	100
	0.750		1.230	99.445 + 0.750 = 100.195	99.445
		2.565			100.195 − 2.565 = 97.630
	1.935		2.225	97.970 + 1.935 = 99.905	100.195 − 2.225 = 97.970
		1.835			98.07
	3.115		3.220	96.685 + 3.115 = 99.8	99.905 − 3.220 = 96.685
			2.875		96.925
	ΣBS		ΣFS		

check :-

$\Sigma BS - \Sigma FS$ = last RL − first RL

6.475 − 9.550 = 96.925 − 100

3.075 = 3.075

Rise and fall method:-

1. The following readings where observed successfully with levelling Instrument. The Instrument has shifted after 5th and 11th reading
0.585, 1.010, 1.735, 3.295, 3.775, 0.350, 1.300, 1.795, 2.575, 3.375, 3.895, 1.735, 0.635, 1.605.
Draw page of level book and determine RL at various points By which first reading of RL was taken as 135.00 m.

Station	B.S	I.S	F.S	Rise	Fall	R.L
A	0.585					135.00
		1.010			0.425	134.575
		1.735			0.725	133.85
		3.295			1.560	132.290
B	0.350		3.775		0.480	131.810
		1.300			0.950	130.86
		1.795			0.495	130.365
		2.575			0.780	129.585
		3.375			0.800	128.785
C	1.735		3.895		0.520	128.265
		0.635		1.1 (+)		129.365
			1.605		0.970	126.395
	$\Sigma BS = 2.60$	$\Sigma FS = 9.295$		$\Sigma R = 1.1$	$\Sigma F =$	

$\Sigma BS - 2.610$

$\Sigma FS = 9.275$

Σ Raise $= 1.1$

Σ fall $= 7.705$

check :-

$\Sigma BS - \Sigma FS = 2.610 - 9.275 = -6.605$

$\Sigma R - \Sigma F = 1.1 - 7.705 = -6.605$

last RL - first RL

128.395 - 135

$= -6.605$

(2) The following readings where observed successfully with levelling Instrument the Instrument has shiffted 6^{th}, 10^{th}

0.680, 1.455, 1.855, 2.330, 2.885, 3.880, 1.055, 1.860, 2.265, 3.540, 0.835, 0.945, 1.530, 2.250, RL was 80.750

Station	B.S	I.S	F.S	Rise	Fall	R.L
	0.680					80.750
		1.455			0.775	79.975
		1.855			0.4	79.575
		2.330			0.475	79.1
		2.885			0.555	78.545
	1.055		3.880		0.495	78.05
		1.860			0.805	77.245
		2.265			0.405	76.84
	0.835		3.540		1.275	75.565
		0.945			0.11	75.455
		1.530			0.585	74.87
		2.250			0.72	74.15

$\Sigma BS =$ [illegible]

$\Sigma FS = 692$

$\Sigma R =$ [illegible]

$\Sigma F_{al} = 66$

Last R = 74.15 [illegible]

First R = [illegible]

Check:

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

$0 - 66 = 74.15 - 80.750$

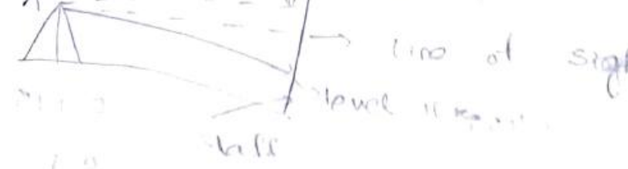
$66 = 66$

Effects of curvature on levelling

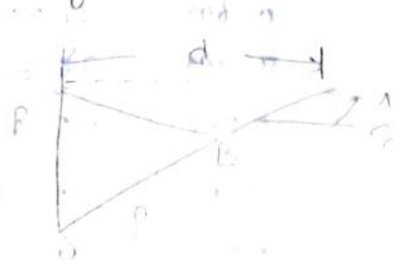
1. human error
2. Instrumental error
3. Natural error

   (a) curvature error → Depend on earth

Instrument has a more distance [illegible] there is a form of error



If the distance is less the line of sight and horizontal line will be lie on same line single line



By applying pythogroes theorem :-

$$(R+C_c)^2 = R^2 + d^2$$

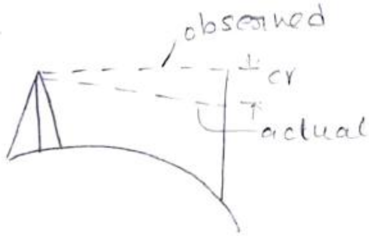
$$R^2 + 2RC_c + C_c^2 = R^2 + d^2$$

$$C_c(2R + C_c) = d^2$$

$$C_c = \frac{d^2}{2R+C_c} = \frac{d^2}{2R}$$

C_c is negatibe

<u>Refraction</u>:-



$$C_R = \frac{1}{7} C_c$$

$$C_R = \frac{1}{7} \times \frac{d^2}{2R}$$

$$\boxed{C_R = \frac{d^2}{14R}}$$

In rise and fall method the gradient is

$$\text{gradient} = \frac{\Sigma \text{fall}}{L(n-2)}$$

n = no. of readings

Included = previous line ± 180 − Next line.

UNIT :- 2

Count Contouring :-

=> Definition
=> uses of contours
=> Characteristics of contours
=> methods of contour
=> Interpolation method
=> Drawing of contour

Definition :-

It is an Imaginary line on the ground surface joining points of Equal Elevations.
Joining lines is known as contour lines
A group of contour lines Represents contour map.

Contour Interval :-

The vertical distance between any two consecutive contours. is called Contour Interval
(or)
Joint It is a difference between RL of two contours is known as contour interval

Horizontal Equivalent :-

The horizontal distance between any two contours consecutive contours is called horizontal equivalent

Contour gradient :-

$$= \frac{\text{contour Interval}}{\text{Horizontal equivalent}}$$

The ratio between contour Interval and horizontal Equivalent

Use's of contours :-

1. It is used to calculate capacity of reservoir
2. It is used to calculate slope of drainage
3. It is used to align canals, roads, and railway lines
4. It is used to determine direction of ground surface
5. It is estimated quantity of cutting and filling
6. It is used to find the possible route of communication between two points.

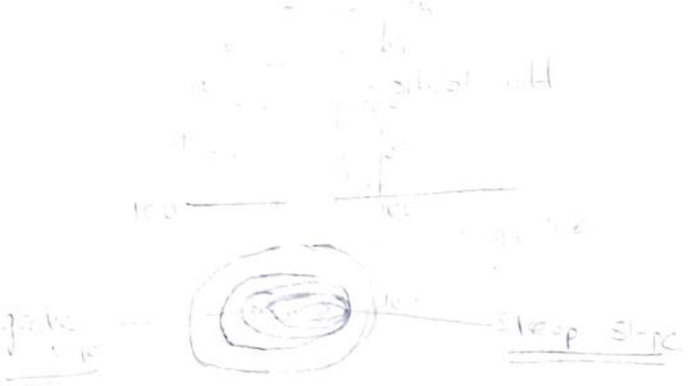
characteristics of contour (or) properties of contour

1. Two contour lines of different elevations can cross eachother in the case of over hanging cliff

2

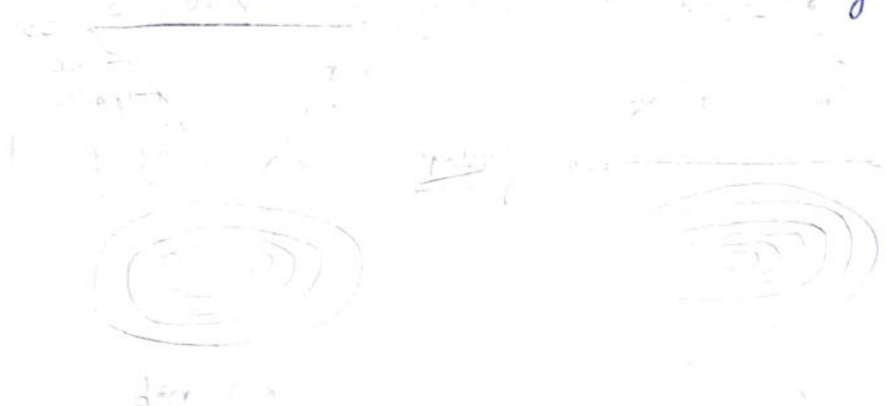
2. If two contour lines of different elevations can unite to form a line

In the case of ~~cliff~~ vertical cliff



3. contour lines are close together which indicates steep slope.
4. If contour lines apart ~~(...)~~ [for] which indicates gentle slope.

5. If contour lines with more higher ~~val~~ RL values Inside which represents hill
6. If ~~Reen'~~ contour lines with ~~two~~ more lower RL values Inside which represents ~~valley~~ valley



7 The contour lines cross with ridge line at a right angle it forms u-shape contours
8 The contour lines cross with valley line at a right angle it forms V-shape contours

U shape V shape

10. The contour lines must be close's but cannot be with in the limit of map [map scale]

Methods of contours:-

1. direct method
2. Indirect method

Direct method:-

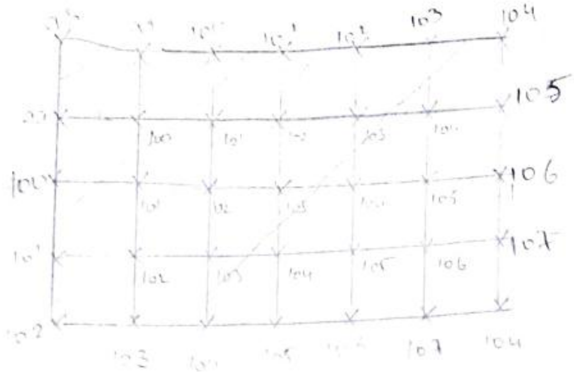
1. In this method R.L values are joined directly on the field
2. This method is suitable in the case of smaller areas.
3. It is highly accuracy.
4. This method takes more time consumption
5. This method is expensive.

Indirect method:-

1. In this method contour lines are joined with the reference to guiding points

It is divided in to ~~three~~ two types

(a) Square method (or) Coordinate method
(b) Cross sectional method



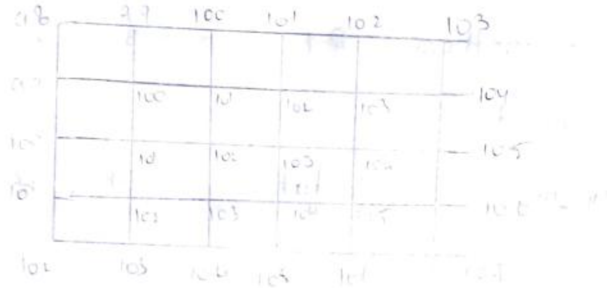
RL = 98.5

99.5

100.5

1. This method is suitable for larger areas
2. It is haviving low accuracy
3. It consumes less time
4. It is less expensive

Cross section method :-



1. It is suitable for very large areas
   Eg :- roads, railways, Canal Etc
2. It having low accuracy
3. It consumes less time
4. It is not expenciy

Interpolation method :-

1. Estimation method
2. Arthmatic calculation method
3. graphical method

Estimate method :-

This method is used for small scale work only

2. This method is extremely rough method

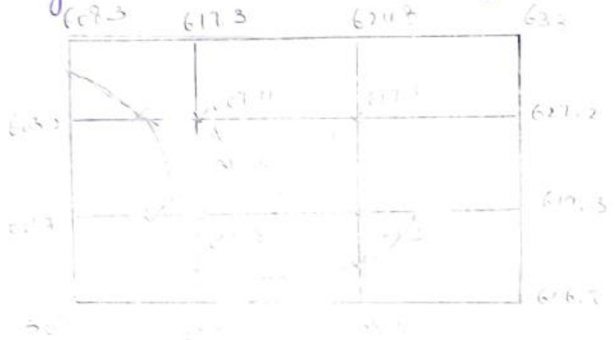
3. In this method position of contour between guiding point are located. By Estimation

Arthmatic Calculations :-

1. It is very accurate method. and time consuming

2. The position of contour points are located by arthmatic Calculations.

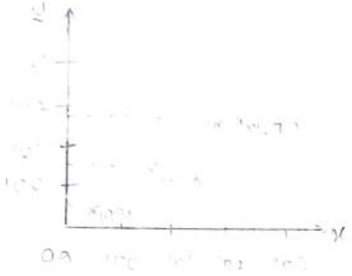
Ex:- a, b, c, d are the guiding points having Elevations 607.4, ~~[illegible]~~, ~~[illegible]~~, 611.3, 612.5, 604.3 respectively as shown in fig



position of 605, 615, will be passess through a, b, c, d.

graphical method:-

In this method the points are plotted based on x-axis and y-axis



Drawing (or) Sketching of contours :-

1. After Interpolation of contour between the guide points are joined smoothly and it forms smooth Curve

2. while drawing the contour line fundamental properties should be consider.
(characteristics)

3 contour lines should be Inked with the help of black and brown colour

4. The contour lines for roads, canals and railway lines should be shown in brown colour.

UNIT :- 3.

Areas & volumes

Areas:- Question

=> Determination of area consisting Regular Intervals
=> Determination of area consisting Irregular Intervals

Methods of calculating areas (or) computation of area :-

1. Dividing total area in to Number of triangles.
2. Imp Based on offset to the base line.
3. Based on latitudes. and departures. directions
4. Based of co-ordinates. Total station
5. Based on map.
6. Based on mechanical method. planimeter is a mechanical device

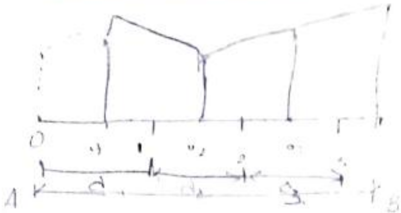
Based on offsets to the base line (larger areas)

There are four rules used for calculating area Based on offsets to the base line.

1. Mid-ordinate rule.
*2. Average (or) mean ordinate rule
**3 Trapezoidal rule
**4 Simpson's one third rule

Mid-ordinate rule :-

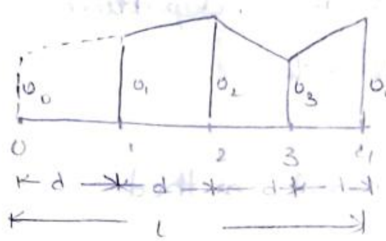
In this rule Base line is divided in to No. of divisions and ordinates are measured mid point of each division

Irregular


formula :-

$$\boxed{A = d\Sigma O}$$ ΣO = ordinates, sum of mid coordinates
d = distance of each divisions

2. Mean (or) Average ordinate rule :-



In this method offsets are measured to each point of division of the base line.

formula :-

$$\boxed{A = \frac{L}{n+1}\Sigma O}$$ $A = \frac{n-1}{n}(O_0+O_1+O_2+ \dots +O_n)d$

$L = n \times d$
L = length of base line
n = number of divisions.
d = distance at each division
ΣO = sum of ordinates

3. Trapezoidal rule :-

In this Rule we will assume figures as Trapezoids this method is more accurate than the above methods

formula :-

$$A = \left[\left(\frac{O_0+O_n}{2}\right) + O_1+O_2+O_3+ \dots +O_{n-1}\right]d$$

Simpson's one third rule :-

$$A = \frac{d}{3}\left[(O_0 + O_n) + 4(O_1 + O_3 + O_5 + \dots + O_{n-1}) + 2(O_2 + O_4 + \dots + O_{n-2})\right]$$

Note :- Simpson's rule is applicable only when Number of ordinates in odd conditions

O = ordinates

n = Number of ordinates

d = distance at each division

Regular interval problems (or) Regular boundary problems

1) The following perpendicular offsets where taken at every 10m interval from the survey line two an irregular boundary line calculate Area between the survey lines at irregular boundary lines by applying

(i) mid ordinate

(ii) Average (or) mean ordinate

(iii) Trapezoidal rule

(iv) Simpsons rule

O_0	O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8
3.25	5.60	4.20	6.65	8.75	6.20	3.25	4.20	5.65

(i) mid rule

$A = d \Sigma O$

$= 10(O_0 + O_1 + O_2 + O_3 + \dots + O_8)$

$= 10(3.25 + 5.60 + 4.20 + 6.65 + 8.75 + 6.20 + 3.25 + 4.20 + 5.65)$

$= 477.559 \text{ m. } \text{sq}m^2$

(ii) Average rule

$n =$ no. of ordinates $= 9$

$$A = \frac{9-1}{9}(3.25 + 5.60, 4.20 + 6.65 + 8.75 + 6.20 + 3.25 + 4.20 + 5.65)$$

$= 42.44\ m^2$

(iii) Trapezoidal rule

draught

$$A = \left[\frac{O_0 + O_n}{2} + (O_1 + O_3 + O_4 + \ldots + O_{n-1})\right] d$$

$$= \left[\frac{3.25 + 5.65}{2} + (5.60 + 4.20 + 6.65 + 8.75 + 6.20 + 3.25 + 4.20)\right] \times 10$$

$4.45 + 38.85$

$= 433\ m^2$

43.3×10

(iv) Simpson's rule

$$\frac{d}{3}\left((O_0 + O_n) + 4(O_1 + O_3 + O_5 + O_7) + 2(O_2 + O_4 + O_6 + O_8)\right)$$

$$= \frac{10}{3}\left((3.25 + 5.65) + 4(5.60 + 6.65 + 6.20 + 4.20) + 2(4.20 + 8.75 + 3.25)\right)$$

$= 439.67\ m^2$

The series of offsets where taken from chain line to a curved boundary line at Interval of 15m. Compute Area between chain line, curved boundary and end of offsets by using average ordinate rule trapezoidal rule, Simpson's rule

$0, 2.65, 3.80, 3.75, 4.65, 3.60, 4.95, 5.85$
$O_0 \quad O_1 \quad O_2 \quad O_3 \quad O_4 \quad O_5 \quad O_6 \quad O_7$

(i) Average

$= \frac{8-1}{8}\left[0+2.65+3.80+3.75+4.65+3.60+4.95+5.85\right) \times 15$

$= 3\cancel{8}3.95\ m^2$

(ii) Trapezoidal

$\frac{O_0+O_n}{2} + O_1+O_2+O_3+ \dots + O_7)d$

$= \frac{0+5.85}{2} + (2.65+3.80+3.75+4.65+3.60+4.95)15$

$= 394.8\ m^2$

(iii) Simpson's rule In even case only we can use this method

$0, 2.65, 3.80, 3.75, 4.65+3.60, 4.95.$

Apply Simpson's rule from 1 to 7^{th} ordinate

$\frac{15}{3}\left[(0+4.95) + 4(2.65+3.75+3.60) + 2(3.80\ 4.65)\right)$

$= 309.25\ m^2$

8^{th} ordinate $\rightarrow \frac{O_0+O_n}{2} \times d$

$= \frac{4.95+5.85}{2} \times 15 = 81\ m^2$

Total Area $= 309.2 + 81$

$= 390.2\ m^2$

Irrigular boundaryes :-

The distance between Each division will not be same (or) Equal

problems

(1) The following perpendicular offsets where taken from chain line ~~to~~ an irrigular boundary.

chainage :-	0	10	25	42	60	75
offsets :	15.5	36.2	31.8	21.6	29	31.5

Calculate Area between chain line, boundary and end offsets by using trapezoidal rule

Solution :-

Trapezodial rule

$$\Delta = \left(\frac{O_0 + O_n}{2}\right) d$$

Area $\Delta_1 = \left(\frac{15.5 + 26.2}{2}\right) \times 10 = 208.5\ m^2$

$\Delta_2 = \left(\frac{26.2 + 31.8}{2}\right) \times 15 = 435\ m^2$

$\Delta_3 = \left(\frac{31.8 + 25.6}{2}\right) \times 17 = 487.9\ m^2$

$\Delta_4 = \left(\frac{25.6 + 29}{2}\right) \times 18 = 491.4\ m^2$

$\Delta_5 = \left(\frac{29 + 31.5}{2}\right) \times 15 = 453.7\ m^2$

Total Area $= \Delta_1 + \Delta_2 + \Delta_3 + \Delta_4 + \Delta_5$

$= 2076.5\ m^2$

(2) The following perpendicular offset, where taken from chain line as follows. Calculate Area between survey line, boundary and end offset by using Trapezoidal rule and Simpsons rule

Chainage	0	15	30	45	60	70	80	100	120	140
offset	7.60	8.5	10.7	12.8	10.6	9.5	8.3	7.9	6.4	4.4

(1) $d = 15$

(2) $d = 10$

(3) $d = 20$

Trapezoidal rule

$$\Delta_1 = \left[\frac{O_0 + O_n}{2} + \Sigma O\right] d$$

consider section (1)

$$\Delta_1 = \left[\frac{0 + 60}{2} + 15 + 30 + 45\right] \times 15$$

$$\Delta_1 = \left[\frac{7.60 + 10.6}{2} + 8.5 + 10.7 + 12.8\right] \times 15$$

$\Delta_1 = 616.5\ m^2$

consider section (2)

$$\Delta_2 = \left[\frac{10.6 + 8.3}{2} + 9.5\right] \times 10$$

$= 189.5\ m^2$

consider section (3)

$$\Delta_3 = \left[\frac{8.3 + 4.4}{2} + 7.9 + 6.4\right] \times 20$$

$= 413\ m^2$

$\therefore$ Total Area $= \Delta_1 + \Delta_2 + \Delta_3$

$= 616.5 + 189.5 + 413$

$= 1219\ m^2$

<u>Simpson's</u> <u>rule</u> :-

Section (1)

$= \frac{d}{3}\left[(O_0+O_n) + 4(O_1+O_3) + 2(O_2+O_4)\right]$

$= \frac{15}{3}\left[(7.60+10.6) + 4(8.5+12.8) + 2(10.7)\right]$

~~10.6~~ 25.2 21.4

$= \cancel{4386}\ m^2$ $624\ m^2$

Section (2)

$= \frac{d}{3}\left[(O_0+O_n) + 4(10.6)\right]$

$= \frac{10}{3}\left[10.6+8.3) + 4(9.5) + 2(0)\right]$

$= 189.67\ m^2$

Section (3)

8.3 7.9 6.4 4.4

Apply this rule ~~form~~ from 1 to 3

$= \frac{20}{3}\left[(8.3+6.4) + 4(7.9) + 2(0)\right]$

$= 308.67\ m^2$

4^{th} ordinate $\rightarrow \frac{O_0+O_n}{2} \times d$

$= \frac{6.4+4.4}{2} \times 20$

$= 108$

Total area $= 308.67 + 108$

$= \cancel{507.67 m^2}$ $416.6\ m^2$ — Δ_3

Total area $= A_1 + A_2 + A_3$

$= 624 + 189.67 + 416.6$

$= 1230.3 m^2$

Volumes :-

~~Synopsis~~. Question

1. determination of volume by using C/sectional level mthod
   (a) Trapezoidal formula
   (b) prismoidal formula (Simpsons)

[volume of earth work, cuttings, and embankments]

2. Determination of volume for barrow pits

Determination of volume by using cross sectional method.

Volume = A×L

There are 5 cross setionals are present

1. level section
2. Two level section
3. Three level section
4. Side hill two level section
5. Multilevel section.

level section :-

$$\boxed{A = (b+nh)\,h}$$

Here
b = width of formation
h = depth of formation (or) height from center
n = horizontal to 1 vertical (ground level)

1 in 2 $n = 2$

Two level Section :-

$$A = \frac{\left[n \times \left(\frac{b}{2}\right)^2 + m^2 (bh + nh^2) \right]}{(m^2 - n^2)}$$

Here,

m = Horizontal distance to 1 vertical

[Inclined condition]

Three- level section :-

$$A = \left[\frac{b}{4} (h_1 + h_2) + \frac{h}{2} (w_1 + w_2) \right]$$

h_1, h_2 = side heights.

w_1, w_2 = side width

For calculating volume at cross section Level method we have two formulas

1. Trapezoidal formula

$$V = d \left[\frac{A_1 + A_n}{2} + A_2 + A_3 + \dots + A_{n-1} \right]$$

2. prismoidal formula

$$V = \frac{d}{3} \left[A_1 + A_n + 4 (A_2 + A_4 + A_6 + \dots) + 2 (A_3 + A_5 + A_7 + \dots) \right]$$

problems

(1) The parismoidal Railway Embankment 10m width with side slope 1½ to 1 Assume ground is to be levelled in a direction to a center line. with Calculate volume in a length of 120m, the centre height at 20m Interval being 2.2, 3.7, 3.8, 4.0, 3.8, 2.8, 2.5.

Given,

width of formation (b) = 10m

Side slope = 1½ : 1

$n = 1.5$

Total length = 120m.

Interval = 20m.

Same level

$$A = (b+nh)h$$

$$A_1 = (b+n\times h_1)h_1 = (10+1.5\times 2.2)2.2 = 29.26\ m^2$$

$$A_2 = (10+1.5\times 3.7)3.7 = 57.53\ m^2$$

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

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

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

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

$$A_7 = (10+1.5\times 2.5)\ 2.5 = 34.37\ m^2$$

Trapesoidal

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

$$= 20\left[\frac{29.26+34.37}{2}+57.53+59.66+64+59.66+59.76+34.37\right]$$

$$V = 6249.8 \, m^3$$

prismoidal

$$V = \frac{d}{3}\left((A_1 + A_n) + 4(O_2 + O_4 + O_6 + \dots) + 2(O_3 + O_8 + \dots) \right)$$

$$= \frac{20}{3}\left[(A_1 + A_n) + 4(A_2 + A_4 + A_6) + 2(A_3 + A_5) \right)$$

$$= \frac{20}{3}\left[\underbrace{(29.26 + 34.51)}_{63.56} + 4\underbrace{(57.53) + 64 + 36.7)}_{632.92} + 2\underbrace{(59.6 + 59.6)}_{238.4} \right]$$

$$= 6316.36 \, m^2$$

(2) The railway embankment 400m long 12 m wide at any formation level, it has side slope 2:1. The ground level at every 100m along the central line as follows. The formation level at 0 chainage is 207. and embankment has raising gradient 1 in 100. The ground is level across central line Calculate the volume of earth work.

Distance	0	100	200	300	400
RL	204.8	206.2	207.5	207.2	208.3

In-tvlar 100

Given,

$b = 12 \, m$

$n = 2$

$h = ?$

total $= 400m$.

Distance	R.L	formation level (1 in 100)	depth
0	204.8	207.0	207 - 204.8 = 2.2
100	206.2	208	208 - 206.2 = 1.8
200	207.5	209	1.5
300	207.2	210	2.8
400	208.3	211	2.7

Level Section :-

Area

$A_1 = (12 + 2\times2.2)\,2.2 = 36.08\,m^2$

$A_2 = (12 + 2\times1.8)\,1.8 = 28.08\,m^2$

$A_3 = (12 + 2\times1.5)\,1.5 = \cancel{63.0\,m^2}\ 22.5\,m^2$

$A_4 = (12 + 2\times2.8)\,2.8 = 49.2\,m^2$

$A_5 = (12 + 2\times2.7)\,2.7 = 46.9\,m^2$

Trapezoidal :-

$$V = d\left[\frac{A_1 + A_n}{2} + A_2 + A_3 + A_4\right]$$

$d = 100$

$$= 100\left[\frac{36.08 + 46.9}{2} + 28.08 + 22.5 + 49.2\right]$$

$$= 14127\,m^3$$

Prismoidal

$$= \frac{100}{3}\left[(36.08 + 46.9) + 4(28.08 + 49.2) + 2(22.5)\right]$$

$$= 14587\,m^3 \quad 14570$$

(3) find out volume of earth work in a road cutting 120m long. from the center line as follows formation with 10m side slope 1 in 1 $(n=1)$, Average depth of cutting along the centre line 5m, slope of ground in a c/s 10 to 1

$$A = \frac{\left[n\times\left(\frac{b}{2}\right)^2 + m^2\,(bh + nh^2)\right]}{(m^2 - n^2)}$$

$b = 10m \qquad 1 \text{ to } 1 = n = 1$

$h = 5m \qquad 10 \text{ to } 1 = m = 10$

$$A = \left[\frac{\left(n \times \left(\frac{b}{2}\right)^2 + m^2 (bh + nh^2)\right)}{m^2 - n^2} \right]$$

$$= \frac{\left[1 \times \left(\frac{10}{2}\right)^2 + 10^2 (10 \times 5 + 1 \times 5^2)\right)}{10^2 - 1^2}$$

$$= 76.01\ m^3$$

$V = A \times V$

$V = 76 \times 120$

$= 9120 m^3$ //

(4) The following three level cross section of two stations of two stations 50m apart the width of formation level 12m calculate volume of cutting between two stations

Station   Cross sections

50m 1	$1.7/7.7$	$2.8/0$	$4.6/10.6$
2	$2.9/8.9$	$3.7/0$	$6.9/12.9$

Three level

Station (1)

$$A_1 = \left[\frac{b}{4}(h_1 + h_2) + \frac{h}{2}(w_1 + w_2)\right]$$

$b = 12m$

$h = 2.8$

$w_1 = 10.6$

$w_2 = 7.7$

$h_1 = 4.6$

$h_2 = 1.7$

$$= \left[\frac{12}{4}(4.6 + 1.7) + \frac{2.8}{2}(10.6 + 7.7)\right]$$

$A_1 = 44.52\ m^2$

Section ②

$h = 3.7, \quad h_1 = 6.9 \quad h_2 = 2.9, \omega_1 = 12.9, \omega_2 = 8.9, b = 12m$

$$A_2 = \left[\frac{b}{4}(h_1 + h_2) + \frac{h}{2}(\omega_1 + \omega_2)\right]$$

$$= \left[\frac{12}{4}(6.9 + 2.9) + \frac{3.7}{2}(12.9 + 8.9)\right]$$

$A_2 = 69.73 m^2$

Trapezoidal

$$V = \left(\frac{A_1 + A_n}{2}\right) d$$

$$= \left[\frac{44.52 + 69.73}{2}\right] 50$$

$$= 2856 m^3$$

prismodial formula when in even case

$$\boxed{V = \frac{L}{6}(A_1 + 4A_m + A_2)}$$

prismoidal formula

Three level $= \left[\frac{b}{4}(h_1 + h_2) + \frac{h}{2}(\omega_1 + \omega_2)\right]$

Even case $V = \frac{V}{6} A_1 + 4A_m + A_2$

$A_m = ?$

$b = 12m$

$h = 2.8 \rightarrow$ section ① $\qquad h = \frac{2.8 + 3.7}{2} = 3.25m$

$h = 3.7 \rightarrow$ section ②

$h_1 = 4.6$ @ section ① $\qquad h_1 = \frac{4.6 + 6.9}{2} = 5.75$

$h_1 = 6.9$ @ section ②

$w_1 = 10.6$ @ section ① $w_1 = \frac{10.6+12.9}{2} = 11.75$

$w_1 = 12.9$ @ section ②

$h_2 = 1.7$ @ section ① $h_2 = \frac{1.7+2.9}{2} = 2.3$

$h_2 = 2.8$ @ section ②

w_2 @ section ① $= 7.7$ $w_2 = \frac{7.7+8.9}{2} = 8.3$

$w_2 = 8.9$ @ section ②

$$A_m = \frac{b}{4}(h_1\text{mean} + h_2\text{mean}) + \frac{h\text{mean}}{2}(w_1\text{mean} + w_2\text{mean})\Big]$$

$$= \left[\frac{12}{4}(5.75+2.3) + \frac{3.25}{2}(11.75+8.3)\right]$$

$$A_m = 56.7 m^2$$

Substituting the Am in prismoidal rule

$$V = \frac{L}{6}(A_1 + 4 A_m + A_2)$$

$$= \frac{50}{6}(44.52 + 69.73 + 4(56.7)]$$

$$= 2843 m^3$$

Volume of Barrow pit :-

In the case of Barrow pits total area is divided in to Number of Rectangles and triangles

1. If it is reactanglear condition (or) square

$$V = \left[\frac{h_a+h_b+h_c+h_d}{4}\right] \times A$$

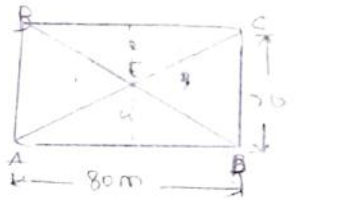
2. If it is triangular condition

$$V = \left[\frac{h_a+h_b+h_c}{3}\right] \times A$$

Problems

(1) A Rectangular plot ABCD forms a pit Excavated for Road work. E is a point of Intersection of diagonals. Calculate volume of excavation at following points, length of AB 50m length of BC 80m.

point	A	B	C	D	E
original level	45.2	49.8	51.2	47.2	52.0
final level	38.6	39.8	42.6	40.8	42.5



Solution:-

Depth of cutting at A = 45.2 - 38.6 = 6.6m

Depth of cutting at B = 49.8 - 39.8 = 10m

Depth of cutting at C = 51.2 - 42.6 = 8.6m

Depth of cutting at D = 47.2 - 40.8 = 6.4m

Depth of cutting at E = 52.0 - 42.5 = 9.5m

Consider Δ ABE $= \frac{h_a+h_b+h_c}{3} = \frac{6.6+10+9.5}{3} = 8.7m$

$A = \frac{1}{2} \times 50 \times 40 = 1000 m^2$ $\quad = \Delta = $ (Avg. height) × Area

$= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 50 \times 40 = 1000 m^2$

$V = 8.7 \times 1000 = 8700 m^3$

(2)

$\Delta AED = \frac{6.6+9.5+6.4}{3} = 7.63 \quad = 1000 \times 7.5 = 7500 m^3$

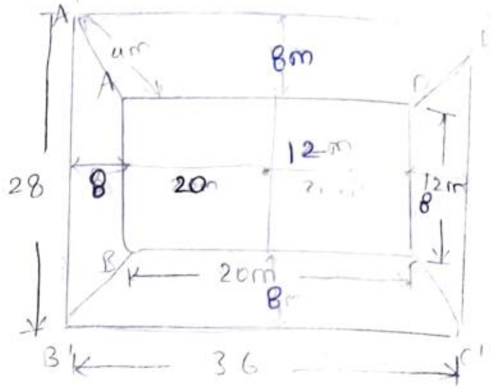
(3) $\Delta BEC = \frac{10+9.5+8.6}{3} = 9.36 \quad = 1000 \times 9.36 = 9366 m^3$

(4) $\Delta DEC = \frac{6.4+9.5+8.6}{3} = 8.3 \quad = 1000 \times 8.16 = 8166 m^3$

Total ~~Area~~ Volume = 8700 + 7500 + 9366 + 8166

= 33732 m^3

(2) An excavation to be made for a reservoir 20m long 12 m width at a bottom surface having side slope 2 in 1 calculate volume of excavation if depth is 4m. The ground surface is levelled before the excavation.



length of resoivor at Top

$= L + 2nh$

$= 20 + 2 \times 2 \times 4 = 36 m$

width of reservior at top

$= b + 2nh$

$= 12 \times 2 \times 2 \times 4 = 28 m.$

length of reservoir at mid height.

$= \frac{20+36}{2} = 28 m$

width of reservoir at mid height

$= \frac{12+28}{2} = 20 m$

Side width $= (28 - 20) = 8m$

Area of bottom Resoirer $= 20 \times 12 = 240 m^2$

Area at Top $= 36 \times 28 = 1008 m^2$

Area of resoirer at mid height $= 28 \times 20 = 560 m^2$

The area of ABCD And A'B'C'D' are parallel to each other since prismoidal formula can be used prismoidal formula at Gren

$V = \frac{\text{depth}}{6} (A_1 + A_2 + 4 A_m)$

$= \frac{4}{6} (240 + 1008 + 560)$

$= 2325 m^3$

Unit: 4

part A

Curves

→ Types of curves
→ Neccesity of curves
→ Elements of sample curve
→ Setting out of curve

part:- B

construction Survey

→ Introduction (Setting out)
→ Building setting out
→ culvert setting out

Types of Curves:

(i) Horizontal, vertical curves

Horizontal Curve :- (i) Simple curve
(ii) Compound curve
(iii) Reverse curve

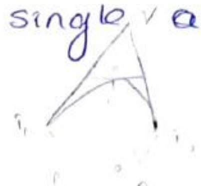
vertical curve :- (i) summit
(ii) valley

Simple Curve :-

It consists of a single arc

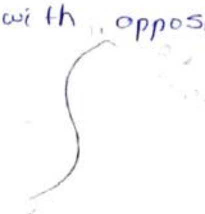
Compound Curve :-

It consists of two (or) more single arc's



Reverse curve :-

It consists of two circular arcs with opposite direction



Necessity of curve :-

It is used to change the direction
It is used to change the alignment
It is used to cross obstcales
It decreases speed

Elements of curve :-

1. Back Tangent - the distance from A to I_1
2. forward Tangent - the distance from I_1 - B
3. point of curve (PC) - starting point curve is known as point of curve
4. point of Intersection (P.I)
5. point of Tangency (PT) - ending point of point of curve
6. Intersection angle - the angle b/w V_A and V_B
7. Deflection angle - the angle at any point on a curve b/w PC and PB
8. Tangent distance (T) - distance b/w PC to PI / PI to PT

$$\boxed{T = R \tan \frac{\Delta}{2}}$$

9. External distance (E) - distance from mid point of curve to PC
10. length of curve (L) - Total length of curve from PC

$$\boxed{E = R \times \sec \frac{\Delta}{2}}$$

11. length of chord to PT - the arc joints PC - PT

$$\boxed{L' = 2R \sin \frac{1}{2}\Delta}$$

12. long chord - the ordinate from mid point of long chord to mid point of curve
13. ~~Mid~~ Mid ordinate (M) = $R\left[1 - \frac{(\cos \Delta)}{2}\right]$

part :- B

construction survey [setting outs]

Introduction:-

It is a process of transferring the distance from the plan already prepared to the ground before setting is called construction (or) Setting out the plan as designed and prepared is set out on the ground in the correct position

Setting for the controls

1 Horizontal controls

2 vertical control

Setting out of building.

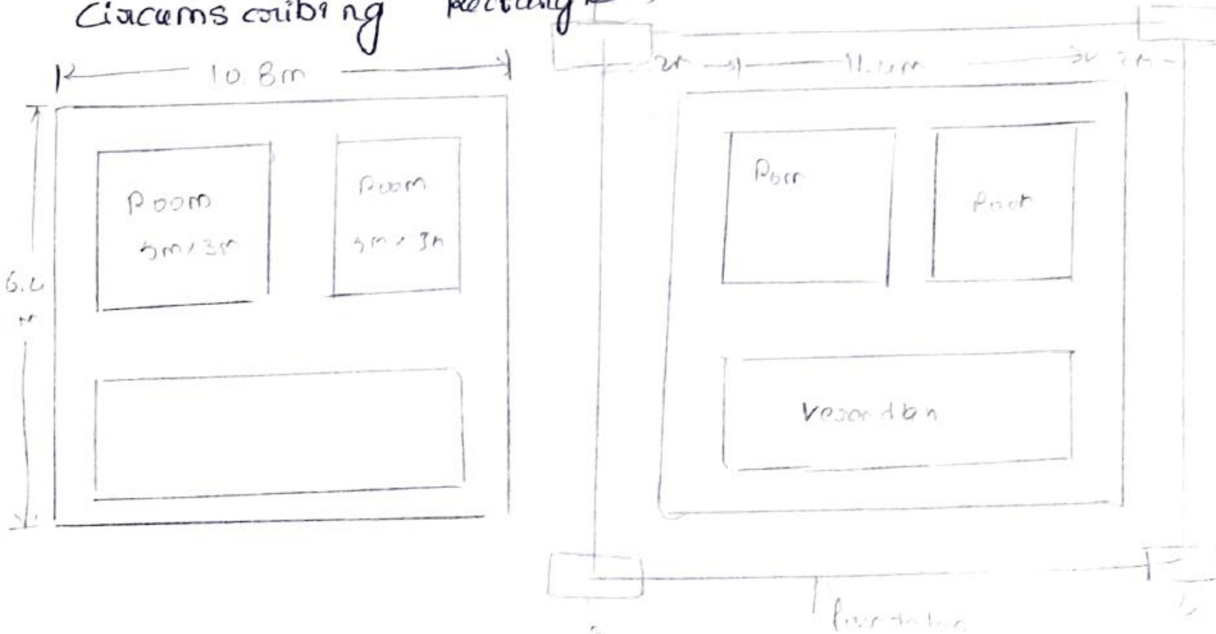
It is depend on foundation

Instrument

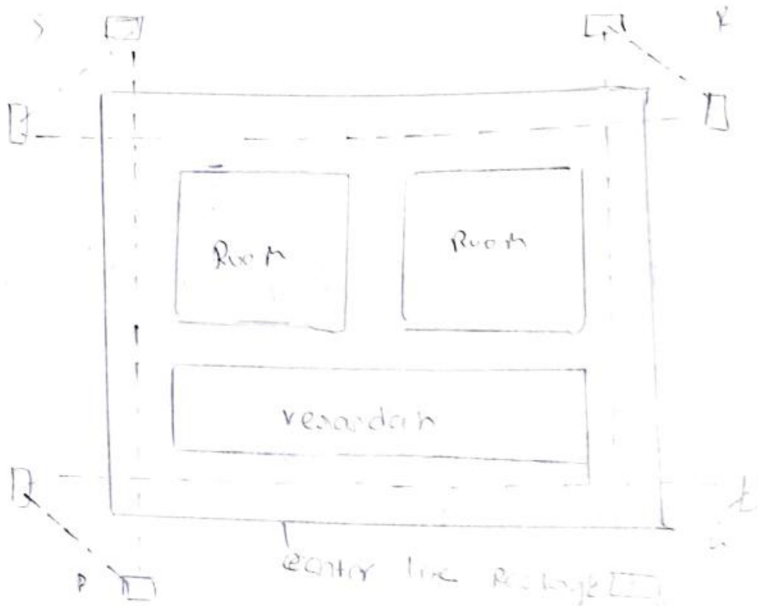
steel tape

two metallic tapes, Right angle, nails, hammer

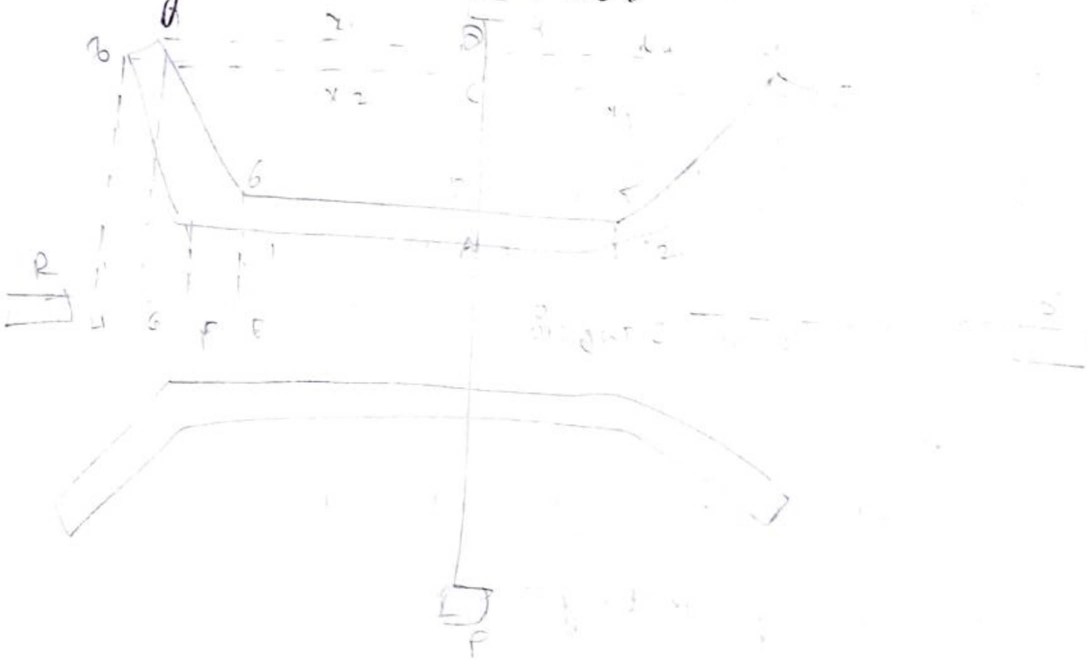
Circumscribing Rectangle :



Based on centre line :-



10) Setting out of culvert :



Curves: Definition and Types | Curves| Surveying

Definition of Curves:

Curves are regular bends provided in the lines of communication like roads, railways etc. and also in canals to bring about the gradual change of direction. They are also used in the vertical plane at all changes of grade to avoid the abrupt change of grade at the apex.

Curves provided in the horizontal plane to have the gradual change in direction are known as Horizontal curves, whereas those provided in the vertical plane to obtain the gradual change in grade are known as vertical curves. Curves are laid out on the ground along the centre line of the work. They may be circular or parabolic.

Classification of Curves:

(i) Simple,

(ii) Compound

(iii) Reverse and

(iv) Deviation

(i) Simple Curve:

A simple curve consists of a single arc of a circle connecting two straights. It has radius of the same magnitude throughout. In fig. 11.1 T1 D T2 is the simple curve with T1O as its radius.

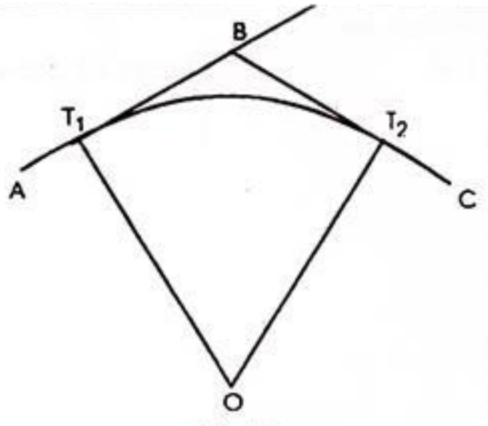


Fig 11.1

(ii) Compound Curve:

A compound curve consists of two or more simple curves having different radii bending in the same direction and lying on the same side of the common tangent. Their centres lie on the same side of the curve. In fig. 11.2, T1 P T2 is the compound curve with T1O1 and PO2 as its radii.

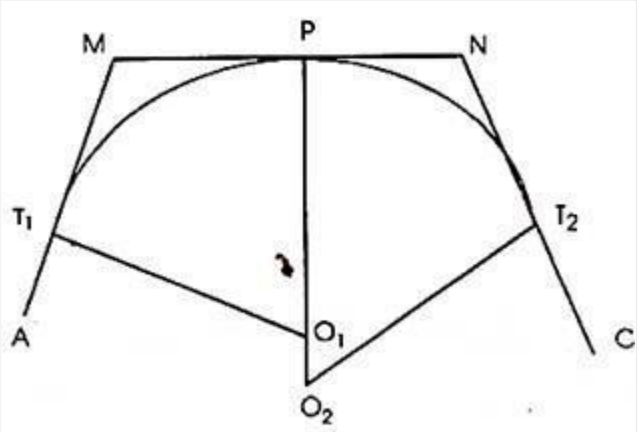


Fig 11.2

(iii) Reverse (or Serpentine) Curve:

A reverse or serpentine curve is made up of two arcs having equal or different radii bending in opposite directions with a common tangent at their junction. Their centres lie of opposite sides of the curve. In fig. 11.3 T1 P T2 is the reverse curve with T1O1 and PO2 as its radii.

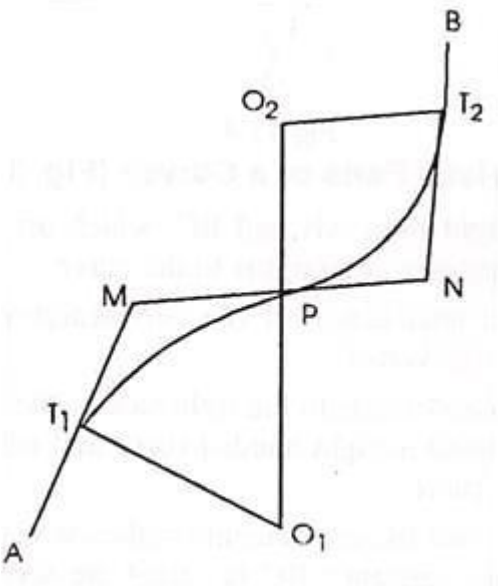


Fig 11 3

Reverse curves are used when the straights arc parallel or intersect at a very small angle. They are commonly used in railway sidings and sometimes on railway tracks and roads meant for low speeds. They should be avoided as far as possible on main railway lines and highways where speeds are necessarily high.

(iv) Deviation Curve:

A deviation curve is simply a combination of two reverse curves. It is used when it becomes necessary to deviate from a given straight path in order to avoid intervening obstructions such as a bend of river, a building, etc. In fig. 11.4. T_1 EDFT_2 is the deviation curve with T_1O, EO_2 and FO_2 as its radii.

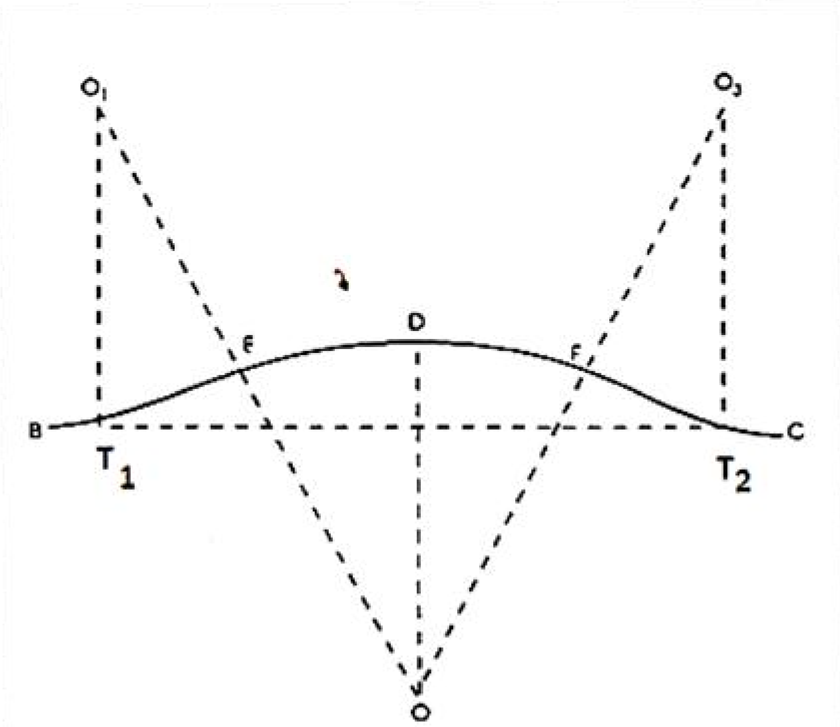


Fig 11.4

Names of Various Parts of a Curve: (Fig. 11.5):

(i) The two straight lines AB and BC, which are connected by the curve are called the tangents or straights to the curve.

(ii) The points of intersection of the two straights (B) is called the intersection point or the vertex.

(iii) When the curve deflects to the right side of the progress of survey as in fig. 11.5, it is termed as right-handed curve and when to the left, it is termed as left-handed curve.

(iv) The lines AB and BC are tangents to the curves. AB is called the first tangent or the rear tangent BC is called the second tangent or the forward tangent.

(v) The points (T_1 and T_2) at which the curve touches the tangents are called the tangent points. The beginning of the curve (T_1) is called the tangent curve point and the end of the curve (T2) is called the curve tangent point.

(vi) The angle between the tangent lines AB and BC (ABC) is called the angle of intersection (I)

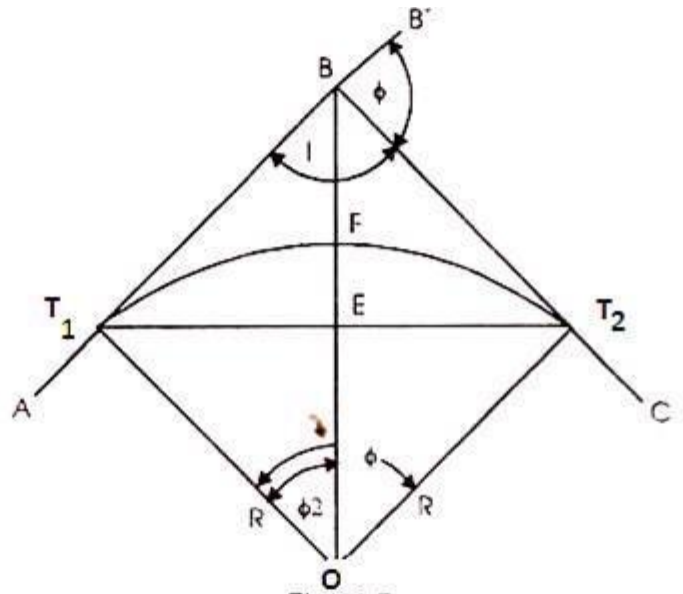


Fig 11.5

(vii) The angle by which the forward tangent deflects from the rear tangent is called the deflection angle (ϕ) of the curve.

(viii) The distance the two tangent point of intersection to the tangent point is called the tangent length (BT_1 and BT_2).

(ix) The line joining the two tangent points (T_1 and T_2) is known as the long-chord

(x) The arc T_1FT_2 is called the length of the curve.

(xi) The mid-point (F) of the arc (T_1FT_2) in called summit or apex of the curve.

(xii) The distance from the point of intersection to the apex of the curve BF is called the apex distance.

(xiii) The distance between the apex of the curve and the midpoint of the long chord (EF) is called the versed sine of the curve.

(xiv) The angle subtended at the centre of the curve by the arc T_1FT_2 is known as the Central angle and is equal to the deflection angle (ϕ).

Elements of a Curve (Fig. 11.5):

(*i*) Angle of intersection + Deflection angle = 180°

or $I + \phi = 180°$ ... ...(Eqn. 11.1)

(*ii*) $\angle T_1OT_2 = 180° - I = \phi$ ... ...(Eqn. 11.2.)

(*i.e.* the central angle = the deflection angle).

(*iii*) Tangent length $= BT_1 = BT_2 = OT_1 \tan \frac{\phi}{2}$

$$= R \tan \frac{\phi}{2} \quad \text{... ... ...(Eqn. 11.3)}$$

(*iv*) Length of Long Chord $= 2T_1E = 2 \times OT_1 \sin\left(\frac{\phi}{2}\right)$

$$= 2R \sin \frac{\phi}{2} \quad \text{... ... (Eqn. 11.4)}$$

(*v*) Length of the curve = Length of the arc T_1FT_2

$$= R\phi \text{ (in radians)}$$

$$= \frac{\pi R \phi}{180°} \quad \text{... ... (Eqn. 11.5)}$$

(*vi*) Apex distance $= BF = BO - OF$

$$= R \sec \frac{\phi}{2} - R$$

$$= R\left(\sec\left(\frac{\phi}{2}\right) - 1\right) \quad \text{... ...(Eqn. 11.6)}$$

(*vii*) Versed sine of the curve $= EF = OF - OE$

$$= R - R\cos\frac{\phi}{2}$$

$$= R\left(1 - \cos\frac{\phi}{2}\right) = R \text{ versine } \frac{\phi}{2} \quad \text{... ...(Eqn. 11.7)}$$

Designation of Curves:

A curve may be designated either by the radius or by the angle subtended at the centre by a chord of particular length In India, a curve is designated by the angle (in degrees) subtended at the centre by a chord of 30 metres (100 ft.) length. This angle is called the degree of the curve (D).

The relation between the radius and the degree of the curve may be determined as follows:

Refer to fig 11.6:

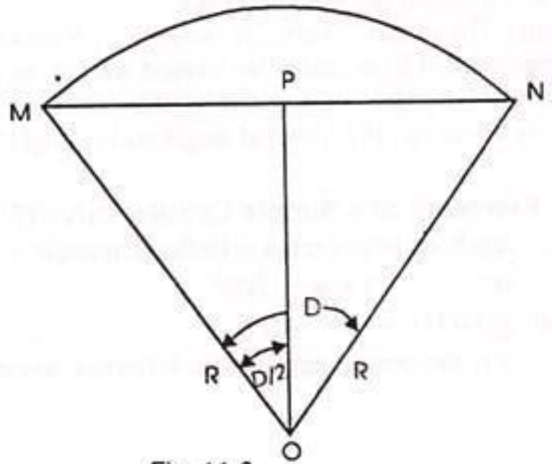


Fig. 11.6

Let R= The radius of the curves in meters

D= The degree of the curve

MN= The chord, 30m long

P= The mid-point of the chord

In Δ OMP, OM = R

$$MP = \frac{1}{2}MN = 15 \text{ m}$$

$$\angle MOP = \frac{D}{2}$$

Then, $\sin \frac{D}{2} = \frac{MP}{OM}, \frac{15}{R}$

or $$R = \frac{15}{\sin \frac{D}{2}} \quad \textbf{(Exact)} \qquad \text{... ...(Eqn. 11.8)}$$

But when D is small, $\sin \frac{D}{2}$ may be assumed approximately equal to

$= \frac{D}{2}$ in radians.

$$R = \frac{15}{\frac{D}{2} \times \frac{\pi}{180°}} = \frac{15 \times 360}{\pi D}$$

$$= \frac{171.87}{D}$$

or say, $$R = \frac{1719}{D} \quad \textbf{(approximate)} \qquad \text{... ... (Eqn. 11.9)}$$

The approximate relation holds good up to 5° curves. For higher degree curves, the exact relation should be used.

Methods of Curve Ranging:

A curve may be set out:

1. By linear methods, where chain and tape are used.

2. By angular or instrumental methods, where a theodolite with or without a chain is used.

Before starting setting out a curve by any method, the exact positions of the tangent points between which the curve lies, must be determined.

For this, proceed as follows: (Fig. 11.5)

(i) Having fixed the directions of the straights, produce them to meet at point (B).

(ii) Set up a theodolite at the intersection point (B) and measure the angle of intersection (I). Then find the deflection angle (ϕ) by subtracting (I) from 180°. i.e., $\phi = 180^\circ - I$

(iii) Calculate the tangent length from the Eqn. 11.3:

$$\left(\text{tan lenght} = R \tan\frac{\Phi}{2}\right)$$

(iv) Measure the tangent length (BT_1) backward along the rear tangent BA from the intersection point B, thus locating the position of T_1.

(v) Similarly, locate the position of T_2 by measuring the same distance forward along the forward tangent BC from B,

Having located the positions of the tangent points T_1 and T_2; their changes may be determined. The change of T_1 is obtained by subtracting the tangent length from the known change of the intersection point B. And the change of T_2 is found by adding the length of the curve to the change to T_1.

Then the pegs are fixed at equal intervals on the curve. The interval between the pegs is usually 30 m or one chain length. This distance should actually be measured along the arc, but in practice it is measured along the chord, as the difference between the chord and the corresponding arc is small and hence negligible. In order that this difference is always small and negligible, the length of the chord should not be more than 1/20th of the radius of the curve. The curve is then obtained by joining all these pegs.

The distances along the centre line of the curve are continuously measured from the point of beginning of the line up to the end, i.e., the pegs along the centre line of the work should be at equal interval from the beginning of the line to the end. There should be no break in the regularity of their spacing in passing from a tangent to a curve or from a curve to a tangent.

For this reason, the first peg on the curve is fixed at such a distance from the first tangent point (T_1) that its change becomes the whole number of chains i.e. the whole number of peg interval. The length of the first chord is thus less than the peg interval and is called as a sub- chord. Similarly, there will be a sub chord at the end of the curve. Thus, a curve usually consists of two-chords and a number of full chords. This is made clear from the following example.

Linear Methods of Setting out Curves

The following are the methods of setting out simple circular curves by linear methods and by the use of chain and tape: 1. By ordinates from the Long chord 2. By Successive Bisection of Arcs. 3. By Offsets from the Tangents. 4. By Offsets from Chords Produced.

Method # 1. By Ordinates from the Long Chord (Fig. 11.8):

Let T1T2=L= the length of the Long chord

ED= O0= the offset at mid-point (e) of the long chord (the versed sine)

PQ=Ox= the offset at distance x from E

Draw QQ1 parallel to T1 T2 meeting DE at Q1

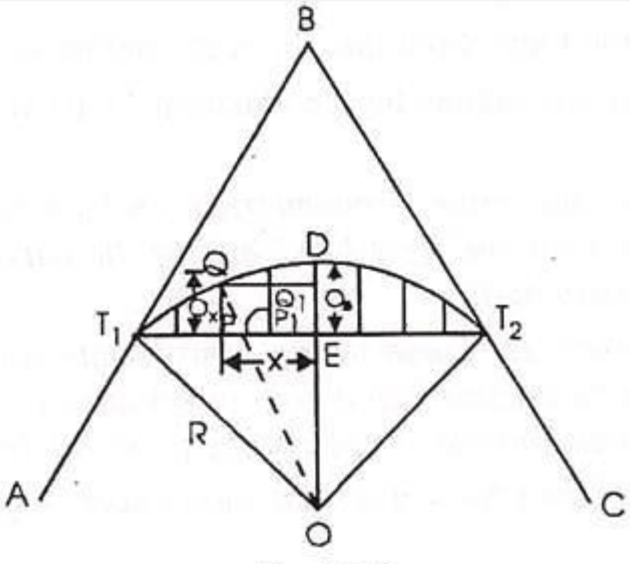


Fig. 11.8

Join OQ cutting T_1T_2 in P_1.

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

But $OQ = R$; $QQ_1 = x$

and $OQ_1 = OE + EQ_1 = (R - Q_3) + O_x$

$$R^2 = x^2 \{(R - O_0) + O_0\}^2$$

or $(R - O_0) + O_x = \sqrt{R^2 - x^2}$

Hence $$O_x = \sqrt{R^2 - x^2} - (R - O_\infty)$$

(Exact) ... ...(Eqn. 11.10)

Where $O_0 = ED = OD - OE$

$$= R - \sqrt{R^2 \left(\frac{L}{2}\right)^2}$$ **... ...(Eqn. 11.10, a)**

When the radius of the curve is large as compared with the length of the long chord, the offset may be equated by the approximate formula which is derived as follows:

Here O_x is assumed to be equal to the radial ordinate QP_1.

$$QP \times 2R = T_1P \times PT_2$$

or $$QP_1 = \frac{T_1P \times PT_2}{2R}$$

Now $T_1P = x$, and $PT_2 = L - x$

$$Q_x = \frac{x(L - x)}{2R}$$ **(approximate) ... ...(Eqn. 11.11)**

Note:

In the exact equation (11.1), the distance x of the point P is measured from the mid-point of the long chords; while in the approximate equation (11.11), it is measured from the first tangent point (T1).

Procedure of Setting Out the Curve:

(i) Divide the long chord into an even number of equal parts.

(ii) Calculate the offsets by the equation 11.10 at each of the points of division.

Note:

1. Since the curve is symmetrical on both sides of the middle- ordinate, the offsets for the right-hand half of the curve are the same as those for the left-hand half.

2. If the offsets are found by the approximate equation (11.11), the long chord should be divided into a convenient number of equal parts and the calculated offsets laid out at each of the points of division.

This method is used for setting out short curves e.g., curves for street bends.

Method # 2. By Successive Bisections of Arcs (Fig 11.10):

It is also known as Versine Method. Join T1 T2 and bisect it at E. Set out the offset ED the versed since equal to:

$R(1-\cos\frac{\Phi}{2}$, thus fixing the point Don the curve

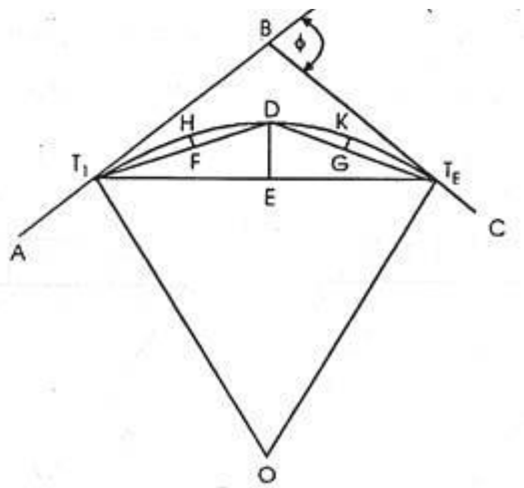


Fig. 11.10.

Join T1D and DT2 and bisect them at F and G respectively. Then set outsets FH and GK at F and G each equal to $R\left(1-\cos\frac{\phi}{4}\right)$ thus fixing two more points H and K on the curve. Then each of the offsets to be set out at mid points of the chords T1H, HD, DK and KT2 is equal to $R\left(1-\cos\frac{\phi}{8}\right)$. By repeating this process, set out as many point as are required.

This method is suitable where the ground outside the curve is not favorable to the tangents.

Method # 3. By Offsets from the Tangents:

The offsets may be either radial or perpendicular to the tangents.

(a) By Radial Offsets (Fig 11.11a):

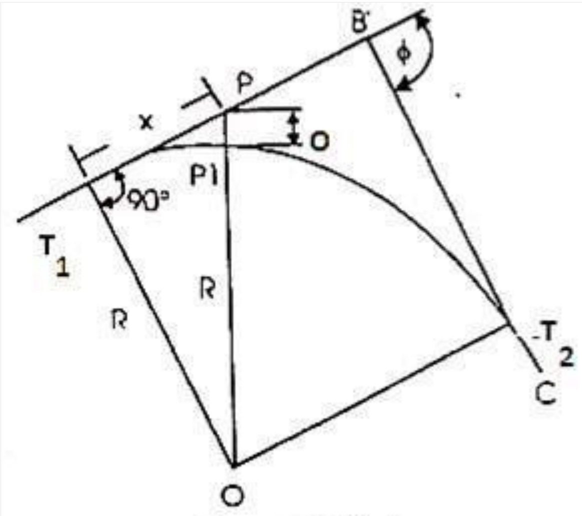


Fig 11.11 (a)

Let $O_x = PP_1$ = the radial offset at P at a distance of x from T_1 along the tangent AB

$$PP_1 = OP - OP_1, \text{ where } OP = \sqrt{R^2+x^2} \text{ and } OP_1 = R$$

$$O_x = \sqrt{R^2+x^2} - R \qquad \textbf{(exact) ... ...(Eqn. 11.12)}$$

When the radius is large, the offsets may be calculated by the approximate formula, which may be derived as under:

$$PT_1^2 = PP_1 \times (2R + PP_1)$$

i.e. $$x^2 = O_x (2R + O_x) = 2RO_x + O_x^2$$

Since O_x^2 is very small as compared with 2R, it may be neglected.

$$x^2 = 2R.O_x$$

or $$O_x = \frac{x^2}{2R} \quad \text{(approximate)} \qquad \text{... ...(Eqn. 11.13)}$$

(b) By Offsets perpendicular to the Tangents (Fig 11.11,b):

Let $O_x = PP_1$ = the perpendicular offset at P at a distance of x from T_1 along the tangent AB.

Draw P_1P_2 parallel to BT_1, meeting OT_1 at P_2

Then $P_1P_2 = PT_1 = x$; $T_1P_2 = PP_1 = O_x$.

Now $T_1P_2 = OT_1 — OP_2$

where $OT_1 = R$, and $OP_2 = \sqrt{R^2 - x^2}$

$$O_x = R - \sqrt{R^2 - x^2} \quad \text{(exact)} \qquad \text{...(Eqn. 11.14)}$$

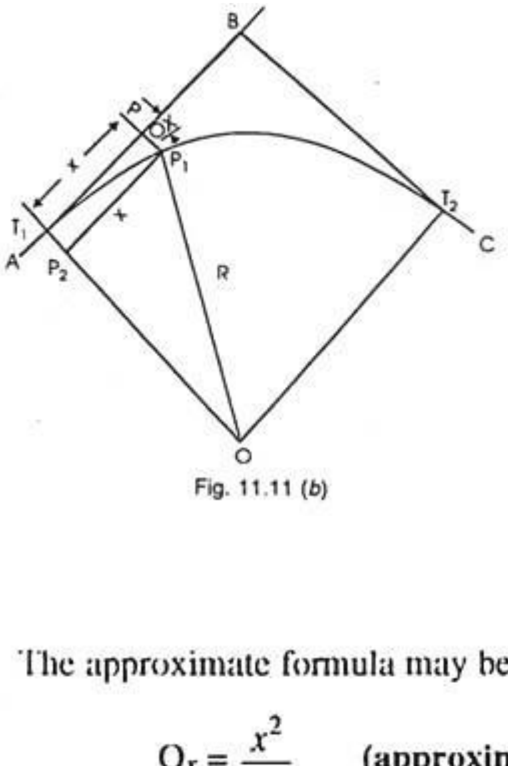


Fig. 11.11 (*b*)

The approximate formula may be obtained similarly as in (a) above ,

$$O_x = \frac{x^2}{2R} \quad \text{(approximate)} \qquad \text{...(Eqn. 11.15)}$$

Procedure of setting out the curve:

(i) Locate the tangent points T1 and T2.

(ii) Measure equal distances, say 15 or 30 m along the tangent from T1.

(iii) Set out the offsets calculated by any of the above methods at each distance, thus obtaining the required points on the curve.

(iv) Continue the process until the apex of the curve is reached.

(v) Set out the other half of the curve from the second tangent.

This method is suitable for setting out sharp curves where the ground outside the curve is favourable for chaining.

Method # 4. By Offsets from Chords Produced (Fig. 11.12):

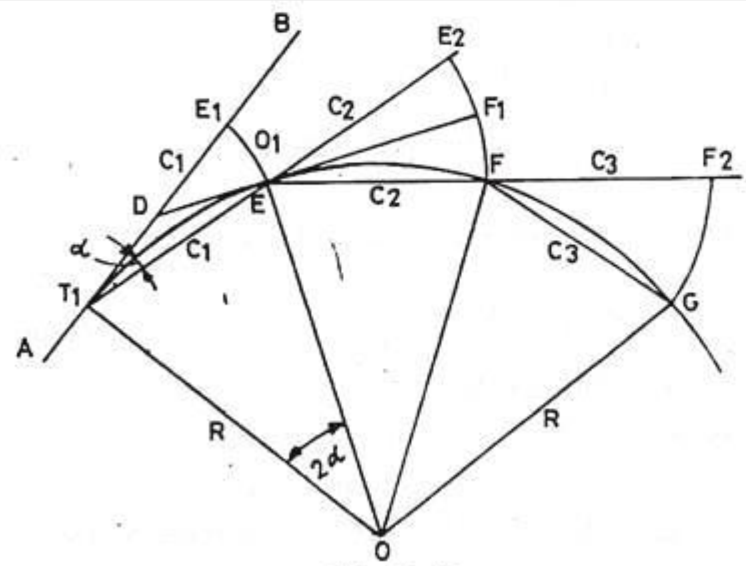


Fig. 11.12

Let AB = the first tangent; T1 = the first tangent point E, F, G etc. on the successive points on the curve T1E = T1E1 = C1 = the first chords.

EF, FG, etc. = the successive chords of length C2, C3 etc., each being equal to the full chord.

∠ BT1E = α in radians = the angle between the tangents BT1 and the first chord T1E.

E1E = O1 = the offset from the tangent BT1

E2F = O2 = the offset from the chord T1E produced.

Produce T1E to E2 such tharEE2 = C2. Draw the tangent DEF1 at E meeting the first tangent at D and E2F at F1.

∠BT1E= α in the radians= the angle between the tangents BT1and the first chord T1E.

E1E=O1= the offset from the tangent BT1

E2F=O2= the offset from the chord T1E produced.

Produce T1E to E2 such that EE2= C2. Draw the tangent DEF1at E meeting the first tangent at D and E2Fat F1.

The formula for the offsets may be derived a under:

∠ BT1E=x

∠T1OE=2x

The angle subtended by any chord at the center is twice the angle between the chord and the tangent

$$\frac{\text{arc}\, T_1E}{\text{Radius}\, OT_1} = 2\alpha$$

But arc T_1E is approximately equal to chord $T_1E = C_1$

$$\frac{C_1}{R} = 2\alpha$$

or $$\alpha = \frac{C_1}{2R}$$

Also $$\frac{\text{arc}\, E_1E}{T_1E} = \alpha$$

But arc E_1E is approximately equal to chord $E_1E = O_1$

$$O_1 = C_1 \times \alpha$$

Putting here the value of α as calculated above.

$$O_1 = C_1 \times \frac{C_1}{2R} = \frac{C_1^2}{2R} \quad \ldots \quad \ldots \quad \ldots \text{(Eqn. 11.16)}$$

$$O_2 = \text{offset}\ E_2F = E_2F_1 + F_1F$$

To find out F_2F_1, consider the two triangles T_1EE_1 and EF_1E_2

$\angle E_2EF_1 = \angle DET_1$ (vertically opposite angles) :

$\angle DET_1 = \angle DT_1E$, since $DT_1 = DE$, both being trangents to the circle.

$$\angle E_1EF_1 = \angle DET_1 = \angle DT_1E$$

Both the Δs being nearly isosceles, may be taken as approximately similar.

$$\frac{E_2F_1}{EE_2} \approx \frac{E_1E}{T_1E_1}$$

$\angle$ α

i.e. $$\frac{E_2F_1}{C_2} = \frac{O_1}{C_1}$$

or $$E_2F_1 = \frac{C_2 \times O_1}{C_2}$$

$$= \frac{C_2}{C_1} \times \frac{C_1^2}{2R} = \frac{C_1C_2}{2R}$$

F_1F being the offset from the tangent at E, is equal to

$$\frac{EF^2}{2R} = \frac{C_2^2}{2R}$$

the second offset, $$O_2 = \frac{C_1C_2}{2R} + \frac{C_2^2}{2R},$$

$$= \frac{C_2(C_1 + C_2)}{2R} \quad \text{... (Eqn. 11.17)}$$

Similarly the third offset, $$O_3 = \frac{C_3(C_2 + C_3)}{2R}$$

Since $C_2 = C_3 = C_1$.................................etc,

$$O_3 = \frac{C_2^2}{R} \quad \text{... ... ...(Eqn. 11.18)}$$

Each of the remaining offsets O4,O5 etc expect the last one (On) is equal to O3. Since the length of the last chord is usually less than the length of the chord, the last offset,

$$O_n = \frac{C_n(C_{n-1} + C_n)}{2R} \quad \text{... ... ...(Eqn. 11.19)}$$

Procedure of Setting out the Curve (Fig. 11.12):

(i) Locate the tangent points (T1 and T2) and find out their changes. From these changes, calculate lengths of first and last sub-chords and find out the offsets by using the equations 11.16 to 11.19.

(ii) Mark a point E1 along the first tangent T1B such that T1E1 equals the length of the first sub-chord.

(iii) With the zero end of the chain (or tape) at T1 and radius = T1E1, swing an arc E1E and cut off E1E = O1, thus fixing the first point E on the curve.

(iv) Pull the chain forward in the direction of T1E produced until the length EE2 becomes equal to the second chord C2.

(v) Hold the zero end of the chain at E. and radius = C2, swing an arc E2F and cut off E2F = O2, thus fixing the second point F on the curve.

(vi) Continue the process until the end of the curve is reached. The last point fixed in this way should coincide with the previously located point T2. If not, find the closing error. If it is large i.e., more than 2 m, the whole curve are moved sideways by an amount proportional to the square of their distances from the tangent point T1. The closing error is thus distributed among all the points.

This method is very commonly used for setting out road curves.

Angular Methods for Setting out Curves

The following two methods are the methods of setting out simple circular curves by angular or instrumental methods: 1. By Rankine's Tangential Angles. 2. By Two Theodolites.

Method # 1. Rankine's Method of Tangential or Deflection Angles: (Fig. 11.14):

In this method, the curve is set out by the tangential angles (also known as deflection angles) with a theodolite and a chain (or tape). The method is also called as chain and theodolite method.

The deflection angles are calculated as follows:

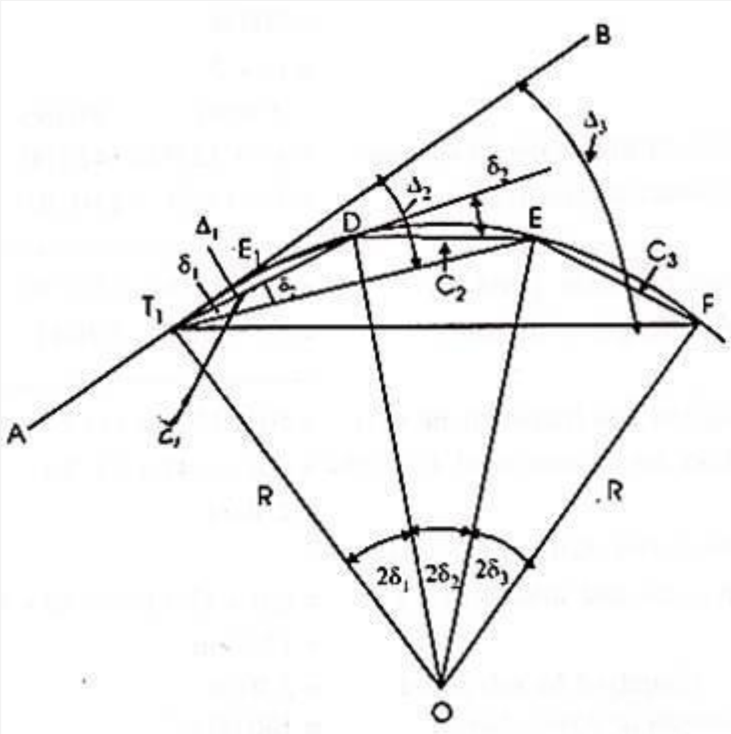


Fig. 11.14

Let T1 and T2 be the tangent points and AB the first tangent to the curve.

D, E, F, etc. =the successive points on the curve,

R = the radius of the curve.

C1, C2, C3 etc. = the lengths of the chords T1D, DE, EF etc., i.e., 1st, 2nd, 3rd chords etc.

δ 1, δ 2, δ 3 etc. = the tangential angles which each of the chords T1 D1, DE, EF, etc., makes with the respective tangents T1, D, E. etc.

Δ1, Δ2, Δ 3 etc. = the total tangential or deflection angles which the chords T1D, DE, EF, etc. make with the first tangent AB.

Now the chord T_1D is approximately equal to arc $T_1D = C_1$

$$\angle BT_1D = \delta_1 = \frac{1}{2} \angle T_1OD = 2\delta_1 \quad \angle T_1OD = 2\delta_1$$

$$\frac{\text{arc}\, T_1D}{\text{Radius}\, OT_1} = \angle T_1OD \text{ in radians}$$

or $$\frac{C_1}{R} = 2\delta_1 \text{ radians}$$

or $$\delta_1 = \frac{C_1}{R} \text{ radians}$$

$$= \frac{C_1}{2R} \times \frac{180}{\pi} \text{ degrees}$$

$$= \frac{C_1}{2R} \times \frac{180}{\pi} \times 60 \text{ minutes} \quad \ldots \quad \ldots(\text{Eqn. 11.20})$$

Similarly, $\delta_2 = 1718.9 \frac{C_2}{R}$; $\delta_3 = 1718.9 \frac{C_3}{R}$; and so on

$$\delta_n = 1718.9 \frac{C_n}{R} \text{ minutes} \quad \ldots \quad \ldots(\text{Eqn. 11.21})$$

Since each of the chord lengths C2, C3, C4………… Cn-1 is equal to the length of the full chord, $\delta 2 = \delta 3 = \delta 4$………….. δ n-1.

The total tangential angle (Δ_1) for the first chord (T_1D)

$$= \angle BT_1D = \delta_1$$

$$\therefore \quad \Delta_1 = \delta_1$$

The total tangential angle (Δ_2) for the second chord (DE) = $\angle BT_1E$

But $\angle BT_1E = \angle BT_1D + \angle DT_1E$

It is well known preposition of geometry that the angle between the tangent and a chord equals the angle which the chord subtends in the opposite segment.

Now ∠DT1E is the angle subtended by the chord DE in the opposite segment, therefore, it is equal to the tangential angle ($\delta 2$) between the tangent D and the chard DE

$$\therefore \quad \Delta_2 = \delta_1 + \delta_2 = \Delta_1 + \delta_2$$

Similarly,

$$\Delta_3 = \delta_1 + \delta_2 + \delta_3 = \Delta_2 + \delta_3$$

$$\Delta_n + \delta_1 + \delta_2 + \delta_3 \ldots\ldots\ldots\ldots + \delta_n$$

$$= \Delta_{n-1} + \delta_n \quad \ldots \quad \ldots\text{(Eqn. 11.22)}$$

Check:

The total deflection angle BT1 T2 $= \Delta n = \frac{\phi}{2}$

where ϕ is the deflection angle of the curve.

If the degree of die curve (D) is known, the deflection angle for 30 m chord is equal 1/2D degrees, and that for the sub-chord of length C1,

$$= \frac{C_1}{30} \times \frac{D}{2} \text{ degrees}$$

$$\delta_1 = \frac{C_1 \times D}{60}; \quad \delta_2 = \delta_3 \ldots\ldots\ldots \delta_{n-1} = \frac{D}{2};$$

$$\delta_n = \frac{C_n \times D}{60} \quad \ldots \quad \ldots \quad \ldots\text{(Eqn. 11.23)}$$

Procedure of Setting out the Curve:

(i) Locate the tangent points (T1 and T2) and find out their changes. From these changes, calculate the lengths of first and last sub-chords and the total deflection angles for all points on the curve as described above.

(ii) Set up and level the theodolite at the first tangent point (T1).

(iii) Set the Vernier A of the horizontal circle to zero and direct the telescope to the ranging rod at the intersection point B and bisect it.

(iv) Loosen the Vernier plate and set the Vernier A to the first deflection angle $\Delta 1$, the telescope is thus directed along T1D. Then along this line, measure T1D equal in length to the first sub-chord, thus fixing the first point D on the curve.

(v) Loosen the upper clamp and set the Vernier A to the second deflection angle $\Delta 2$, the line of sight is now directed along T1E. Hold the zero end of the chain at D and swing the other end until the arrow held at that end is bisected by the line of sight, thus fixing the second point (E) on the curve.

(vi) Continue the process until the end of the curve is reached. The end point thus located must coincide with the previously located point (T2). If not, the distance between them is the closing error. If it is within the permissible limit, only the last few pegs may be adjusted; otherwise the curve should be set out again.

Note:

In the case of a left-handed curve, each of the values $\Delta 1$, Δ 2 Δ 3 etc, should be subtracted from 360° to obtain the required value to which the vernier is to be set i.e. the vernier should be set to $(360° - \Delta 1)$, $(360° - \Delta 2)$, $(360° - \Delta$ 2) etc. to obtain the 1st, 2n, 3rd etc, points on the curve.

This method gives highly accurate results and is most commonly used for railway and other important curves.

Table of Deflection Angles

Point	Chainage in metres	Length of chord in metres	Deflection Angle (δ)	Total Angle (Δ)	Theodolite vernier Reading	Remarks
		° ′ ″	° ′ ″	° ′ ″		
T_1	39 + 6.30					
1	40 + 00	23.70	1 58 30	1 58 30	1 58 40	The curve is a right-handed one. The least count of the instrument in 20 ″
2	41 + 00	30	2 30 00	4 28 30	4 28 40	
3	42 + 00	30	2 30 00	6 58 30	6 58 40	
4	43 + 00	30	2 30 00	9 28 30	9 28 40	
5	44 + 00	30	2 30 00	11 58 30	11 58 40	
6	45 + 00	30	2 30 00	14 28 30	14 28 40	
7	46 + 00	30	2 30 00	16 58 40	16 58 40	
T_2	46 + 12.30	12.30	1 01 30	18 00 00	18 00 00	

Method # 2. Two-Theodolite Method (Fig. 11.16):

This method is very useful in the absence of chain or tape and also when ground is not favorable for accurate chaining. This is simple and accurate method but requires essentially two instruments and two surveyors to operate upon them, so it is not as commonly used as the method of deflection angles. In this method, the property of circle ‘that the angle between the tangent and the chord equals the angle which that chord subtends in the opposite segment’ is used.

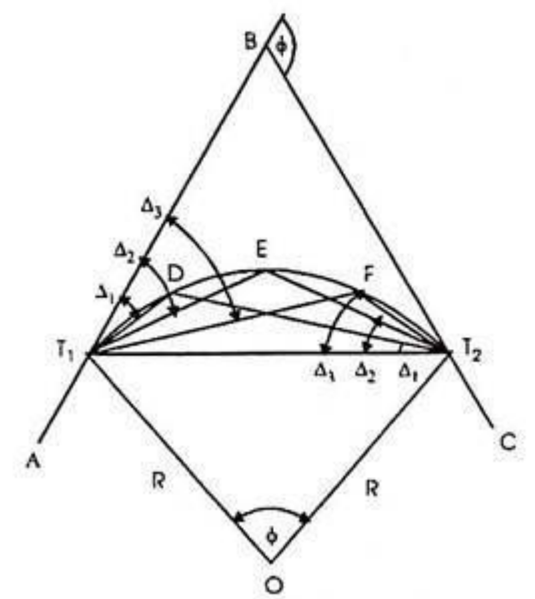


Fig. 11.16

Let D, E, F, etc. be the points on the curve. The angle ($\Delta 1$) between the tangent T1B and the chord T1D i.e. ∠BT1 D = ∠T1T2D. Similarly, ∠BT1E = $\Delta 2$ = ∠T1T2 E, and ∠BT1F = $\Delta 3$ = ∠T1T2F etc. The total deflection angles $\Delta 1$, $\Delta 2$, $\Delta 3$, etc. are calculated from the given data as in the first method (i.e. as in Rankine's method of deflection angles).

Procedure of setting out the curve:

(i) Set up two theodolites, one at T1 and the other at T2.

(ii) Set Vernier of the horizontal circle of each of the theodolites to zero.

(iii) Turn the instrument at T1 to sight the intersection point B and that at T2 to sight T1.

(iv) Set the Vernier of each of the instruments to read the first deflection angle $\Delta 1$. Now the line of sight of the instrument at T1 is along T1D and that of the instrument at T2 is along T2D. Their point of intersection is the required point on the curve Direct the assistant to move the ranging rod until it is sighted exactly by both the theodolites, thus fixing the point D on the curve.

(v) Then set the Vernier of each of the instrument to the second deflection angle $\Delta 2$, proceed as before to obtained the second point (E) on the curve.

(vi) Repeat the process until the whole curve is set out.

Note:

It may so happen that the point T1 may not be visible from the point T2. In such a case, direct the telescope of the instrument at T2 towards B with the Vernier A set to zero. Now loosen the Vernier plate and set the Vernier A to read an angle of $\left(360^\circ - \frac{\phi}{2}\right)$. The telescope is thus directed along T2 T1. For the first point D on the curve, set the Vernier A to read $\left(360^\circ - \frac{\phi}{2} + \Delta_1\right)$. Similarly, for the second point E, set the Vernier A to $\left(360^\circ - \frac{\phi}{2} + \Delta_2\right)$, and so on.

Transition Curves:

A non-circular curve of varying radius introduced between a straight and a circular curve for the purpose of giving easy changes of direction of a route is called a transition or easement curve. It is also inserted between two branches of a compound or reverse curve.

Advantages of providing a transition curve at each end of a circular curve:

(i) The transition from the tangent to the circular curve and from the circular curve to the tangent is made gradual.

(ii) It provides satisfactory means of obtaining a gradual increase of super-elevation from zero on the tangent to the required full amount on the main circular curve.

(iii) Danger of derailment, side skidding or overturning of vehicles is eliminated.

(iv) Discomfort to passengers is eliminated.

Conditions to be fulfilled by the transition curve:

(i) It should meet the tangent line as well as the circular curve tangentially.

(ii) The rate of increase of curvature along the transition curve should be the same as that of increase of super-elevation.

(iii) The length of the transition curve should be such that the full super-elevation is attained at the junction with the circular curve.

(iv) Its radius at the junction with the circular curve should be equal to that of circular curve.

There are three types of transition curves in common use:

(1) A cubic parabola,

(2) A cubical spiral, and

(3) A lemniscate, the first two are used on railways and highways both, while the third on highways only.

When the transition curves are introduced at each end of the main circular curve, the combination thus obtained is known as combined or Composite Curve.

Super-Elevation or Cant:

When a vehicle passes from a straight to a curve, it is acted upon by a centrifugal force in addition to its own weight, both acting through the centre of gravity of the vehicle. The centrifugal force acts horizontally and tends to push the vehicle off the track.

In order to counteract this effect the outer edge of the track is super elevated or raised above the inner one. This raising of the outer edge above the inner one is called super elevation or cant. The amount of super-elevation depends upon the speed of the vehicle and radius of the curve.

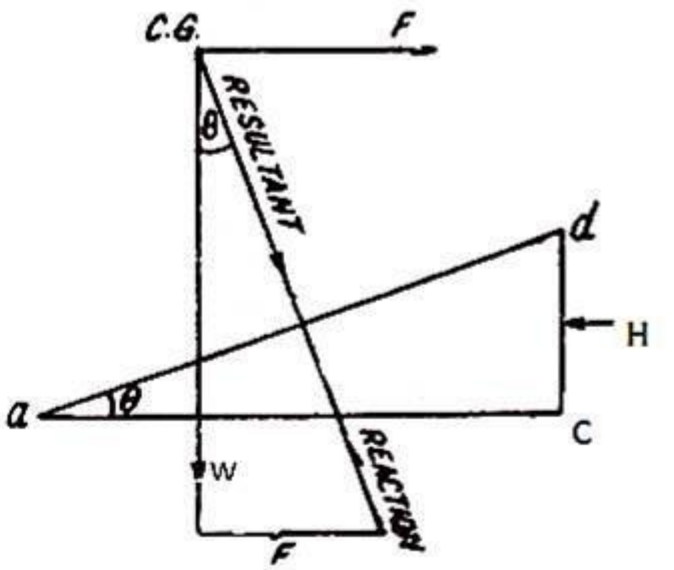


Fig. 11.24

Let:

W = the weight of vehicle acting vertically downwards.

F = the centrifugal force acting horizontally,

v = the speed of the vehicle in meters/sec.

g = the acceleration due to gravity, 9.81 meters/sec^2.

R = the radius of the curve in meters,

h = the super-elevation in meters.

b = the breadth of the road or the distance between the centres of the rails in meters.

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

The centrifugal force, $F = \dfrac{Wv^2}{gR}$

$$\therefore \quad \frac{F}{W} = \frac{v^2}{gR}$$

If θ is the inclination of the road or rail surface, the inclination of the vertical is also θ

$$\tan\theta = \frac{dc}{ac} = \frac{F}{W} = \frac{v^2}{gR}$$

uper-elevation = $b \tan\theta$.

$$= \frac{bv^2}{gR} \quad \ldots \quad \ldots \quad \textbf{(Eqn. 11.28)}$$

Characteristics of a Transition Curve (Fig 11.25):

Here two straights AB and BC make a deflection angle Δ, and a circular curve EE' of radius R, with two transition curves TE and E'T' at the two ends, has been inserted between the straights.

(i) It is clear from the figure that in order to fit in the transition curves at the ends, a circular imaginary curve ($T_1F_1T_2$) of slightly greater radius has to be shifted towards the centre as (E_1 EF E E_1. The distance through which the curve is shifted is known as shift (S) of the curve, and is equal to $\frac{L^2}{24R}$, where L is the length of each transition curve and R is the radius of the desired circular curve (EFE'). The length of shift (T_1E_1) and the transition curve (TE) mutually bisect each other.

Fig. 11.25:

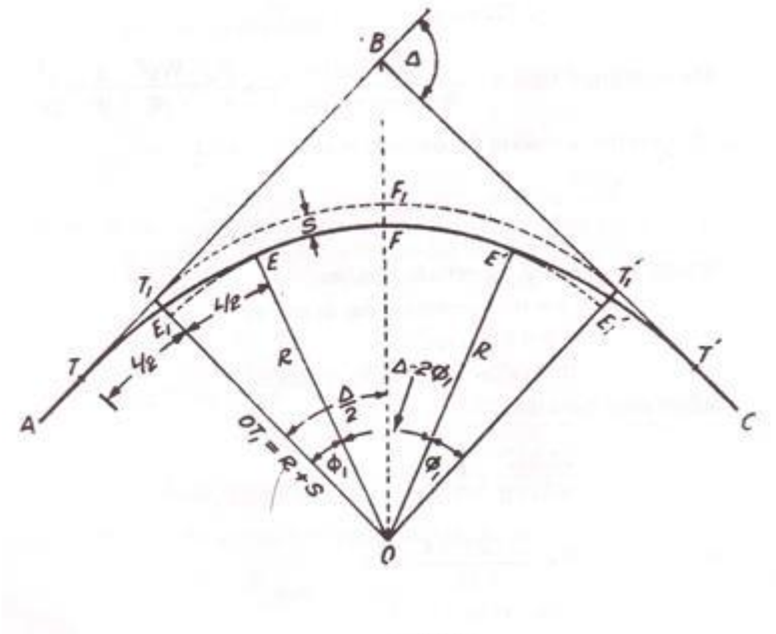


Fig 11.25

(ii) The tangent length for the combined curve

$$= OT_1 \tan \frac{\Delta}{2} + \frac{L}{2}$$

$$= (R + S) \tan \frac{\Delta}{2} + \frac{L}{2}$$

(iii) The spiral angle $\phi_1 = \frac{\frac{L}{2}}{R} = \frac{L}{2R}\ radians$

(iv) The central angle for the circular curve:

$\angle EOE' = \Delta 2\phi_1$

(v) Length of the circular curve EFE'

$$= \frac{\pi R(\Delta - 2\phi_1)}{180^\circ}, \text{ where } \Delta \text{ and } \phi_1 \text{ are in degrees.}$$

(vi) Length of the combined curve TEE'T"

$$= TE + EE' + E'T'$$

$$= L + \frac{\pi R(\Delta - 2\phi_1)}{180^\circ} + L$$

$$= \frac{\pi R(\Delta - 2\phi_1)}{180^\circ} + 2L$$

(vii) Change of beginning (T) of the combined curve = Change of the intersection point (B)-total tangent length for the combined curve (BT).

(viii) Change of the junction point (E) of the transition curve and the circular curve = Change of T + length of the transition curve (L).

(ix) Change of the other junction point (E') of the circular curve and the other transition curve-change of E + length of the circular curve.

(x) Change of the end point (T') of the combined curve = change of E' + length of the transition curve.

Check:

The change of T thus obtained should be = change of T + length of the combined curve.

Note:

The points on the combined curve should be pegged out with through change so that there will be sub-chords at each end of the transition curve and of the circular curve.

(xi) The deflection angle for any point on the transition curve distant I from the beginnings of combined curve (T),

$$\alpha = \frac{l^2}{6RL} \text{ radians} = \frac{1800 l^2}{\pi RL} \text{ minutes.}$$
$$= \frac{573 l^2}{RL} \text{ minutes.}$$

Check:

The deflection angle for the full length of the transition curve:

$$\alpha = \frac{l^2}{6RL} = \frac{L^2}{6RL} \qquad (\because l = L)$$
$$= \frac{L}{6R} \text{ radians} = \frac{1}{3}\phi_1$$

(xii) The deflection angles for the circular curve are found from:

$$\delta_n = 1718.9 \; \frac{C_n}{R} \text{ minutes.}$$

Check:

The deflection angle for the full length of the circular curve:

$$\Delta_n = \frac{1}{2} \times \text{Central angle}$$

i.e., $\Delta_n = \frac{1}{2} \times (\Delta - 2\emptyset_1)$

(xiii) The offsets for the transition curve are found from:

Perpendicular offset, $y = \frac{x^3}{6RL}$, where x is measured along the tangent TB

Tangentail offset, $y = \frac{l^3}{6RL}$, where I is measured along the curve

Check : (*a*) The offset at half the length of the transition curve,

$$y = \frac{l^3}{6RL} = \frac{(L/2)^3}{6RL} \quad (\because l = L/2)$$

$$= \frac{L^2}{48R} = \frac{1}{2}S$$

(*b*) The offset at junction point on the transition curve,

$$y = \frac{l^3}{6RL} = \frac{L^3}{6RL} = \frac{L^2}{6R} (\because l = L)$$

$$= 4S$$

(xiv) The offsets for the circular curve from chords producers are found from:

$$O_n = \frac{C_n (C_{n-1} + C_n)}{2R}$$

Method of Setting Out Combined Curve by reflection Angles (Fig. 11.25):

The first transition curve is set out from T by the deflection angles and the circular curve from the junction point E. The second transition curve is then set out from T' and the work is checked on the junction point E' which has been previously fixed from E.

(i) Assume or calculate the length of the transition curve.

(ii) Calculate the value of the shift by:

$$S = \frac{L^2}{24R}$$

(iii) Locate the tangent point T by measuring backward the total tangent length BT (article 11.14, ii) from the intersection point B along BA, and the other tangent T by measuring forward the same distance from B along BC.

(iv) Set up a theodolite at T, set the Vernier A to zero and bisect B.

(v) Release the upper clamp and set the Vernier to the first deflection angle (x_1) As obtained from the table of deflection angles, the line of sight is thus directed along the first point on the transition curve. Place zero end of the tape at T and measure along this line a distance equal to first sub chords, thus locating first point on the transition curve.

(vi) Repeat the process, until the end of the curve E is reached.

Check:

The last deflection angle should be equal to $\phi_1/3$, and the perpendicular offset from the tangent TB for the last point E should be equal to 4S.

Note:

The distance to each of the successive points on the transition curve is measured from T.

(vii) Having laid the transition curve, shift the theodolite to E and set it up and level it accurately.

(viii) Set the Vernier to a reading($360° - 2/3\ \phi 1$) for a right-hand curve (or $2/3\ \phi 1$) for a left-hand curve and lake a back sight on T. Loosen the upper clamp and turn the telescope clockwise through an angle $2/3\ \phi 1$ the telescope is thus directed towards common tangent at E and the Vernier reads 360°. Transit the telescope, now it points towards the forward direction of the common tangent at E i.e. towards the tangent for the circular curve.

(ix) Set the Vernier to the first tabulated deflection angle for the circular curve, and locate the first point on the circular curve as already explained in simple curves.

(x) Set out the complete circular curve up to E' in the usual way

Check:

The last deflection angle should be equal to $\frac{1}{2}(\Delta - 2\phi_1)$

(xi) Set out the other transition curve from T as before. The point E' to be set from T should be the same as already set out from E.

Method of Setting Out a Combined Curve by Tangential Offsets (Fig. 11.25):

(i) Assume or calculate the length of the transition curve.

(ii) find the value of the shift train, $S = \frac{L^2}{24R}$.

(iii) Locate the tangent points T and T as in article (11.15, iii),

(iv) Calculate the offset for the transition curve as in article (11.14 xiv)

(v) Locate die points on the transition curve as well as on the circular curves by setting out the respective offsets.

UNIT - 5

MODERN FIELD SURVEY SYSTEMS

EDM

* Measurement principle of EDM
* characteristics of EDM.
* Accuracy in EDM

Total station

* Introduction
* Advantages and types
* Applications
* field procedure

DGPS

* Introduction
* working principal
* DGPS receivers
* Application
* LIDAR

Methods of distance measurement

1. DDM (or) Direct distance measurement:-

This is mainly done by chaining (or) Taping.

2. ODM (or) optical distance measurement :-

This measurement is conducted by tacheometry, horizontal subtense method or telemetric method. These are carried out with the help of optical wedge attachments

3. EDM ~~Electronic~~ electromagnetic Distance measurement.

What is EDM?

* It is a surveying instrument and it is used for measuring distance electronically between two p... through the electromagnetic rays.
* EDM has a accuracy of 1 In 10^5, and distance is 100 km.

The wave's are used in EDM.

1. Micro wave - long range, freq 3-30 GHz, Tellurometer
2. Visible light - medium, freq 5×10^{14} Hz, Geodimeter
3. Infrared - short, freq 3×10^{14} Hz, Distomat

Basic functions:-

Generation → modulation → Tansmission → propogation → Reflection → Reception - Demodulation → distance measurement

Applications of T.S

* Detailed survey
* controlled survey
* Height measurement
* Fixing of missing pillars
* Resection
* Area calculation etc
* Remote distance measurement (RDM) (or) missing line measurement.

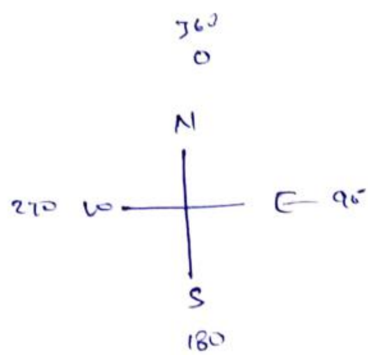
1st unit formulas

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

Length $= \frac{L'}{L} \times$ measured distance

Pull $= \left(\frac{P - P_0}{AE}\right) L$

Sag $= \frac{L w^2}{24 n^2 P^2}$ slope $= \frac{h^2}{2L}$ $L(1-\cos\theta)$



QCB - to WCB to QCB

NE WCB

SE 180 - WCB

SW WCB - 180 BB = FB ± 180

NW 360 - WCB

Included angles

Included angle = B.B of previous line − F.B of next li

Check $(2n-4)\,90$

Raise and ~~fall method~~ Height of instrument

In these method where the place is shift at that point is FS and that shifted front side is BS.

Unit - 5

Electronic Distance Measurement and Remote Sensing

GIS

Geographic Information System

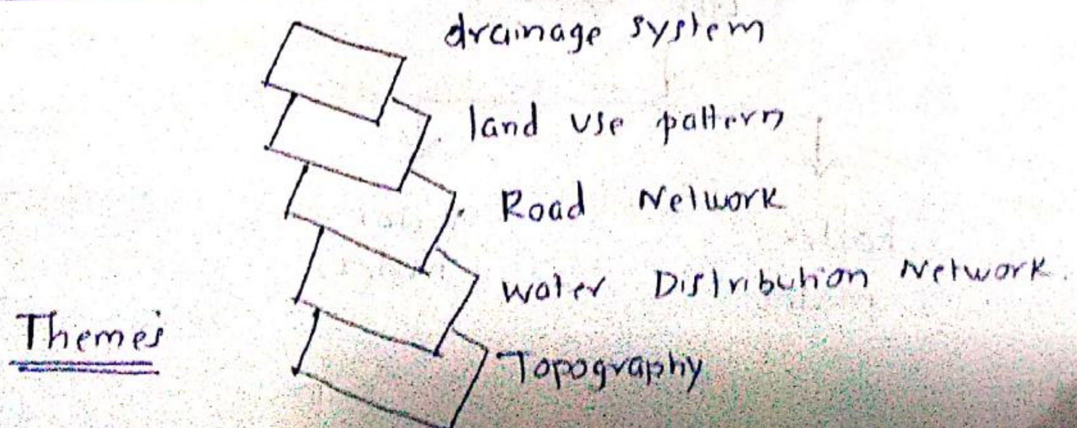
* It is an computer based tool for mapping and analysing thing's that exist and event's that happen's on earth.

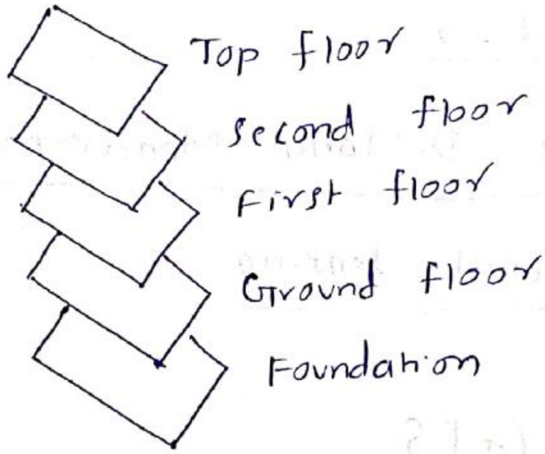
* GIS technology integrate's common database operation such as query & statictical analysis with unique visualization and geographic analysis benifit's offered by analysis

Principle's of GIS

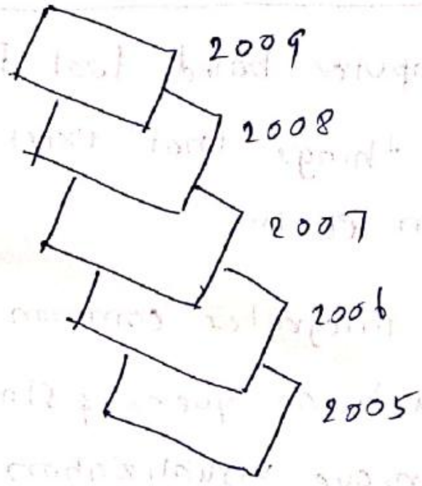
* It contains store's information about the world as a collection of thematic layer that can be linked together by geography.

* Geographic referencie's





floor wise information



Time period.

* It contains either an explicit geographic reference, such as latitude and longitude (or) National grid co-ordinate, (or) an implicit reference such as address, postal code, concus Name, forst Details etc.

GIS System

- Raster model
- Vector Model.

Components of GIS

A working GIS Integrates five key components

1. Software
2. Hardware
3. Data
4. People
5. Method.

1. Software

* Tool for input & manipulation of GIS
* A database Management System

2. Hardware

* It's a computer on which GIS operates.

3. Data

Most important contact & component of a GIS is the Data geographic data and related tabulated data can be collected in house or purchased from a commercial data provider.

4. People.

GIS technology is of limited value with out the people who manage the system and develop plans for applying it to real world problems.

Method

A successful GIS operates according to a well Designed plan an Method.

Applications of GIS :-

* Inconcept of Geographic information infrastructure has brought about a dramatic philosophical and technological revolution in the Developement of GIS

* GIS is became an important tool for Government officials to manage land and Natural Resources.

Major operation areas of GIS

1. Academic

* Research in engineering / sciences

* Humanities & science.

2. Industry

* Surveying & mapping

* Transportation - vehicle tracking

* Forestry and Resources.

3 Business

* Banking

* Real estate - Building management

Government

* National topography mapping
* voting
* surveying and mapping
* waste water service / management

Military

* Training, command & control
* Intelligence gathering.

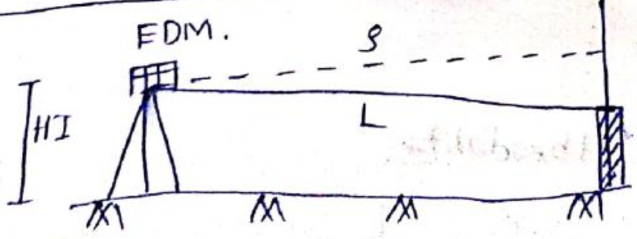
Electronic Distance Measurement

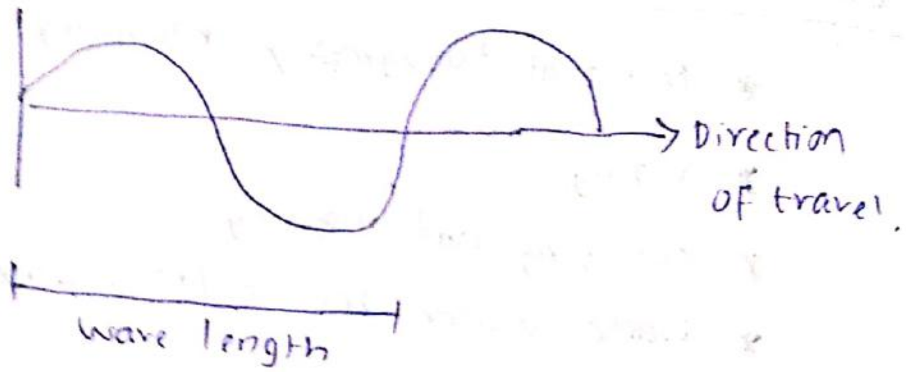
EDM

Introduction

* EDM's are mountable with optic / electronic thodolites.
* EDM was first Introduced in 1950.
* Initially EDM used to Measure Distance
* Electronic theodolite was rapid & advance technology they are available in lighter, simpler and less expansive instruments nowadays.

Principles of EDM





$$\lambda = \frac{c}{f}$$

Where

c – velocity in km/sec

λ – wave length in metres

f - frequency in Hz (cycle/sec).

* The principle of EDM currently used in Total station. Distance Measurement through waves

Types of EDM

Depending upon Different wave length

1. Infrared wave Instrument
2. light wave system
3. microwave Instrument
4. Geodimeter
5. Tellurometer.
6. Distomat
7. Electronic theodolite.

Infrared System / Instrument

* This equipement helped & working with modulated infrared waves.
* The use of Infrared Instrument is high in civil engineering survey work's.
* although these type of Instruments used to measure maximum Distance of about 3 to 5 km only.
* Distomate's, electronic theodolite's of total station comes under this catogory.
* In this system, Instruments are having accuracy of ± 10mm per km can be obtained.

Electronic theodolite's of Total station

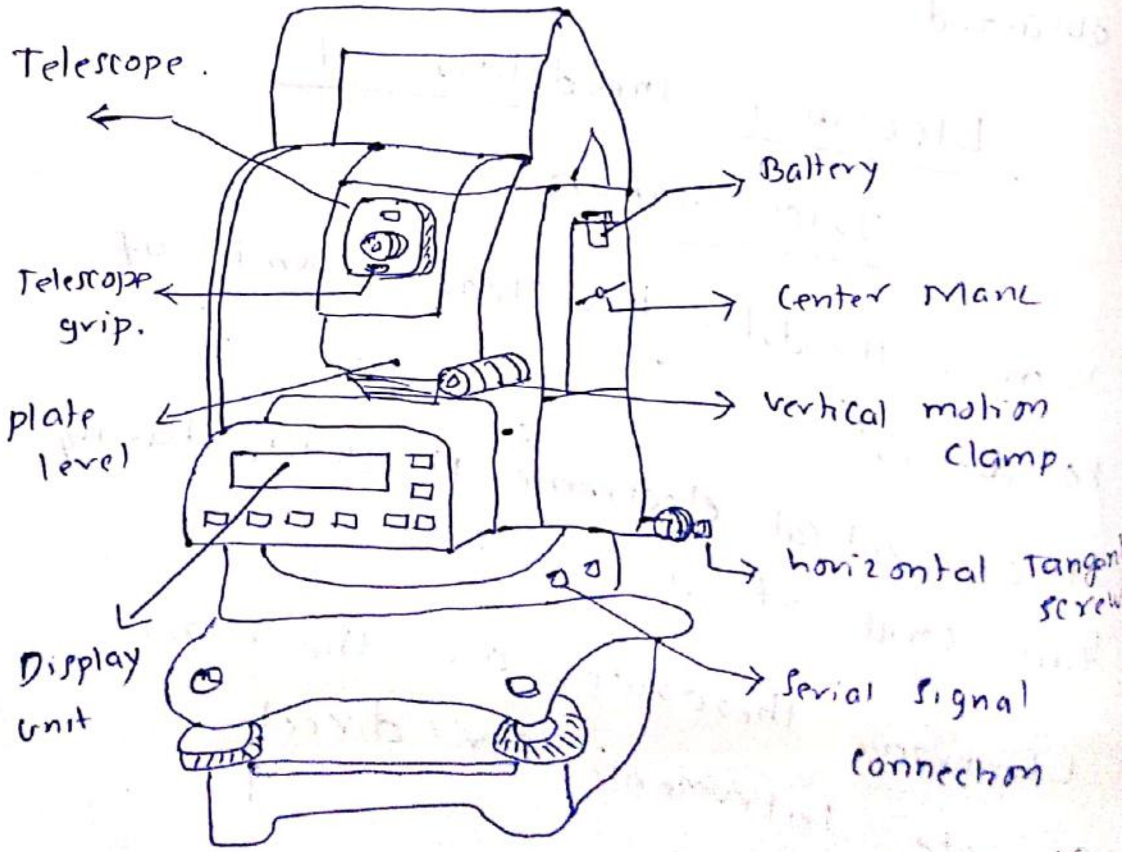
* Vernier theodolite have least count of 20" (or) 10".
* Micro optical electronic theodolite having least count of 0.1".
* Electronic theodolite's are the most accurate Intrument's for direct observations.
* These Introments works withe electronic speed & most accurasy.

Uses of Electronic Theodolite.

* Used for angle Measurement
* Used for wide Distance for angular and Distance Measurement
* It is Compatable with theodolite accessaries
* It can connect with computer throu RS 232 interface connection.

Total station

Total station is a combination of electronic theodolite and EDM.



components of Total station.

Components of Total Station

* Sight collimation
* onboard Battery
* Battary locking Lever.
* Telescope eye piece
* Telescope focussing Knob.
* Telescope grip
* Vertical motional Clamp
* Vertical Tangent screw.
* Horizontal motion clamp
* horizontal Tangent screw.
* plate Level
* Instrument Center Mark
* Display unit
* serial signal connection.

Types of Total station

1. Manual total station
2. Semi automatic
3. Automatic total station.

procedure

* Select a suitable position for Instrument station, which is suitable for observer to take readings.
* Remove the plastic cap from the telescope tripod.

* Instrument Height is an important aspect for effective and Comfortable Surveying process

* level up the total station to an Arbitary point.

* To occupy the existing Station above reference point first roughy Level up the tripod. head right above the point.

* For Levelling up the circular bubble attached to the level is useful.

levelling up

* adjust the three foot screws to make Level the instrument
* after Levelling measure the Height of the instrument from the Center marked point on the side of the Instrument to the ground and note that value of HI

precausions to be taken during Total Station surveying

* Do not make the total station wet.

* Take maximum care while remaved Battery and data tool from the total station.

* Never Release the handle Before total Station is Fixed on it

* Use Both hands to hold total Station @ every time.

* DO not carry tripod without Removing Total Station.

* Don't choose hot Climate for Total Station work.

* Because Climate may Influence in Results and errors may occuring during those kind of activities.

Advantages :-

* Quick setting of the instrument on the tripod using laser plumont.

* plotting and area computation at any user Required Scale can be done.

* Using Robotic total station Single surveyor Can perform the whole survey works

* Integration of Data is possible & easy to arrive Results.

* Automation of world maps and full GIS map creation is possible.

Dis advantages

* Instrument is costly
* Skilled persons Required to perform surveying work's
* field check is not possible.
* Result Depending upon climatic condition's.

Scanned with CamScanner