Complete the station (B) and (A)

station	Area (m^2) Cut	Area (m^2) Fill	Volume (m^3) Cut	Volume (m^3) 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		
			$\Sigma = 1343.65\ m^3$	$\Sigma = 934.84\ m^3$

* End area

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

Volume of Pyramid:

** $V = \frac{1}{3} * A * L = \frac{1}{3} * 1.35 * 3.6 = 1.62\ m^3$ (3.6 = 44.4 − 40.8)

*** $V = \frac{1}{3} * 2.34 * 3.3 = 2.57\ m^3$ (3.3 = 40.8 − 37.5)

Land levelling

Two ways to compute Land levelling:

① grid method

$$V_{ci} = \frac{[\Sigma c_i]^2}{\Sigma (c+F)_i} * \frac{A_i}{4}$$

$$V_{Fi} = \frac{[\Sigma F_i]^2}{\Sigma (c+F)_i} * \frac{A_i}{4}$$

where: A_i : Area of subgrid.

ΣC_i = summation of cut in corner of subgrid.

ΣF_i = Summation of Fill in Corner of subgrid.

$\Sigma (c+F)_i$ = Summation of cut and Fill of subgrid

$$V_{cut} = \sum_{i=}^{n}$$

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

② weighted mean $(V_{cut} = V_{Fill})$

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

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

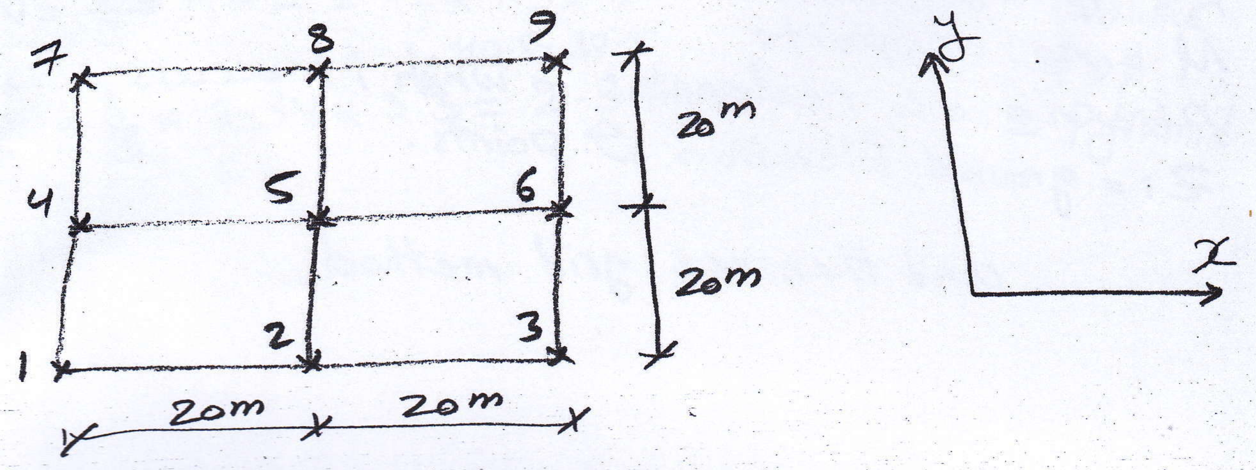
Example/ For the points of gride, the table shown below illustrate the coordinates and ground Elev.

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

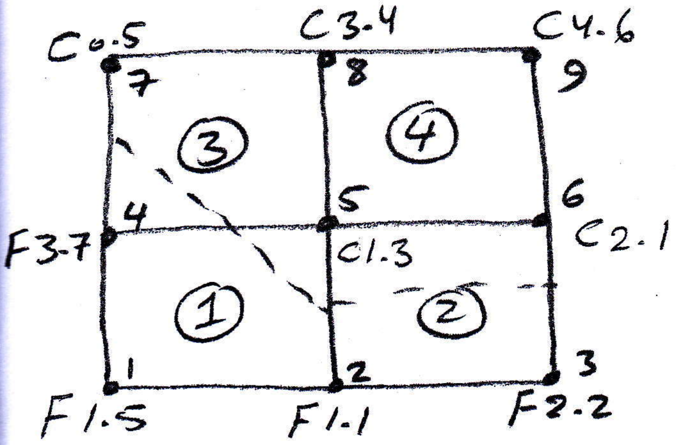
Compute:

① The volume of earth works required for land levelling if the final elevation 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. = { + Cut ; − Fill }



By grid method:

Volume of cut and Fill in subgrid (1)

$$V_{c_1} = \frac{[1.3]^2}{[1.5+1.1+1.3+3.7)} * \frac{20*20}{4} = 22.37\ m^3$$

$$V_{F_1} = \frac{[1.5+1.1+3.7]^2}{[1.5+1.1+1.3+3.7]} * 100 = 522.23\ m^3$$

while subgrid (2)

$$V_{c_2} = \frac{[1.3+2.1]^2}{[1.3+2.1+1.1+2.2]} * 100 = 172.537\ m^3$$

$$V_{F_2} = \frac{[1.1+2.2]^2}{[1.3+2.1+1.1+2.2]} * 100 = 162.537\ m^3$$

while subgrid (3)

$$V_{c_3} = \frac{[0.5+3.4+1.3]^2}{[0.5+3.4+1.3+3.7]} * 100 = 303.820\ m^3$$

$$V_{F_3} = \frac{[3.7]^2}{[0.5+3.4+1.3+3.7]} * 100 = 153.820\ m^3$$

and subgride (4)

$$V_{c4} = \frac{[3.4 + 4.6 + 2.1 + 1.3]^2}{[3.4 + 4.6 + 2.1 + 1.3]} * 100 = 1140 \, m^3$$

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

Total volume of cut

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

Total Volume of Fill

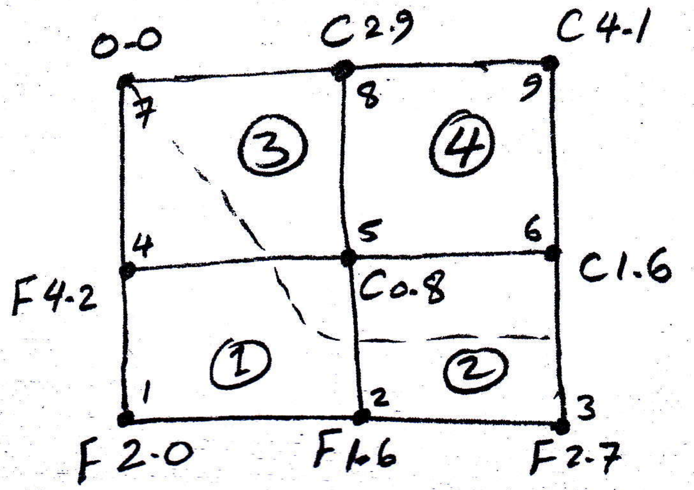
$$V_{Fill} = 522.237 + 162.537 + 153.820 + 0 = 838.594 \, m^3$$

By weighted mean :

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

$$Z_G = \frac{16.5*1 + 16.9*2 + 15.8*1 + 14.3*2 + 19.3*4 + 20.1*2 + 18.5*1 + 21.4 \ldots 22.6*1}{4*4}$$

$$= 18.5 \, m$$



now we can complete the solution by using grid method

$$V_{C_1} = \frac{[0.8]^2}{[0.8+4.2+2+1.6]} * 100 = 7.442\ m^3$$

$$V_{F_1} = \frac{[4.2+2.0+1.6]^2}{[0.8+4.2+2.0+1.6]} * 100$$

for subgrid ①

$$V_{C_2} = \frac{[0.8+1.6]^2}{[0.8+1.6+1.6+2.7]} * 100 = 85.97\ m^3$$

$$V_{F_2} = \frac{[1.6+2.7]^2}{[0.8+1.6+1.6+2.7]} * 100 = 275.970\ m^3$$

For subgrid ②

$$V_{C_3} = \frac{[2.9+0.8]^2}{[0.0+4.2+0.8+2.9]} * 100 = 173.291\ m^3$$

$$V_{F_3} = \frac{[4.2]^2}{[0.0+4.2+0.8+2.9]} * 100 = 223.291\ m^3$$

For subgrid ③

$$V_{C_4} = \frac{[2.9+4.1+0.8+1.6]^2}{[2.9+4.1+0.8+1.6]} * 100 = 940\ m^3$$

$$V_{F_4} = 0.0\ m^3$$

For subgrid ④

Total $V_{cut} = 1206.703\ m^3$

Total $V_{Fill} = 1206.703\ m^3$

$\Rightarrow$ Volume of Cut = Volume of Fill