Engineering Surveying
3rd Stage

Volumes

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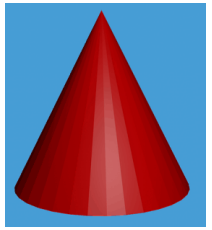
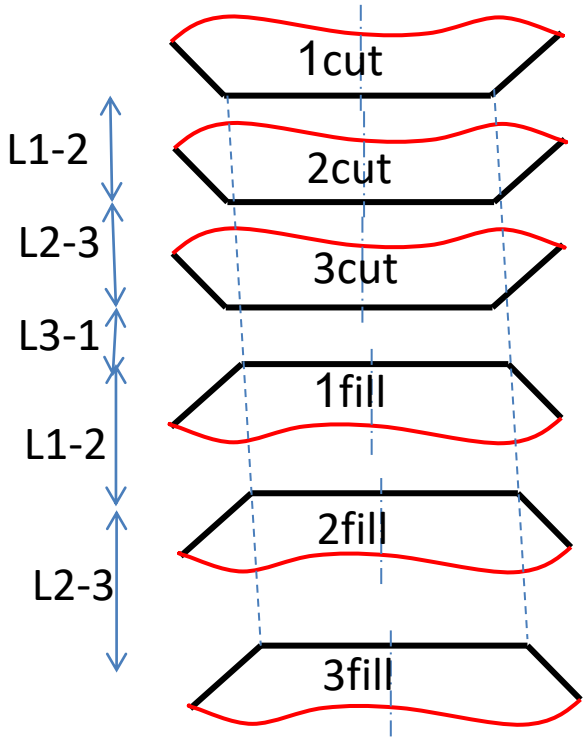
Volume of Pyramid

- $V=\frac{1}{3}$ A.h



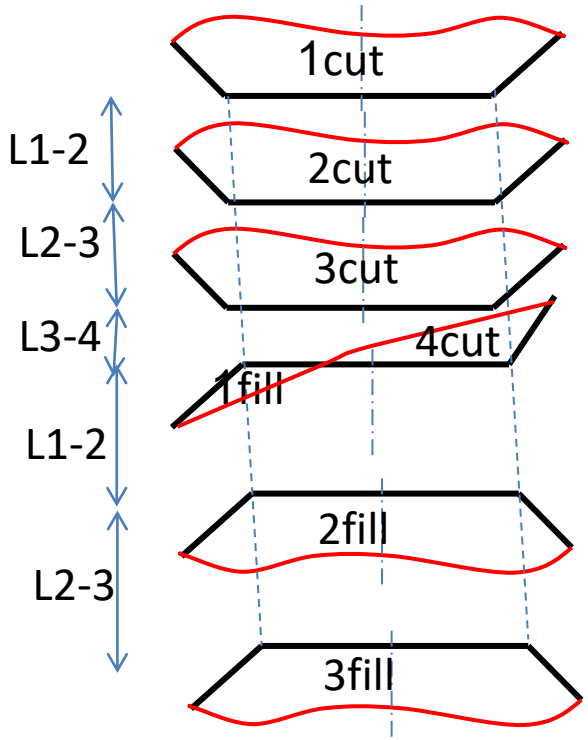
Volume

- $Vc_{1\text{-}2} = L_{1\text{-}2}\left(\frac{A1+A2}{2}\right)$
- $Vc_{2\text{-}3} = L_{2\text{-}3}\left(\frac{A2+A3}{2}\right)$
- $Vc_{3\text{-}1f} = \frac{1}{3}\, A3.L_{3\text{-}1}$
- $Vf_{1\text{-}3c} = \frac{1}{3}\, A1.L_{3\text{-}1}$
- $Vf_{1\text{-}2} = L_{1\text{-}2}\left(\frac{A1+A2}{2}\right)$
- $Vf_{2\text{-}3} = L_{2\text{-}3}\left(\frac{A2+A3}{2}\right)$
- Total Volume C = $L\left(\frac{A1+An}{2} + A2 + A3 + \cdots + An - 1\right)$
- Total Volume F = $L\left(\frac{A1+An}{2} + A2 + A3 + \cdots + An - 1\right)$



Volume

- $Vc_{1-2}=L_{1-2}\left(\frac{A1+A2}{2}\right)$
- $Vc_{2-3}=L_{2-3}\left(\frac{A2+A3}{2}\right)$
- $Vc_{3-4}=L_{3-4}\left(\frac{A3+A4}{2}\right)$
- $Vc_{4-1}=\frac{1}{3}\ A4.L_{1-2}$
- $Vf_{1-3c}=\frac{1}{3}\ A1.L_{3-4}$
- $Vf_{1-2}=L_{1-2}\left(\frac{A1+A2}{2}\right)$
- $Vf_{2-3}=L_{2-3}\left(\frac{A2+A3}{2}\right)$



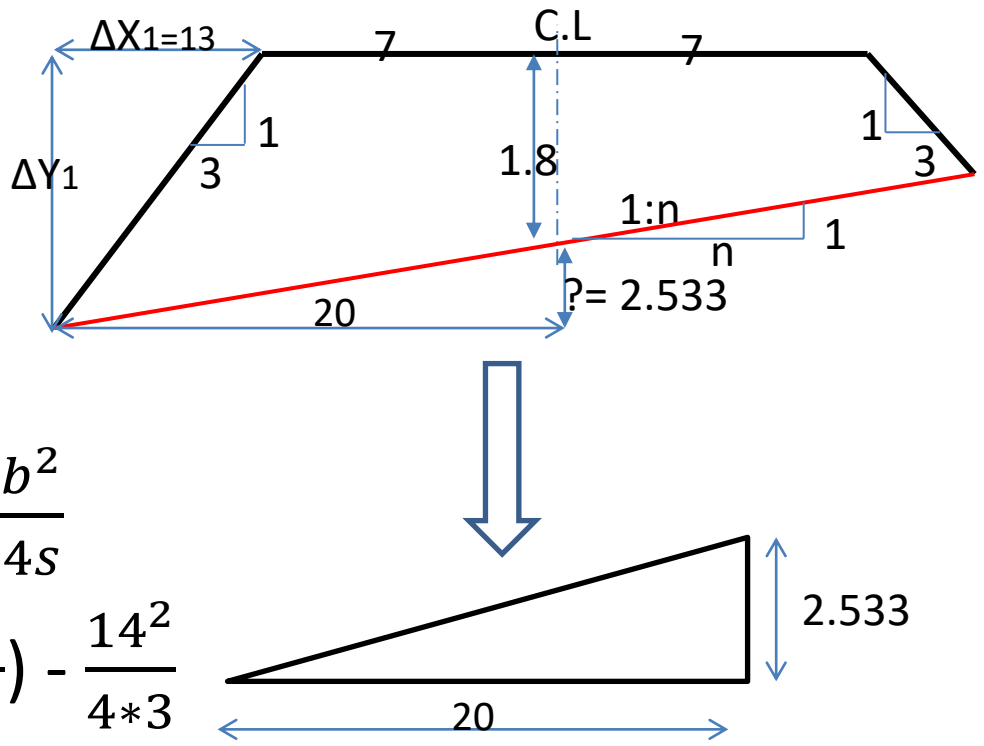
Example

- Compute the total volumes between the following cross sections have width (b=14 m)

Sta.	Cross - Section	Slope
4+20	$\frac{f?}{20.00}$, $\frac{f1.80}{0.00}$, $\frac{f?}{?}$	Ground has uniform slope: (1:s_f)= (1:3.0)
5+38	$\frac{f?}{?}$, $\frac{f1.90}{0.00}$, $\frac{f?}{?}$	Ground from left to right has (1:n1)= up slope(1:15) (1:n2)=up slope(1:10),(1:s)=(1:3)
6+75	$\frac{f?}{9.00}$, $\frac{c\ 0.25}{0.00}$, $\frac{c\ 1.2}{?}$	Ground has uniform slope: (1:n)= (1:12)
8+09	$\frac{c\ 2.75}{?}$, $\frac{c\ 1.1}{4.00}$, $\frac{c\ 2.30}{0.00}$, $\frac{c\ 1.75}{3.20}$, $\frac{c\ ?}{16.50}$	(1:s_c)= (1:3.0)

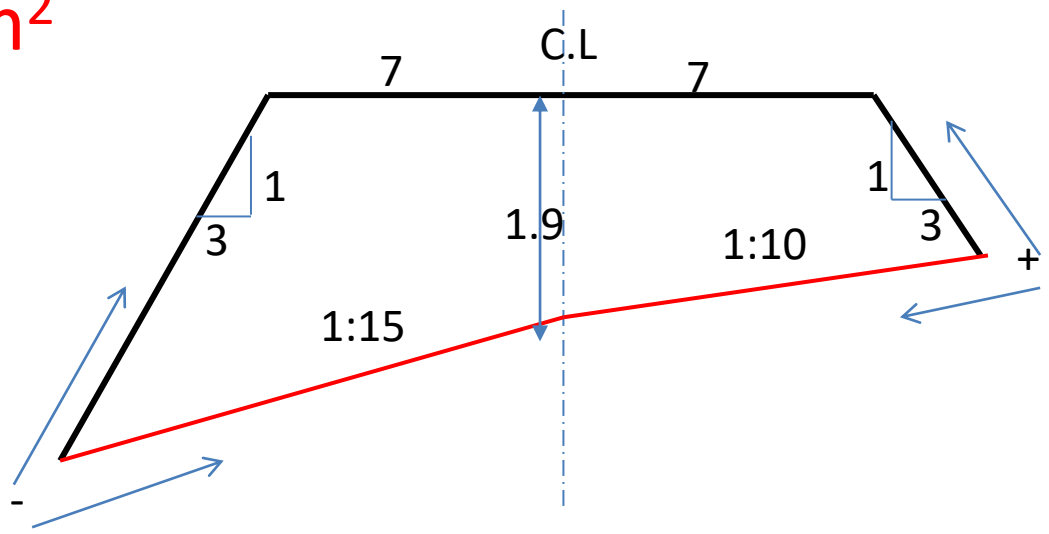
Station 4+20

- $\frac{1}{3} = \frac{\Delta Y}{13}$
- $\Delta Y = 4.33$ m
- $\frac{1}{n} = \frac{2.533}{20}$
- n= 7.89~8
- $A = (h + \frac{b}{2s})^2 (\frac{n^2 . s}{n^2 - s^2}) - \frac{b^2}{4s}$
- $A = (1.8 + \frac{14}{2*3})^2 (\frac{8^2 . 3}{8^2 - 3^2}) - \frac{14^2}{4*3}$
- Af=43.31m^2



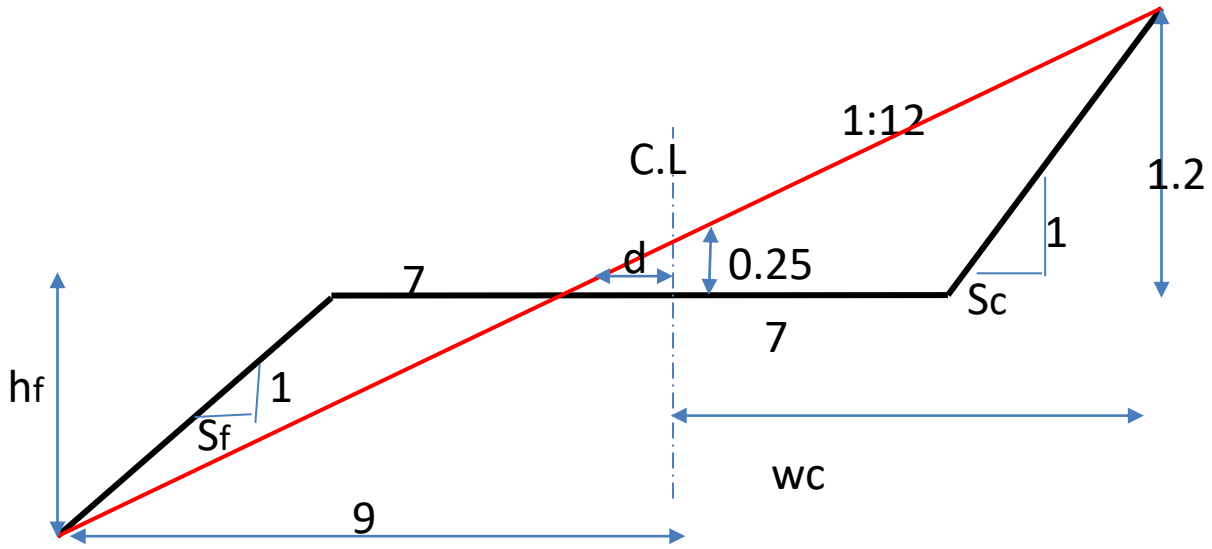
Station 5+38

- $A=\frac{1}{2}\left(h+\frac{b}{2s}\right)^2\left(\frac{n1s}{n1-s}+\frac{n2s}{n2+s}\right)-\frac{b^2}{4s}$
- $A=\frac{1}{2}\left(1.9+\frac{14}{2*3}\right)^2\left(\frac{15*3}{15-3}+\frac{10*3}{10+3}\right)-\frac{14^2}{4*3}$
- Af= 37.95 m^2

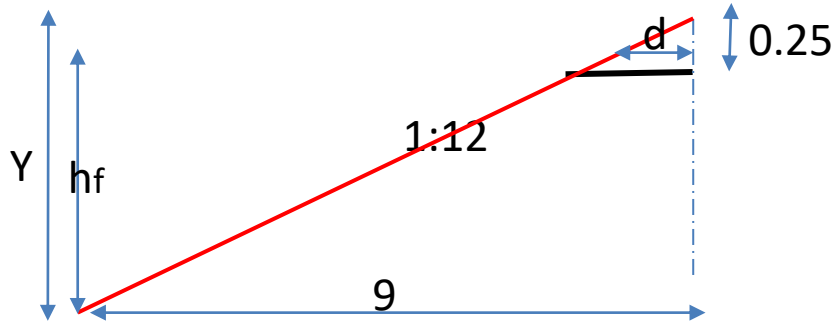


Station 6+75

- $\frac{1}{n} = \frac{0.25}{d}$
- d= 3 m.



- $\frac{1}{n} = \frac{Y}{9}$
- Y=0.75
- hf= 0.75-0.25= 0.5 m.



Station 6+75

- $Ac=\frac{hc}{2}\left(\frac{b}{2}+d\right)$
- $Ac=\frac{1.2}{2}(7+3)$
- Ac = 6 m^2
- $Af=\frac{hf}{2}\left(\frac{b}{2}-d\right)$
- $Af=\frac{0.5}{2}(7-3)$
- Af = 1 m^2

Station 8+09

$$\frac{1}{s} = \frac{\Delta Y}{16.5-7}$$

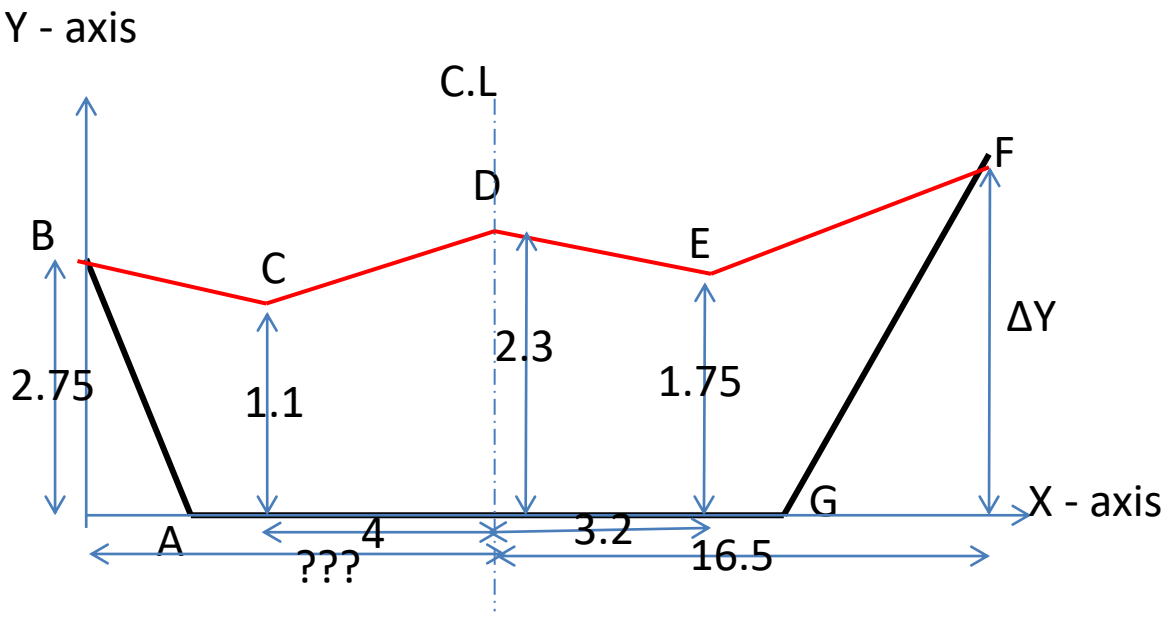
$$\frac{1}{3} = \frac{\Delta Y}{16.5-7}$$

$\Delta Y = 3.17$ m.

$$\frac{1}{3} = \frac{2.75}{\Delta X}$$

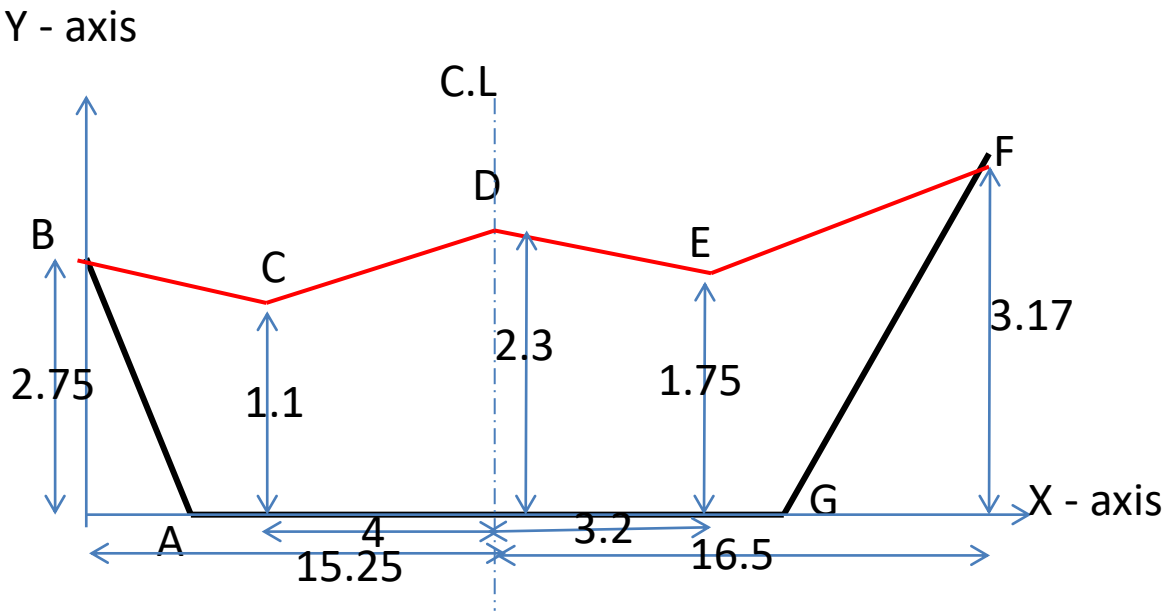
$\Delta X = 8.25$ m.

???=7+8.25= 15.25 m.



Station 8+09

- A=(8.25,0)
- B=(0,2.75)
- C=(11.25,1.1)
- D=(15.25,2.3)
- E=(18.45,1.75)
- F=(31.75,3.17)
- G=(22.25,0)



Station 8+09

N	E
N1	E1
N2	E2
N3	E3
N4	E4
N5	E5
N6	E6
N7	E7
N1	E1

N	E
0	8.25
2.75	0
1.1	11.25
2.3	15.25
1.75	18.45
3.17	31.75
0	22.25
0	8.25

2A =l 82.506l

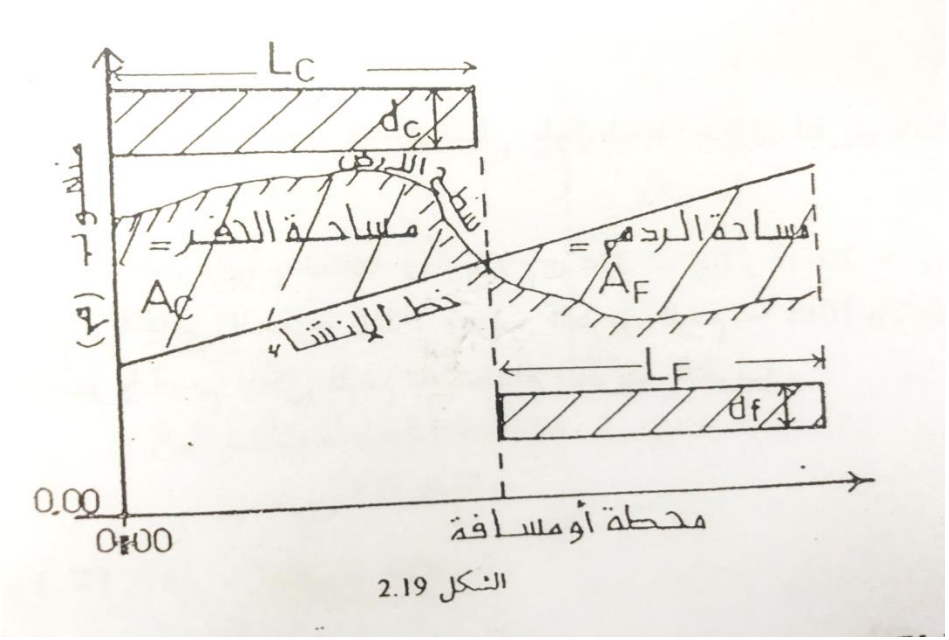
A c =41.25 m^2

Computation volume

- $Vf_{1\text{-}2}=L_{1\text{-}2}\left(\frac{A1+A2}{2}\right)$
- $Vf=118\left(\frac{43.31+37.95}{2}\right)+137\left(\frac{37.95+1}{2}\right)+134\left(\frac{1}{3}\right)$
- $Vf=7506.39m^3$
- $Vc_{1\text{-}2}=L_{1\text{-}2}\left(\frac{A1+A2}{2}\right)$
- $Vc=134\left(\frac{41.25+6}{2}\right)+137\left(\frac{6}{3}\right)$
- $Vc=3439.95m^3$

Approximate Method for Computing Volume From the Profile

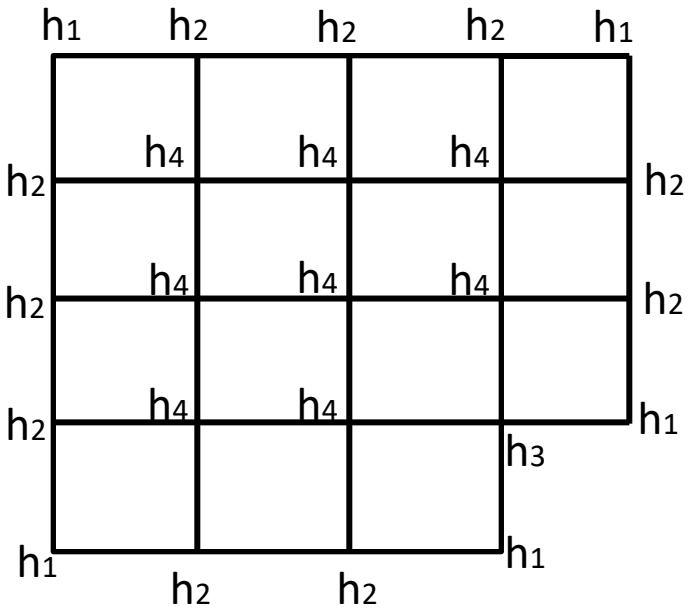
- $d_c(\text{in m.})=\frac{Ac}{Lc}$
- $a_c=d_c\ (b_c+s_c.d_c)$
- $V_c= a_c*L_c$
- $d_f(\text{in m.})=\frac{Af}{Lf}$
- $a_f=d_f\ (b_f+s_f.d_f)$
- $V_f= a_f*L_f$
- مثال الكتاب ص 80



الشكل 2.19

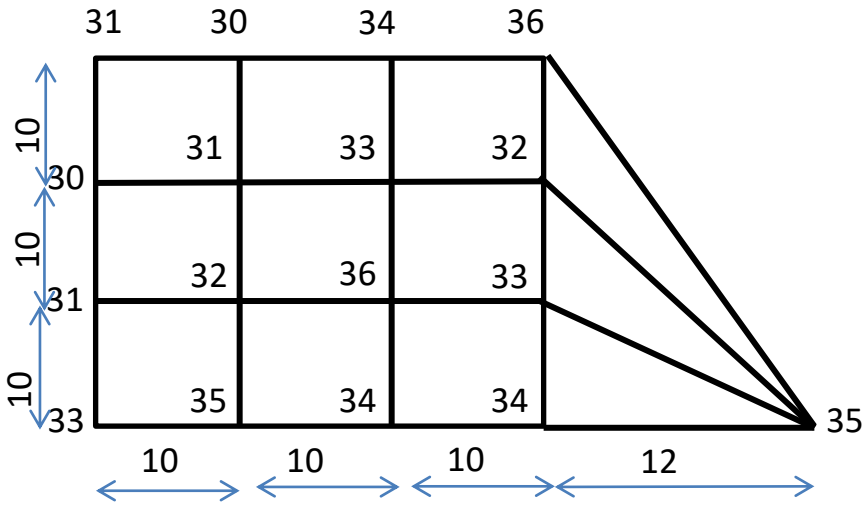
Volume of a Barrow Pit or Volume from Spotheights

- $Vc = A_{(square)}\left(\frac{\sum h1+2\sum h2+3\sum h3+4\sum h4}{4}\right)$
- $Vc = A_{(triangle)}\left(\frac{\sum h1+2\sum h2+3\sum h3+4\sum h4+5\sum h5+6\sum h6+7\sum h7+8\sum h8}{3}\right)$

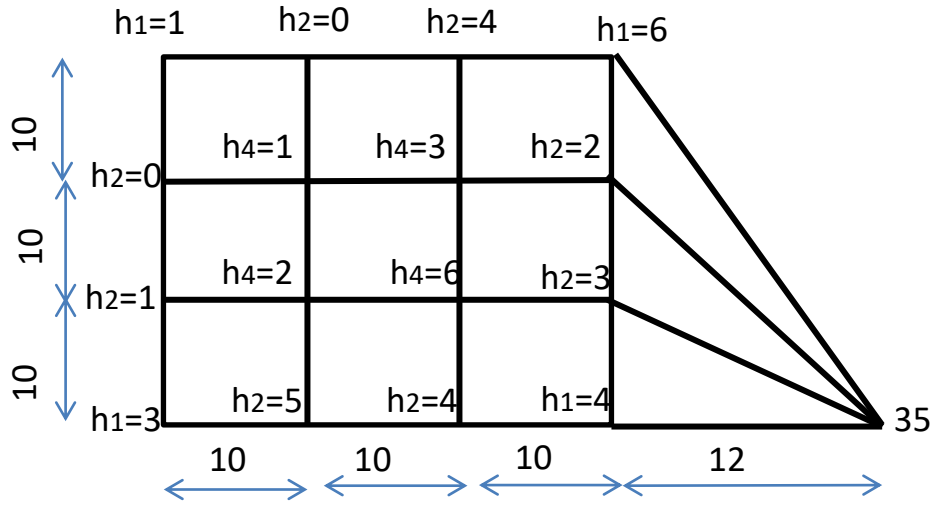


Example

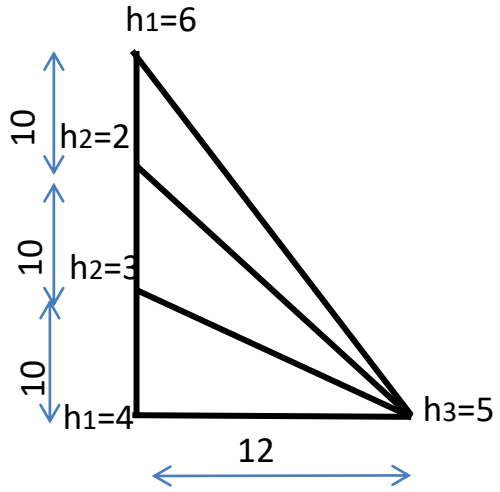
1. Compute amount of cut needed to level the ground at a level of 30 m.
2. Compute the expected amount of fill to raise the ground at a level of 40 m.
3. Calculate the level at which cut and fill are equal.



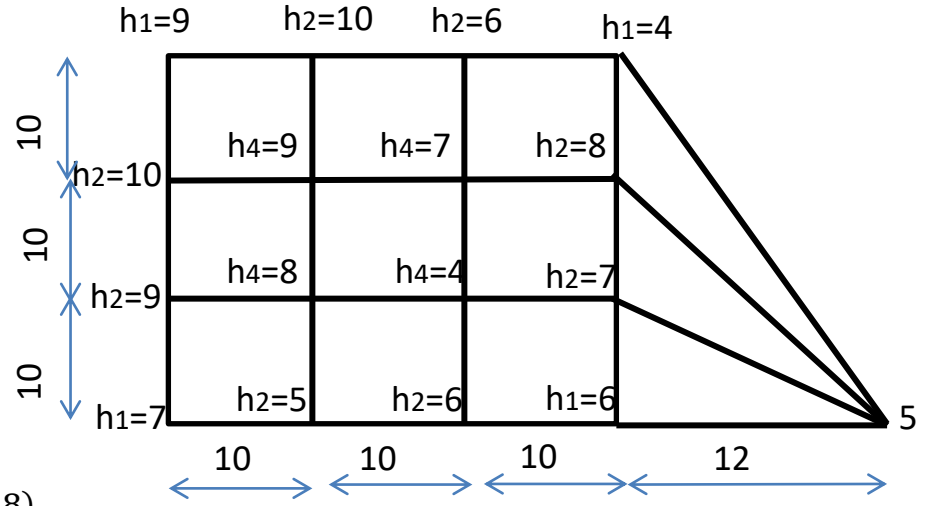
Compute amount of cut needed to level the ground at a level of 30 m.



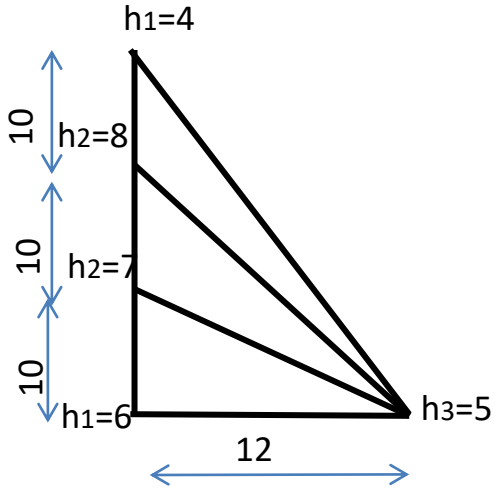
- Vc=A($\frac{\sum h1+2\sum h2+3\sum h3+4\sum h4}{4}$)
- $\sum h1$=3+1+6+4=14 m.
- $\sum h2$ = 1+0+0+4+2+3+4+5
- =19 m.
- $\sum h3 = 0$
- $\sum h4$ = 2+1+3+6= 12m.
- Vc(square)=(10*10)($\frac{14+2(19)+3(0)+4(12)}{4}$)=2500 m^3
- $\sum h1$=6+4=10 m.
- $\sum h2$= 2+3 =5m.
- $\sum h3$ = 5m.
- Vc=A($\frac{\sum h1+2\sum h2+3\sum h3+4\sum h4+5\sum h5+6\sum h6+7\sum h7+8\sum h8}{3}$)
- Vc(triangle)=A($\frac{\sum h1+2\sum h2+3\sum h3+0}{3}$)= ½*10*12 ($\frac{10+2(5)+3(5)+0}{3}$)
- Vc(triangle)=700m^3
- Vc(total)= 2500+700=3200m^3



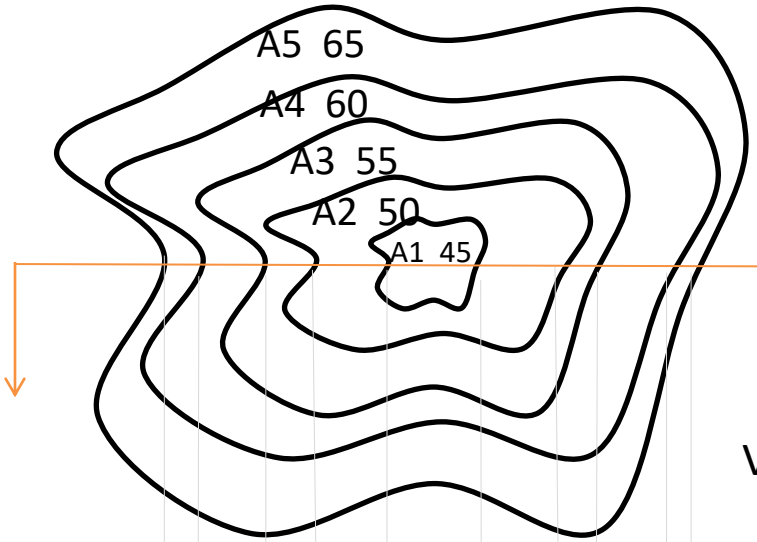
Compute the expected amount of fill to raise the ground at a level of 40 m.

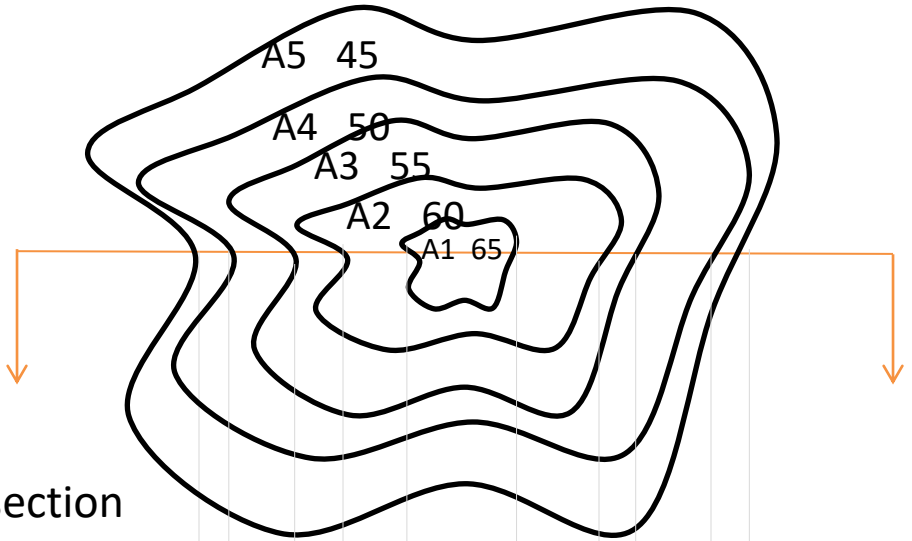


- Vf=A($\frac{\sum h1+2\sum h2+3\sum h3+4\sum h4}{4}$)
- $\sum h1$=7+9+4+6=26 m.
- $\sum h2$ = 9+10+10+6+8+7+6+5=61m.
- $\sum h3 = 0$
- $\sum h4$ = 8+9+7+4= 28m.
- Vf(square)=(10*10)($\frac{26+2(61)+3(0)+4(28)}{4}$)=6500 m^3
- Vf(triangle)=A*h=($\frac{1}{2}$*10*12*$\frac{4+8+5}{3}$)+=($\frac{1}{2}$*10*12*$\frac{8+7+5}{3}$)
- +=($\frac{1}{2}$*10*12*$\frac{6+7+5}{3}$)
- Vf(triangle)=1100 m^3
- Vf(total)= 6500+700=7600 m^3

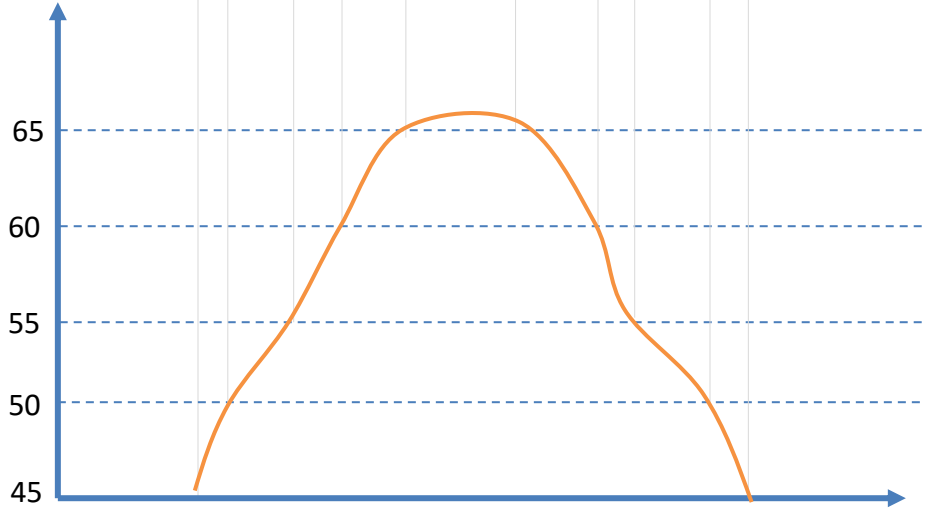


Volume from Contour





Vertical section



Example

- The land for a specified area containing a hilltop, where the area confined within the contour lines as following below, find the total Volume to level the ground at a level of 105 m. if you know the total area of the land = (60*40) m^2
- The scale = 1:1500

Con.elev.	125	120	115	110	105	100	95	90
Area (cm^2	2.8	3.6	4.2	5.4	6.2	7.4	8.8	10.2

Solution

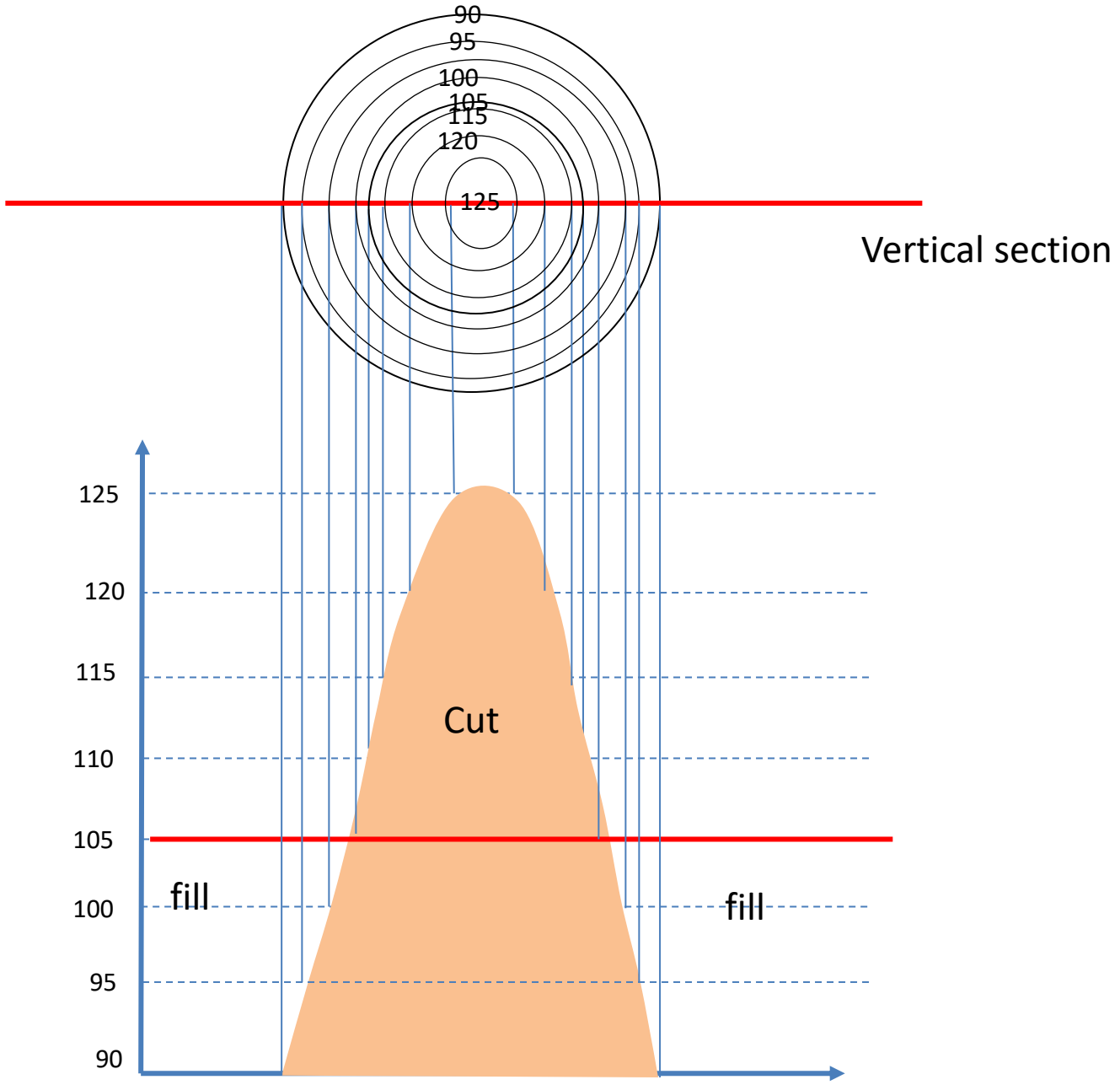
1cm= 15 m

1cm^2 = 225 m^2

Con.elev.	125	120	115	110	105	100	95	90
Area (cm^2	2.8	3.6	4.2	5.4	6.2	7.4	8.8	10.2
Area (m^2	630	810	945	1215	1395	1665	1980	2295

Total Volume C = hi ($\frac{A1+An}{2}$+ $A2 + A3 + \cdots + An - 1$)

Total Volume f = hi ($\frac{A1+An}{2}$+ $A2 + A3 + \cdots + An - 1$)


90
95
100
105
115
120
125
Vertical section
125
120
115
110
105
100
95
90
Cut
fill
fill

- Area of land (base) = (60*40)= 2400 m^2
- A105= 2400-1395= 1005
- A100= 2400-1665= 735
- A95= 2400-1980= 420
- A90= 2400-2295= 105
- Total Volume f = 5 ($\frac{105+1005}{2}$+ $420 + 735$)= 8550 m^3
- Total Volume c = 5 ($\frac{1395+630}{2}$+ $1215 + 945 + 810$)= 19912.5 m^3