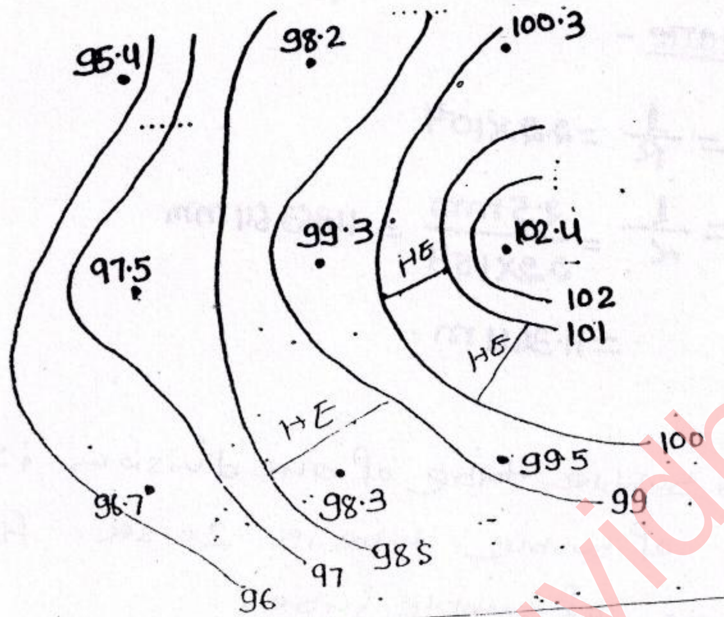
CONTOURS

Contours are the locus of equal elevation points on ground surface.



On a particular contour R.L of all points will be same

Important Terms :-

(1) Contour Intervals :- Difference of R.L b/w two consecutive contour for a drawing is called contour interval. For one drawing contour interval should be kept same at all location.

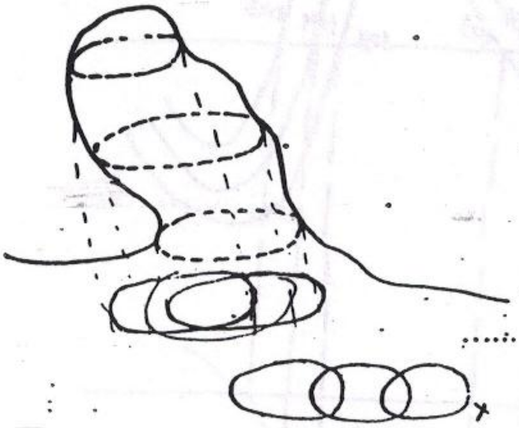
For ex :- In fig - $\boxed{C.I. = 1m}$

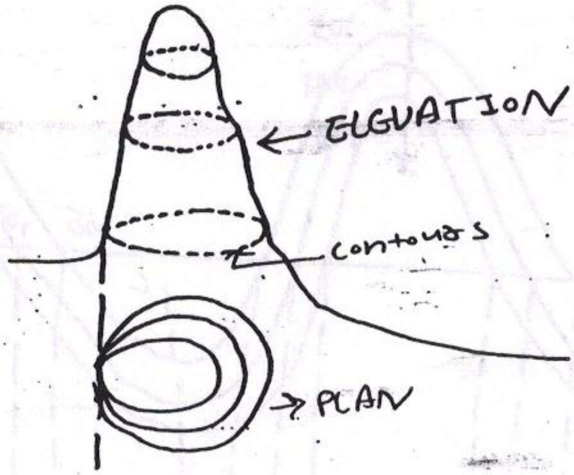
(2) Horizontal Equivalent :- It is the horizontal distance b/w any 2 point on two consecutive contour. It can be different acc. to the Topography.

(3) Properties :-

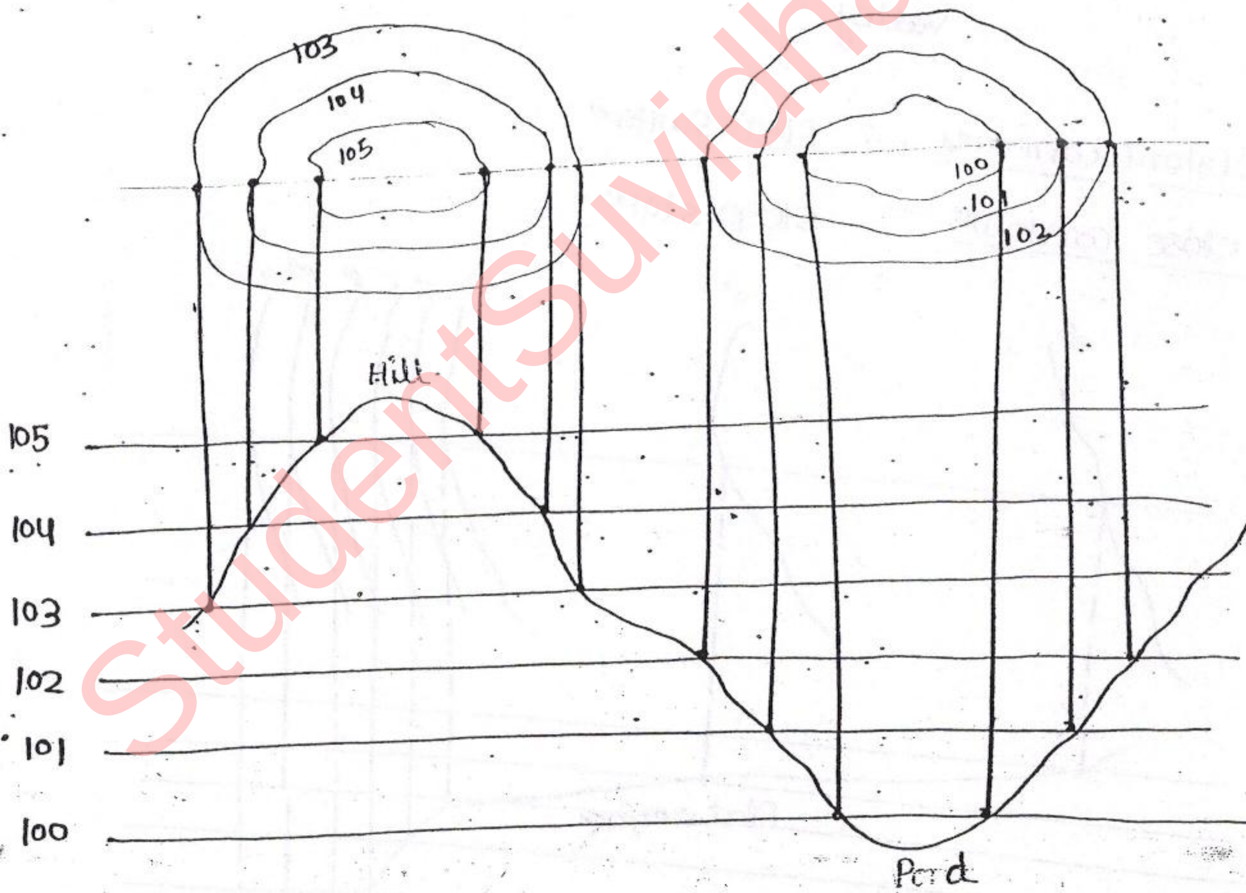
(a) Two contour does not cross each other / does not meet at any point.

exception -

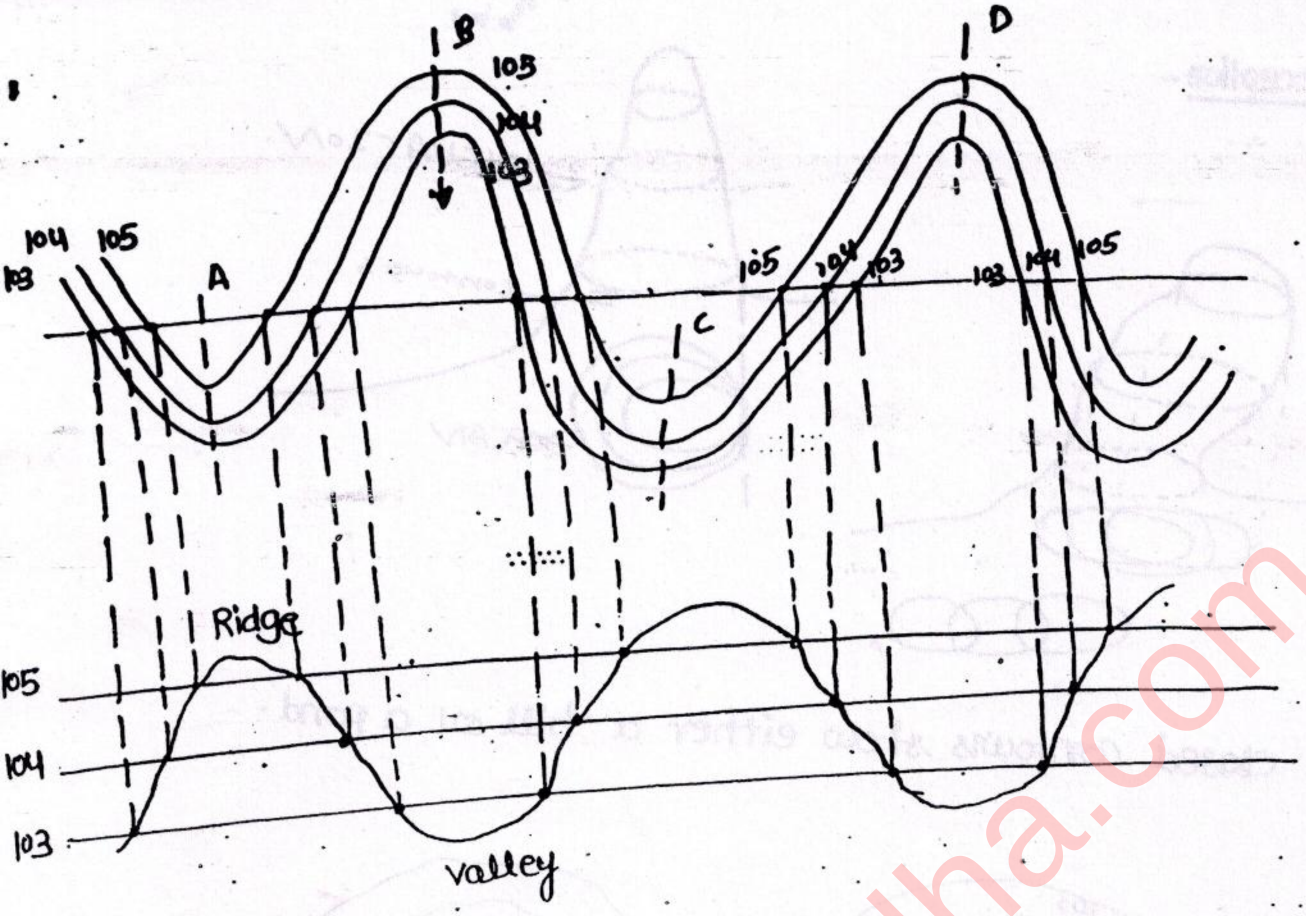




(b) closed contours show either a hill or a pond.

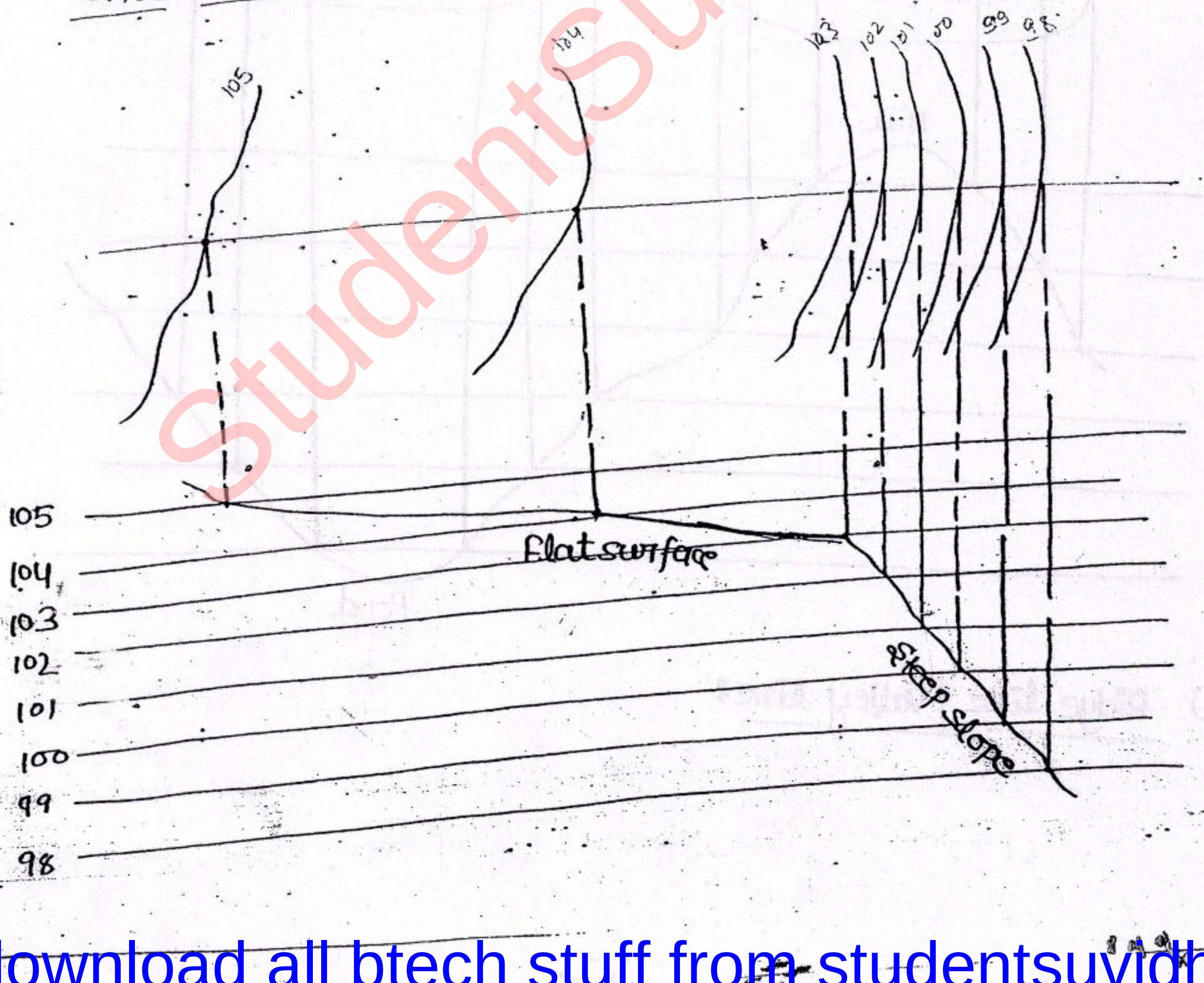


(c) Ridge line / valley line:



(d) Distant contours — Flat surface

Close contours — Steep slope



(e)

How to set alignment of a road in hilly area using a contour plan.

on a uniform gradient

if gradient is to be provid is 1 in x

Ex. gradient = 1 in 30

Scale 1 cm = 5m [say 1cm = 10m]

Length of chord :-

$$= \frac{30\text{ m}}{10\text{ m}} = 3\text{cm}$$

- In Rise in 30 m horizontal distance

AREA / VOLUME

(1) Area :-

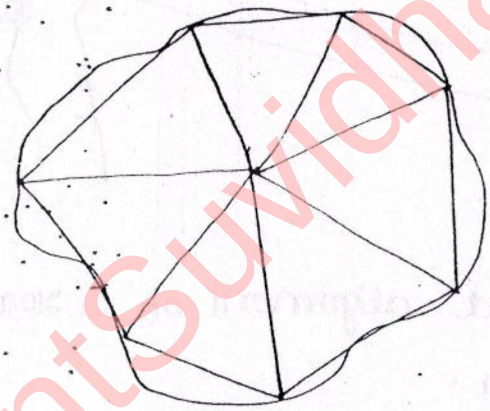
(A) By dividing into a no. of triangles.

Area of triangle -

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

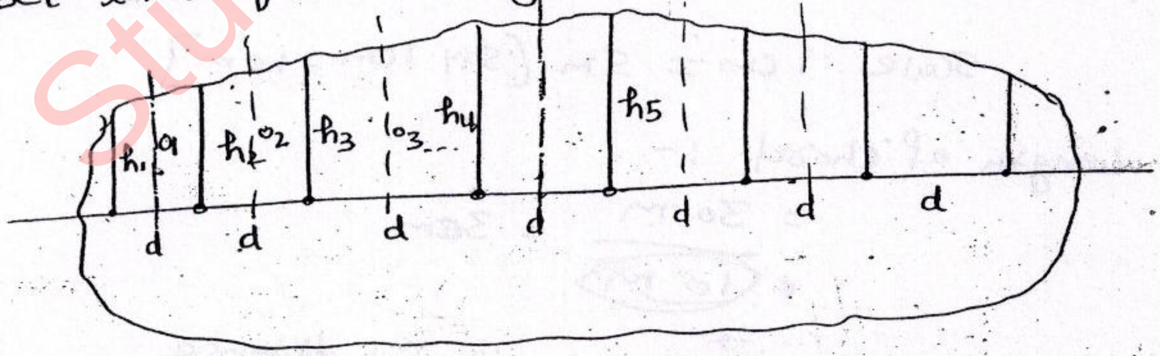
$$s = \frac{a+b+c}{2}$$

$$A = \frac{1}{2}ab\sin C = \frac{1}{2}bc\sin A = \frac{1}{2}ac\sin B$$



(B) offset Method :

offset taken from a single line at equal interval.



(i) Average ordinate Rule

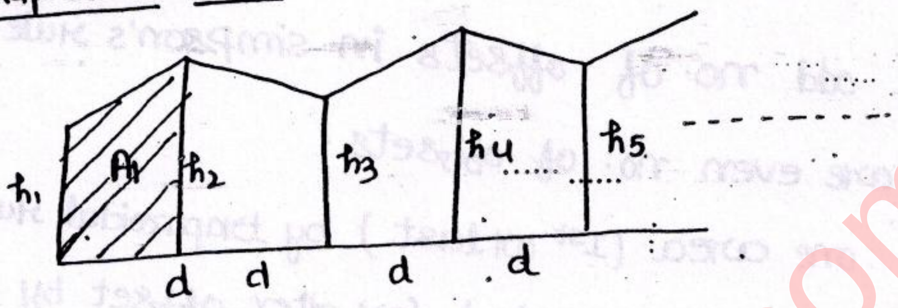
$$A = \left(\frac{h_1+h_2+h_3+ \cdots h_n}{n}\right) \times (n-1)d$$

This is a rough method

(ii) Mid ordinate Rule : If mid ordinates o_1, o_2, o_3 —— are measured.

$$A = d \times (o_1 + o_2 + o_3 + o_4 + \cdots o_n)$$

(iii) Trapezoidal Rule :



Area of one block

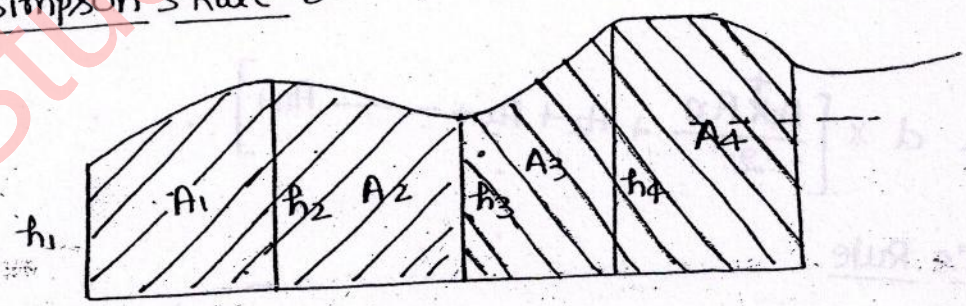
$$A_1 = d \times \left(\frac{h_1 + h_2}{2}\right)$$

$$A_2 = d \times \left(\frac{h_2 + h_3}{2}\right)$$

Total area —

$$A = d\left[\frac{h_1 + h_n}{2} + h_2 + h_3 + \cdots h_{n-1}\right]$$

(iv) Simpson's Rule :



Area of two block -

$$A_1 + A_2 = \frac{d}{3}(h_1 + 4h_2 + h_3)$$

$$A_3 + A_4 = \frac{d}{3}(h_3 + 4h_4 + h_5)$$

Total area —

$$A = \frac{d}{3}\left[(h_1+h_n)+4(h_2+h_4+h_6+---) + 2(h_3+h_5+h_7+---)\right]$$

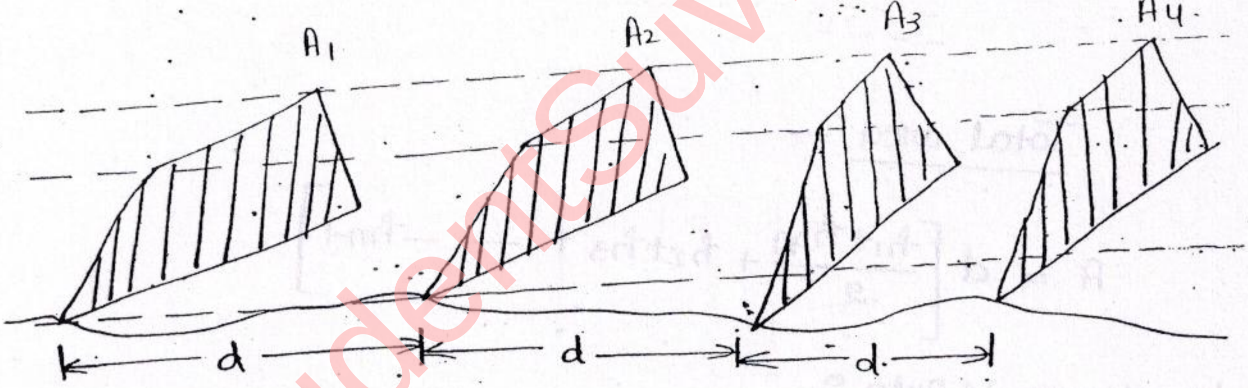
⇒ We need odd no. of offsets in simpson's rule.

⇒ If there are even no. of offsets calculate one area (1st or last) by trapazoidal rule and add in total area calculated for other offset by simpson's rule.

⇒ if a set of area parallel to each other at equal distances are given, total volm contained within area can be found by (1) Trapezoidal Rule (2) Simpson's Rule

(2) Volume :-

(A) Trapazoidal Rule :-



Volume

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

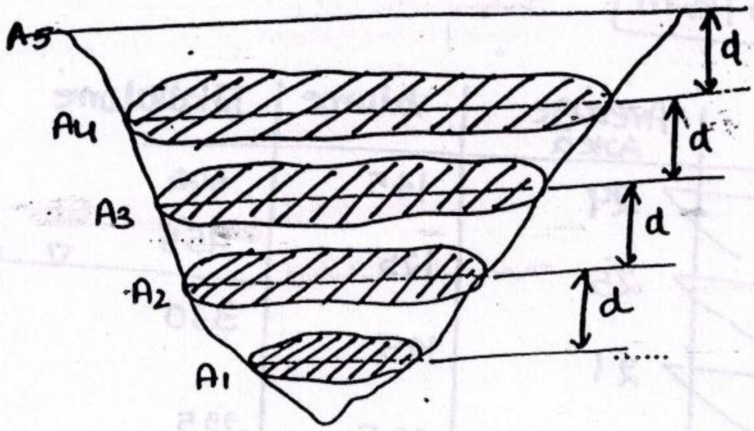
Simpson's Rule

Volume :

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

Another Example -

Volume of water in a reservoir -



Ques: 6(a) In a proposed reservoir. The area contouring within
ES-2006 the contours are.

Contours (in m)	100	95	90	85	80	75	70	65
Area (in ha)	32	26	24	18	15	13	7	2

1 hect = $10^4 m^2$; (100 m x 100 m)

Using the method of end areas calculate -

(1) capacity of reservoir when it is full at 100m level.

(2) Elevation of water level when it is 60% full Ignore the volume below 65 m level.

Solu^n: End Area Method is trapazoidal Rule -

(1) Volume of water when water is full upto 100m

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

$$= 5\left[\frac{32+2}{2} + 26+24+18+15+13+7\right]$$

= 600 Ha m.

(2). When the reservoir is 60% full.

$V = 0.6 \times 600$

$\boxed{V = 360 \text{ Ha-m}}$

Contour	Area	Average Area	Volume	Total Volume
100	32	29	145	600
95	26	25	125	455
90	24	21	105	330
85	18	16.5	82.5	225
80	15	14.0	70.0	142.5
75	13	10	50.0	72.5
70	7	4.5	22.5	22.5
65	2	0		

Neglect

360 Ham

For 330 Ha-m → W.T = 90m

For 455 Ha-m —— W.T = 95 m

For 360 Ha-m —— ?

$$W.T = 90 + \frac{(95-90)}{(455-330)}(360-330)$$

$$\boxed{W.T = 91.2 \text{ m}}$$

Ques: 6(b) A railway embankment is 16m wide with side slope 2to1 assume the ground to be level in the dirn transverse to the centre line. Calculate the volume content contained in a length of 100m, the centre ht at 20m

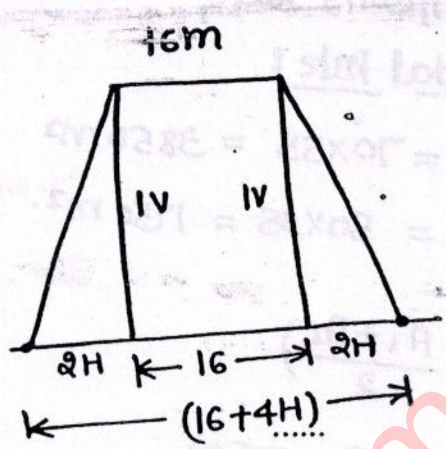
ES-1981

Interval being in 'meter' —

2.0, 4.5, 4.0, 3.5, 2.5, 1.5

⇒ Area

$$A = \frac{(B+B_1)}{2} \times H$$



Distance	height	Top width	Bottom width (16+4H)	Area
0m	2.0	16	24	40 m²
20 m	4.5	16	34	112.5
40 m	4.0	16	32	96
60 m	3.5	16	30	80.5
80 m	2.5	16	26	52.5
100m	1.5	16	22	28.5

$A = \frac{16+24}{2} \times 2.0$

Volume —

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

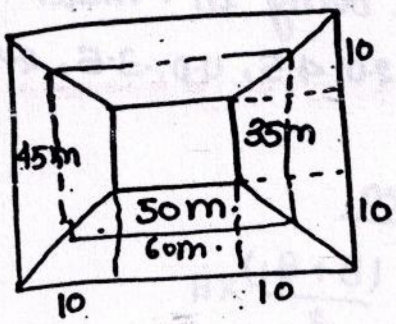
$$= 20 \times \left[\frac{40 + 28.5}{2} + 112.5 + 96 + 80.5 + 52.5\right]$$

$$\boxed{V = 7512 \text{ m}3}$$

Ques :(3) An excavation has been made as shown in figure. Calculate the quantity of earth excavated.

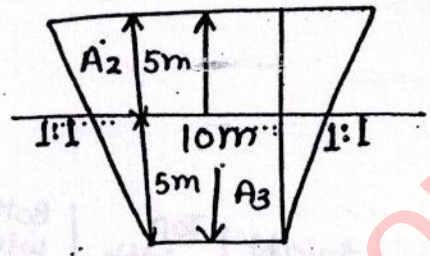
Use:- (I) Trapazoidal Rule.
(II) Simpson's Rule.

(I) **Trapazoidal Rule:**



$\therefore$ $A_1 = 70 \times 55 = 3850\ m^2$

$A_2 = 50 \times 35 = 1750\ m^2$.



$$V = d\left(\frac{A_1 + A_2}{2}\right)$$

$$= 10\left(\frac{3850 + 1750}{2}\right)$$

$$\boxed{V = 28000\ m^3}$$

(II) **Simpson's Rule:**

$A_1 = 70 \times 55 = 3850\ m^2$

$A_2 = 60 \times 45 = 2700\ m^2$

$A_3 = 50 \times 35 = 1750\ m^2$

$$V = \frac{d}{3}\left[A_1 + 4A_2 + A_3\right]$$

$$= \frac{5}{3}\left\{3850 + 4 \times 2700 + 1750\right\}$$

$$= 27333.33\ m^3$$

(III) **Trapazoidal Rule**

$$V = d \times \left\{\frac{A_1 + A_3}{2} + A_2\right\}$$

$$= 5 \times \left\{\frac{3850 + 1750}{2} + 2700\right]$$

$$= 27500\ m^3$$