

Complete the station (B) and (A)

(4)

Station	Area (m ²)		Volume (m ³)	
	Cut	Fill	Cut	Fill
(I) 60+90	34.41		973.80 [*]	
(H) 60+60	30.51		339.61	
(G) 60+44.4	13.03		27.67	1.62 ^{**}
(E) 60+40.8	2.34	1.35	2.57 ^{***}	19.12
(D) 60+37.5		10.24		125.70
(B) 60+30		23.28		788.4
(A) 60+00		29.28		
			$\Sigma = 1343.65 \text{ m}^3$	$\Sigma = 934.84 \text{ m}^3$

* End area

$$V = \frac{1}{2} (34.41 + 30.51) * 30 = 973.80 \text{ m}^3$$

$$** V = \frac{1}{3} * A * L = \frac{1}{3} * 1.35 * 3.6 = 1.62 \text{ m}^3$$

44.4 - 40.8
↓
40.8 - 37.5

$$*** V = \frac{1}{3} * 2.34 * 3.3 = 2.57 \text{ m}^3$$

} Volume of Pyramid

Land Levelling

(5)

Two ways to compute Land levelling:

① grid method

$$V_{ci} = \frac{[\sum C_i]^2}{\sum (C+F)_i} \times \frac{A_i}{4}$$

$$V_{fi} = \frac{[\sum F_i]^2}{\sum (C+F)_i} \times \frac{A_i}{4}$$

where: A_i : Area of subgrid.

$\sum C_i$ = summation of cut in corner of subgrid.

$\sum F_i$ = summation of fill in corner of subgrid.

$\sum (C+F)_i$ = summation of cut and fill of subgrid

$$V_{cut} = \sum_{i=1}^n$$
$$V_{fill} = \sum_{i=1}^n V$$

② weighted mean

$$(V_{cut} = V_{fill})$$

$$Z_G = \frac{\sum_{i=1}^k (Z_i \times n_i)}{4 \times M} = \frac{(Z_1 \times n_1) + (Z_2 \times n_2) + \dots + (Z_k \times n_k)}{4 \times M}$$

k = no. of points

M = no. of parts

n_i = no. of rectangles in which it occurs

Z_i = ground Elevation of points.

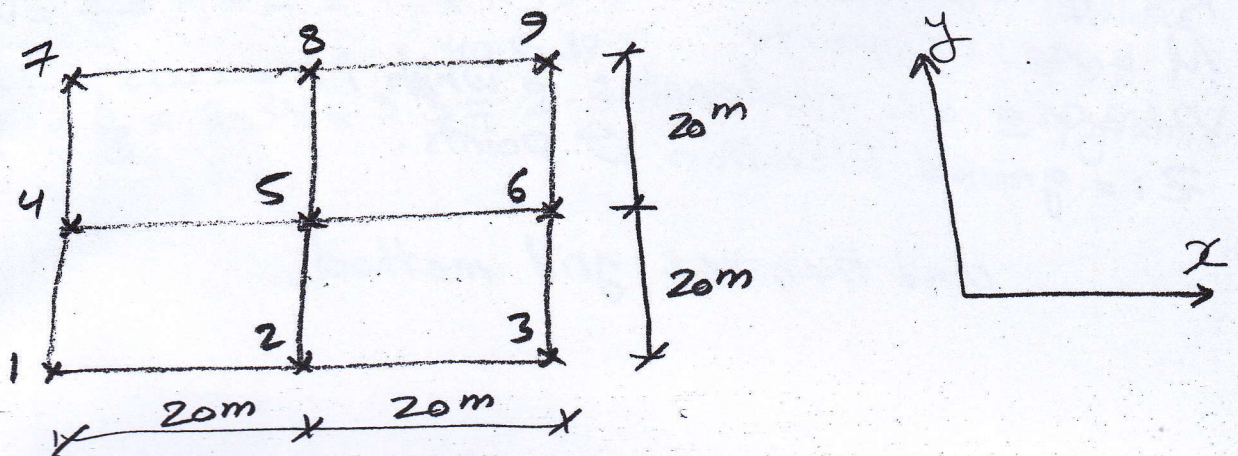
and then use grid method

Example/ For the points of gride, the table shown below illustrate the coordinates and ground Elev. ⑥

point	X (m)	Y (m)	Z (m)
1	10	20	16.5
2	30	20	16.9
3	50	20	15.8
4	10	40	14.3
5	30	40	19.3
6	50	40	20.1
7	10	60	18.5
8	30	60	21.4
9	50	60	22.6

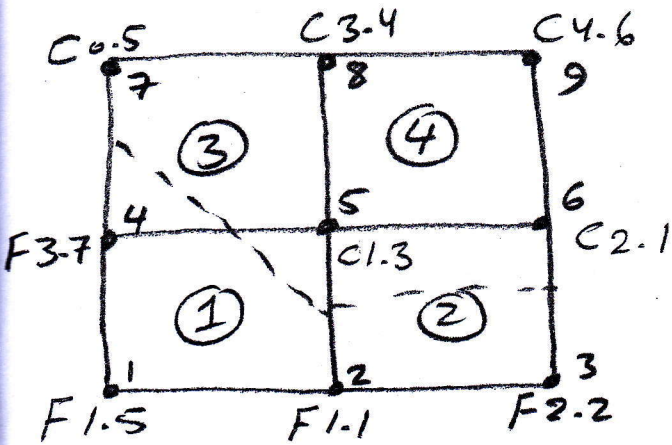
Compute:

- ① The volume of earth works required for land levelling if the final elevations of a plot of land = 18 m
- ② The volume of earth works required for land levelling to horizontal plane so that the volume of cut = volume of fill



ground Elev. - Final Elev. = $\begin{cases} \rightarrow + \text{Cut} \\ \rightarrow - \text{Fill} \end{cases}$

(7)



By grid method:

Volume of cut and Fill in subgrid (1)

$$V_{C1} = \frac{[1.3]^2}{[1.5+1.1+1.3+3.7]} * \frac{20*20}{4} = 22.87 \text{ m}^3$$

$$V_{F1} = \frac{[1.5+1.1+3.7]^2}{[1.5+1.1+1.3+3.7]} * 100 = 522.237 \text{ m}^3$$

while subgrid (2)

$$V_{C2} = \frac{[1.3+2.1]^2}{[1.3+2.1+1.1+2.2]} * 100 = 172.537 \text{ m}^3$$

$$V_{F2} = \frac{[1.1+2.2]^2}{[1.3+2.1+1.1+2.2]} * 100 = 162.537 \text{ m}^3$$

while subgrid (3)

$$V_{C3} = \frac{[0.5+3.4+1.3]^2}{[0.5+3.4+1.3+3.7]} * 100 = 303.820 \text{ m}^3$$

$$V_{F3} = \frac{[3.7]^2}{[0.5+3.4+1.3+3.7]} * 100 = 153.820 \text{ m}^3$$

and subgrid (4)

(3)

$$V_{C4} = \frac{[3.4 + 4.6 + 2.1 + 1.3]^2}{[3.4 + 4.6 + 2.1 + 1.3]} \times 100 = 1140 \text{ m}^3$$

$$V_{F4} = 0 \text{ m}^3$$

Total volume of cut

$$V_{\text{cut}} = 22.237 + 172.537 + 303.820 + 1140 = 1638.6 \text{ m}^3$$

Total volume of fill

$$V_{\text{fill}} = 522.237 + 162.537 + 153.820 + 0 = 838.594 \text{ m}^3$$

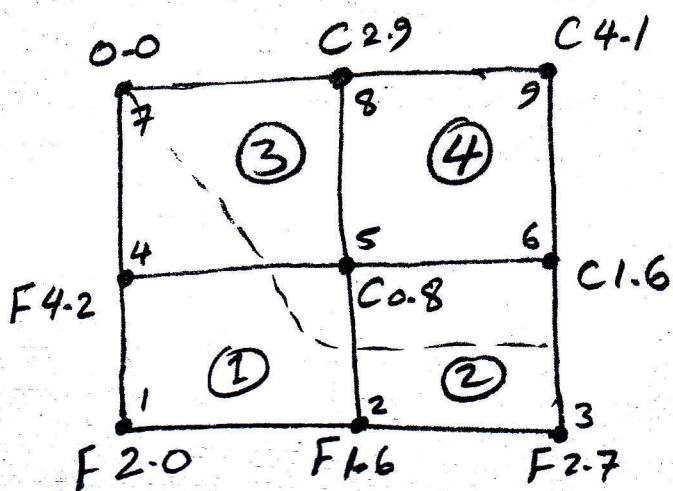
By weighted mean:

$$Z_G = \frac{\sum_{i=1}^k (Z_i \times n_i)}{4M}$$

$$22.6 \times 1$$

$$Z_G = \frac{16.5 \times 1 + 16.9 \times 2 + 15.8 \times 1 + 14.3 \times 2 + 19.3 \times 4 + 20.1 \times 2 + 18.5 \times 1 + 21.4 \times 1}{4 \times 4}$$

$$= 18.5 \text{ m}$$

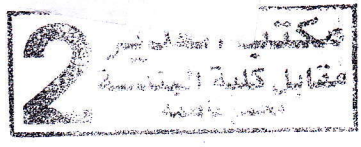


now we can complete the solution by using grid method

$$V_{C1} = \frac{[0.8]^2}{[0.8+4.2+2+1.6]} * 100 = 7.442 m^3$$

$$V_{F1} = \frac{[4.2+2.0+1.6]^2}{[0.8+4.2+2.0+1.6]} * 100$$

for subgrid 1



$$V_{C2} = \frac{[0.8+1.6]^2}{[0.8+1.6+1.6+2.7]} * 100 = 85.97 m^3$$

$$V_{F2} = \frac{[1.6+2.7]^2}{[0.8+1.6+1.6+2.7]} * 100 = 275.970 m^3$$

For subgrid 2

$$V_{C3} = \frac{[2.9+0.8]^2}{[0.0+4.2+0.8+2.9]} * 100 = 173.291 m^3$$

$$V_{F3} = \frac{[4.2]^2}{[0.0+4.2+0.8+2.9]} * 100 = 223.291 m^3$$

For subgrid 3

$$V_{C4} = \frac{[2.9+4.1+0.8+1.6]^2}{[2.9+4.1+0.8+1.6]} * 100 = 940 m^3$$

$$V_{F4} = 0.0 m^3$$

For subgrid 4

Total $V_{cut} = 1206.703 m^3$
 Total $V_{Fill} = 1206.703 m^3$ } \Rightarrow Volume of Cut = Volume of Fill