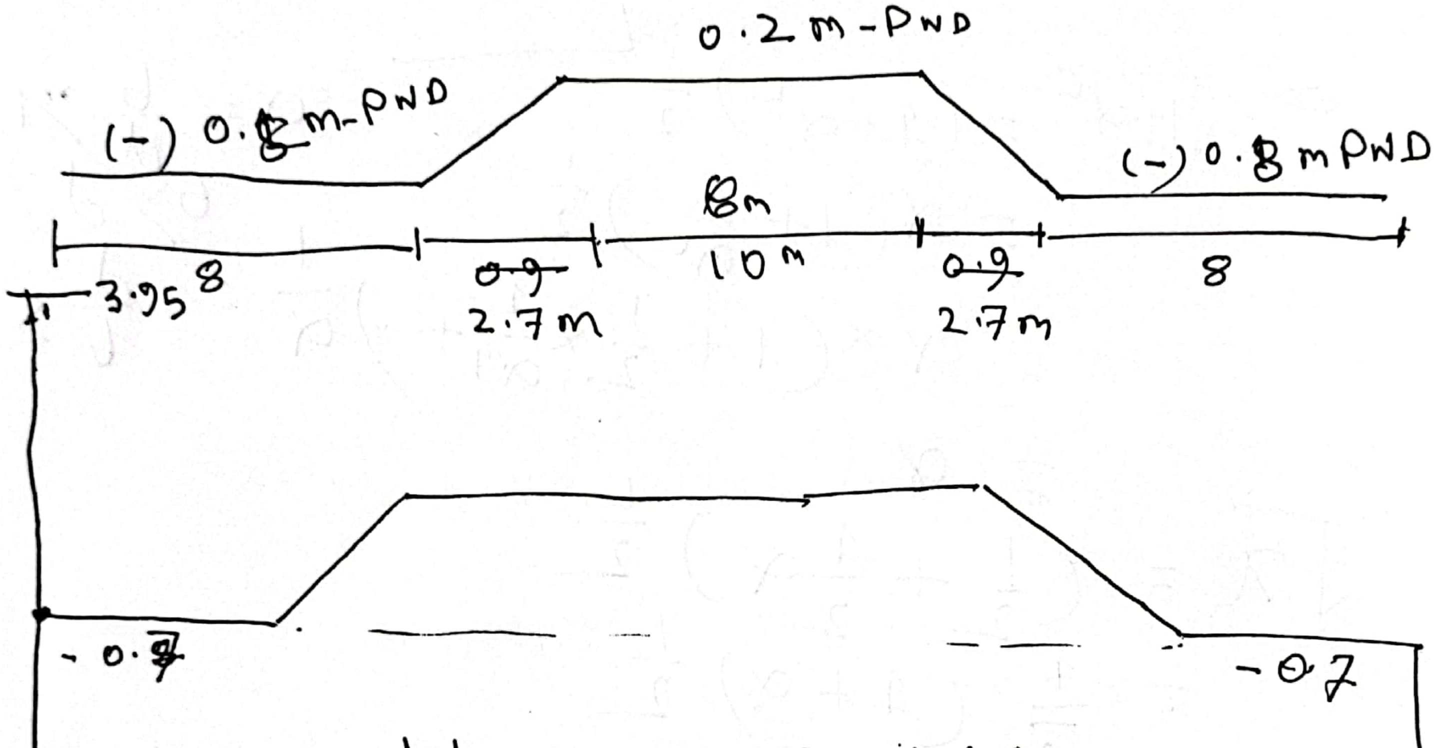
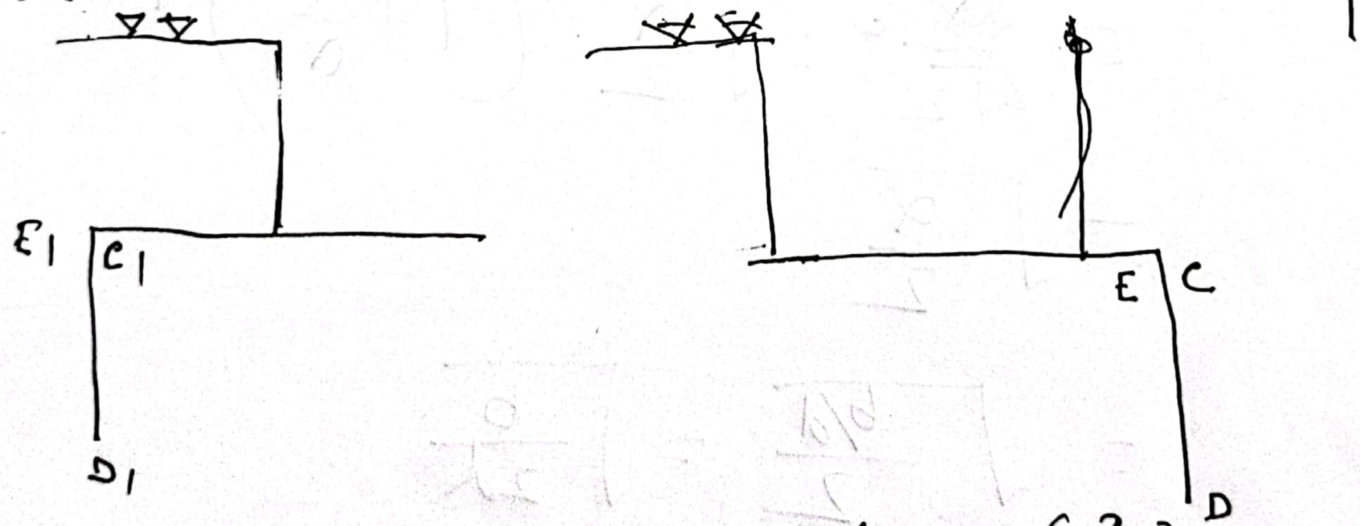
Hydraulic Design of Inlet

AVG GL : 1.5 m PWD



Max m Head difference = 3.95 = 4.65 m



$\phi C_1 = 100 - \phi_E$

$\phi D_1 = 100 - \phi_D$

$\phi_E = \frac{1}{\pi} \cos^{-1}\left(\frac{\lambda - 2}{\lambda}\right)$

$\phi_D = \frac{1}{\pi} \cos^{-1}\left(\frac{\lambda - 1}{\lambda}\right)$

$\lambda = \frac{1 + \sqrt{1 + \alpha^2}}{2}$

$\alpha = \frac{b}{d}$

$$G_E = \frac{H}{d} \times \frac{1}{\pi\sqrt{\lambda}}$$

$$G_E = \frac{1}{7}$$

$$\boxed{\begin{aligned} \lambda &= \frac{1+\sqrt{1+\alpha^2}}{2} \\ \sqrt{\lambda} &= \left(\frac{1+\sqrt{1+\alpha^2}}{2}\right)^{\frac{1}{2}} \end{aligned}}$$

$$\alpha = \frac{b}{d} > 1 \qquad b > d$$

$$\begin{aligned} \sqrt{1+\alpha^2} &= (1+\alpha^2)^{\frac{1}{2}} \\ &= \alpha\left(1+\frac{1}{\alpha^2}\right)^{\frac{1}{2}} \\ &= \alpha \times \left(1 + \frac{1}{2}\times\frac{1}{\alpha^4} + \cdots\right) \\ &= \alpha \end{aligned}$$

$$\frac{1}{\alpha} = \frac{d}{b} \le 1$$

$$\begin{aligned} \sqrt{\lambda} &= \left(\frac{1}{2}+\frac{1}{2}\alpha\right)^{\frac{1}{2}} \\ &= \frac{1}{\sqrt{2}}(1+\alpha)^{\frac{1}{2}} \\ &= \sqrt{\frac{\alpha}{2}}\left(1+\frac{1}{\alpha}\right)^{\frac{1}{2}} \\ &= \sqrt{\frac{\alpha}{2}} \\ &= \sqrt{\frac{b/d}{2}} = \sqrt{\frac{b}{2d}} \end{aligned}$$

$$\begin{aligned} G_E &= \frac{H}{d} \times \frac{1}{\pi \times \sqrt{\frac{b}{2d}}} \\ &= \frac{H}{d} \times \frac{1\times\sqrt{2}}{\pi\times\sqrt{\frac{b}{d}}} = \frac{H}{d}\times\frac{\sqrt{2}\times\sqrt{d}}{\pi\times\sqrt{b}} \end{aligned}$$

$$GE = \frac{H}{\sqrt{d}} \times \frac{\sqrt{2}}{\pi \cdot \sqrt{b}}$$

$$\Rightarrow GE^2 = \frac{H}{d} \times \frac{2}{\pi^2 \cancel{b} \, b}$$

$$\Rightarrow d = \left(\frac{H}{GE \times \pi}\right)^2 \times \frac{2}{\cancel{b} \, b}$$

For Inlet $b = 31.4\,m$ $H = 4.65\,m$

$$d_{min} = \left(\frac{4.65}{1/7 \times \pi}\right)^2 \times \frac{2}{31.4}$$

$$= 6.8\,m$$

$d = 6.8\,m$

$$GE = \frac{4.65}{6.8} \times \frac{1}{3.14 \times \sqrt{3.16}}$$

$$= 0.12$$

$$\alpha = \frac{b}{d} = 5.23$$

$$\lambda = \frac{1 + \sqrt{1+\alpha^2}}{2}$$

$$= 3.16$$

<u>Trail for b</u> : Try <u>b = 35.4 m</u>

$\cancel{\alpha = \frac{b}{d} =}$

$d = 6\,m$

$$\alpha = \frac{b}{d} = 5.9$$

$$\lambda = 3.49$$

for Inlet $b = \cancel{32}\ 31.4\,m$

$$\phi_E = \frac{1}{\pi}\cos^{-1}\left(\frac{\lambda-2}{\lambda}\right)$$

$$= \frac{1}{\pi}\cos^{-1}\left(\frac{3.49-2}{3.49}\right)$$

$$= \frac{1}{\pi}\times 1.13$$

$$= 0.359$$

$$\phi_D = \frac{1}{\pi}\cos^{-1}\left(\frac{\lambda-1}{\lambda}\right)$$

$$= \frac{1}{\pi}\cos^{-1}\left(\frac{3.49-1}{3.49}\right)$$

$$= \cancel{\frac{1}{\pi}}\ \frac{1}{\pi}\times 0.776$$

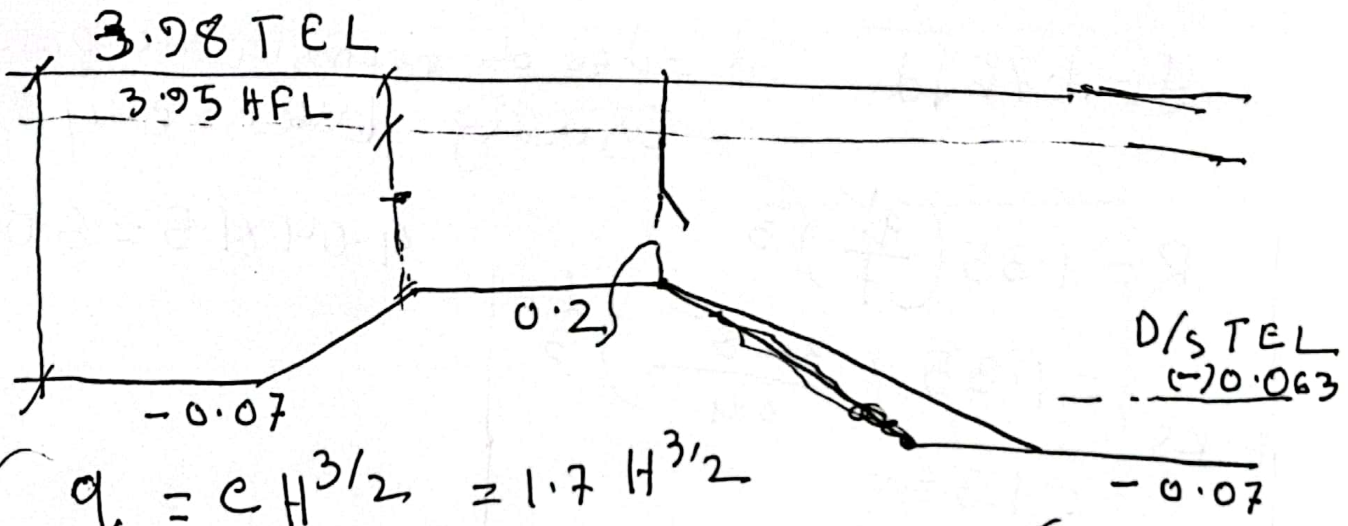
$$= 0.247$$

$$\phi_{D1} = 100 - \phi_D = 0.753$$

~~$\phi E_1 =$~~

$$\phi_{C1} = 100 - \phi_E = 100 - 0.359 = 0.641$$

$$\frac{V^2}{2g} = \frac{0.81^2}{2 \times 9.81} = 0.03\ m$$



$q = CH^{3/2} = 1.7\ H^{3/2}$

$\Rightarrow H^{3/2} = \left(\frac{q}{c}\right)^{2}$

$\Rightarrow \left(H^{3/2}\right)^{2/3} = \left(\frac{q}{c}\right)^{2/3}$

$H = \left(\frac{q}{c}\right)^{2/3} = \left(\frac{35}{1.7}\right)^{2/3} = 7.7$ feet

$= 2.3$

$H_L = 3.95\ m$

$E_{f2} = 2.5$ meters

Level at which Jump will form

$= D/S\ TEL - E_{f2}$

$= (-)\,.0063 - 2.5\ m$

$= (-)\,2.56\ m$ PWD

$y_1 = 0.25\ m$

P 3

TEL : $\frac{v^2}{2g} =$

$q = \frac{Q}{B} = \underline{35 \text{ cfs}} / \text{ft} = \frac{35}{35} = 1 \text{ m}^3/\text{s}/\text{m} = 3.28 \text{ m}^3/\text{sec}/\text{m}$

$f = 1.76\sqrt{d}$ $d = d_{50}$ of representative particle
usually taken $= 0.4$

MKS

$R = 1.35\left(\frac{q^2}{f}\right)^{\frac{1}{3}}$

$= 1.35\left(\frac{3.28^2}{0.4}\right)^{\frac{1}{3}}$

$= 1 \cancel{.35} \times$

$= 4.04 \text{ m}$

$4.04 \times 1.5 = 6.06$

FPS

$R = \cancel{0.91}\left(\frac{12.32^2}{}\right.$

$R = 0.91\left(\frac{q^2}{f}\right)^{\frac{1}{3}}$

$= 0.91\left(\frac{35^2}{0.4}\right)^{\frac{1}{3}}$

TEL $= 13.21$ feet HFL

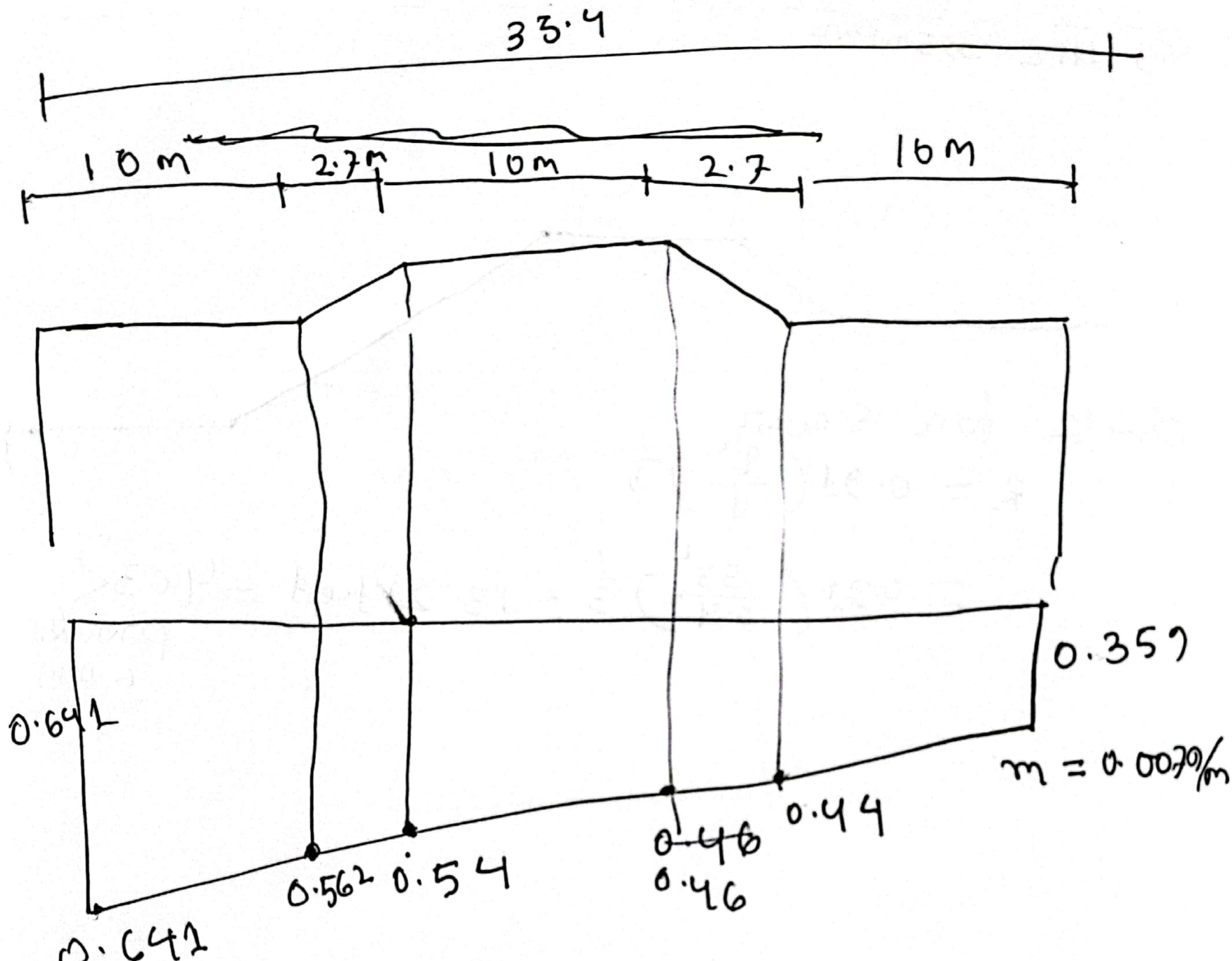
$v = \frac{q}{R} = \frac{35}{13.21} = 2.65$ ft/sec

$= 0.81$ m/sec

$\frac{v^2}{2g} = \frac{\cancel{2.65}}{}$

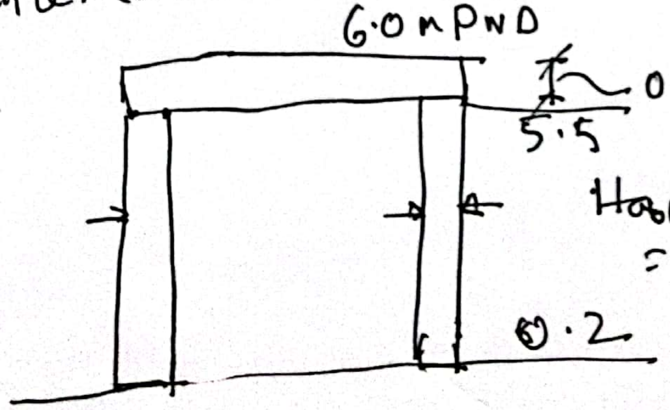
$=$

P-6



Maximum Uplift pressure $= 0.54 \times 4.65$

$= 2.51\,m$



0.500

5.5

$t_{req} = \frac{2.51}{1.6}$

$= 1.6\,m$

Horizontal

$= 5.3 \times 2$

$= \frac{10.6}{6} = 1.76\,m$ of concrete $> 1.6m$

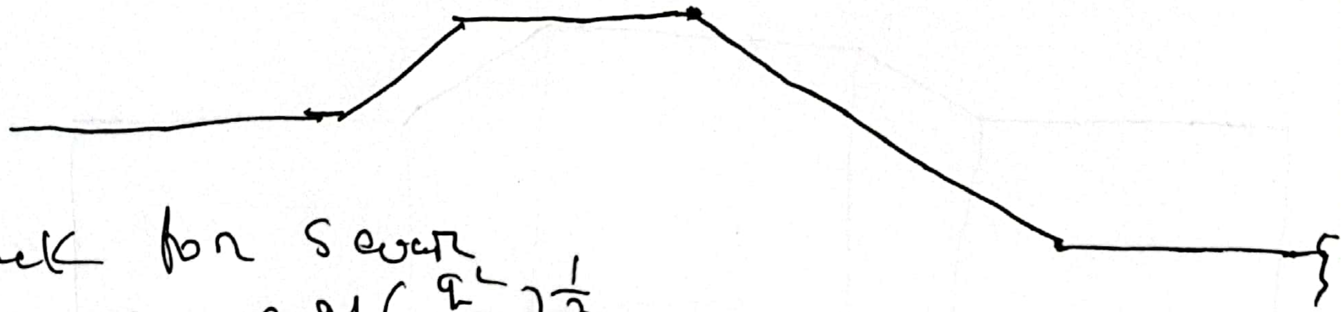
$\times 0.5$

$= 0.8\,m$

Assume $H = 0.6\,m$

TCL

U/S HFL 395m PWD



check for scour

$$R = 0.91\left(\frac{q^2}{f}\right)^{\frac{1}{3}}$$

$$= 0.91\left(\frac{35^2}{0.4}\right)^{\frac{1}{3}} = 13.21 \text{ feet} = 4.03 <$$

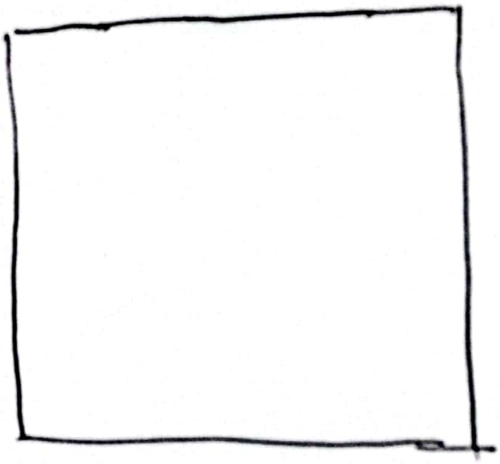
provided 6.0 m

Tandem load $= \cancel{2\times 25 \times 4} = \frac{200}{60}$

.8

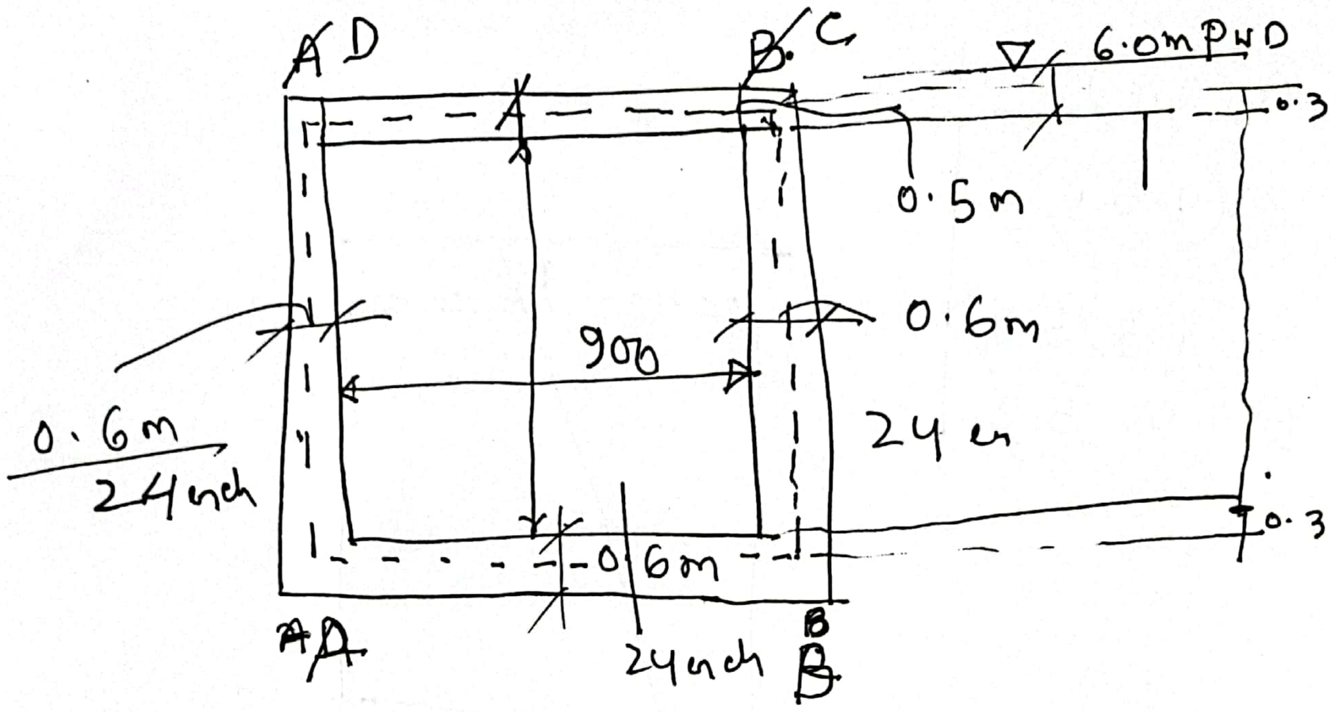
$$\frac{50}{60} = 0.83 \text{ k/ft}$$

$LL = 1 \text{ ksf}$



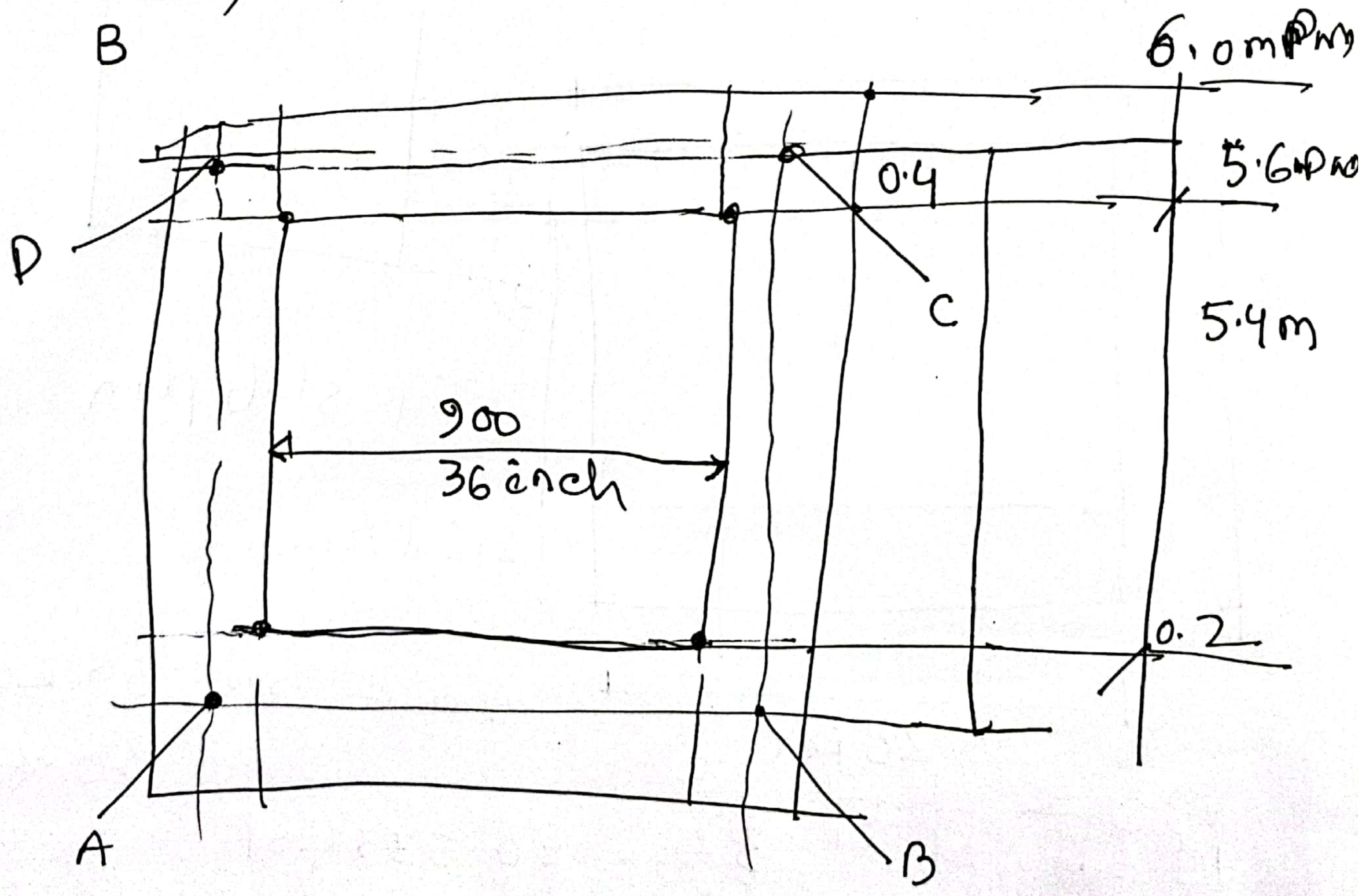
$E_{S1} = E_{S2} + H_L = -2.56 + 2.3 + 3.9$

$= 6.4\,m$


A D
B C
6.0m PWD
0.3
0.5m
0.6m
900
0.6m
24inch
24 in
0.6m
0.3
A
24inch
B

A (0, 0)

B

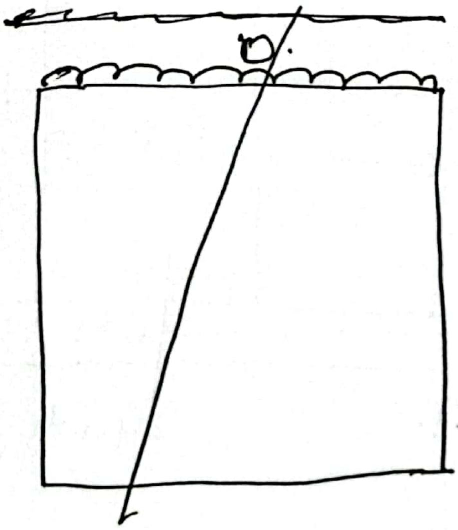

6.0m PWD
5.6 PWD
0.4
D
C
5.4m
900
36 inch
0.2
A
B

A (0.0)

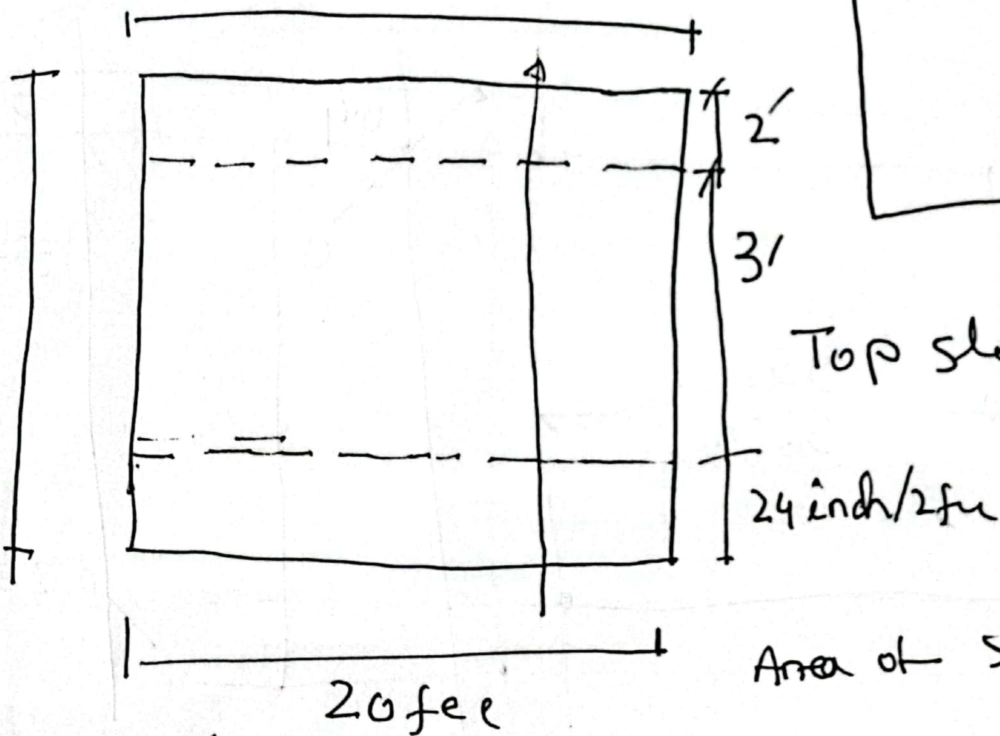
B (1.5, 0)

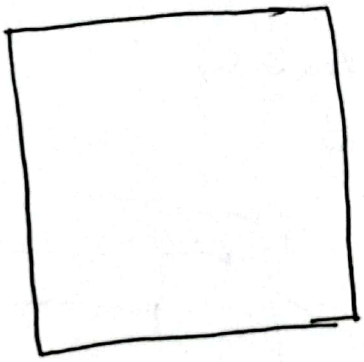
C (1.5, 5.9)

D (0, 5.9

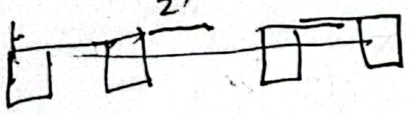


HL93 Live Load





Top slab plan



Area of slab = 3' x 20'

= 60 sft

$\frac{32}{60} = 0.533$ KSf

maximum axled load = 1.06 Ksf

Tandm MPf = 1.25

$0.533 \times 1.25 = 0.67$ KSf