1st 7 wk → masonary building

last 7 wk → bridge



Slab

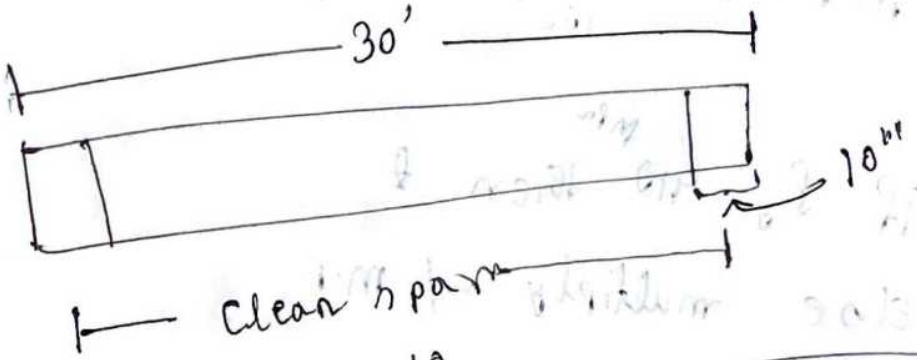
$\frac{L}{B} \geq 2$ → one-way

$\frac{L}{B} < 2$ + beam on 4 sides → two-way

(show calc for all)

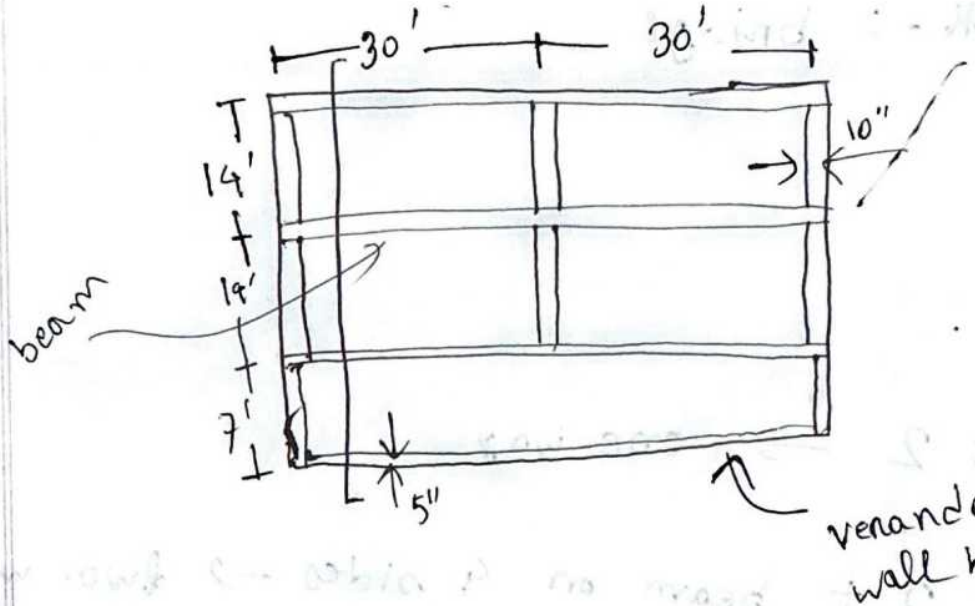
Thickness

t = max of $(l/20, l/24, l/28, l/10)$



$= 30 - \frac{10}{12}$

Use design pad & tracing paper



$f_c' = 4$ ksi

$f_y = 45$ ksi

LL = 40 psf

FF = 30 psf

① L/B check

② thickness, $t = \max(\cdot\cdot\cdot)$

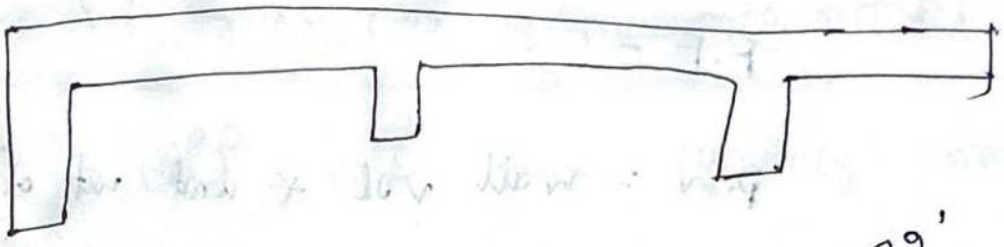
[t < 6" — 0.25"
  > 6" — 0.5"

$$M.F = 0.4 + \frac{f_y}{100}, \text{ or } 0.4 + \frac{f_y}{700}$$

(f_y = ksi) (f_y = mpa)

if $f_y = 410$ mpa then 1

else multiply w/ M.F



$l = 14 - \frac{10}{12}$ ~~+0.1~~ 13.17' → ← 6.79' ~~6.58'~~ →

$= 13.17 ft$

$\frac{l}{24} = \frac{13.17 \times 12}{24} \times mf$ (mf → 0.85)

$= 5.6" \rightarrow 5.75"$

$\frac{l}{28} =$

$= 4.8 \rightarrow 5"$

$\frac{l}{10} =$

$= \sim\sim 5.71 \sim\sim \rightarrow 7"$

$t_{max} = 7"$

side note req:

DL → self wt = $\frac{7}{12} \times 150$ [...]

F.F =

PW = wall vol * unit wt of brick

$\left((30+30') \times 10 \times \frac{10}{12}\right) \times 2 + \ldots$

$\times 0.8$

for window/door gap

veranda + other walls (14'+14')x3

Exclude 0.8 multiplication for veranda

? or 14" wall only

Factored $ld = 1.20L + 1.6LL$

work w/ max pos & max neg mmnt

if L is diff, calc max pos/neg mmnt di repeatedly, use max among

---

$d_{req} = \sqrt{\quad\quad}$ | $m = \phi \rho_{0.05} f_y b d^2 (1 - 0.59 \frac{\rho f_y}{f'_c})$

$\rho_{0.05} = 0.85 \beta_1 \frac{f'_c}{f_y} \frac{\varepsilon_u}{\varepsilon_u + 0.005}$

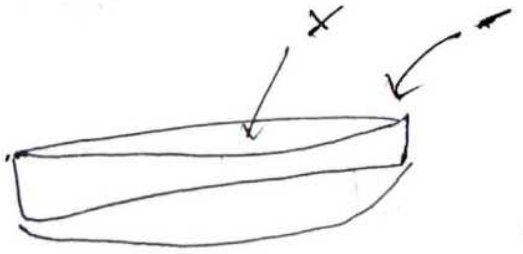
$t_{req} = d_{req} + 1$ ← slab clean-cover

← WC formula

$a = 1'' \quad \cdots \quad a =$

show calc

for lab report start $a_1 = 1''$, 2 trials



check

$A_{s\,min} = 0.002\,bt$ | : 04

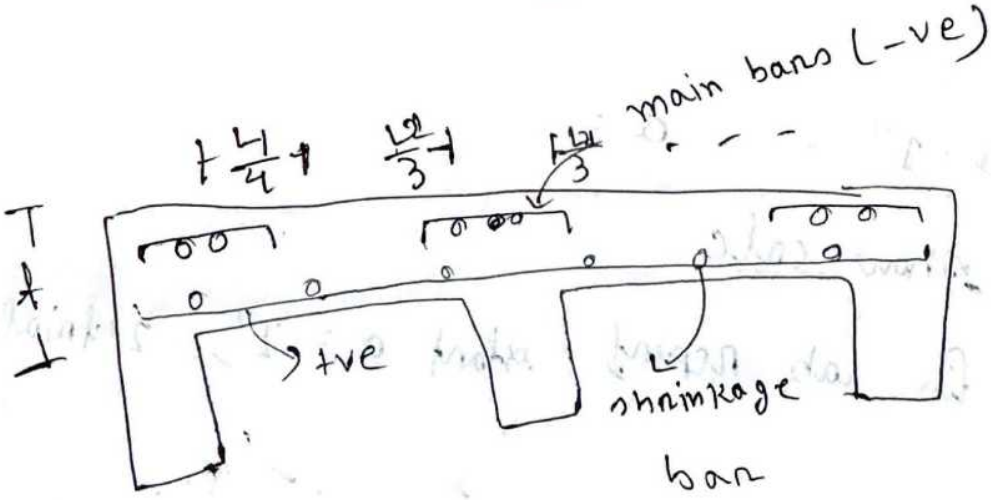
$A_s(+ve) = 0.35\ in^2 \rightarrow 0.4$

$A_s(-ve) = 0.65\ in^2 \rightarrow 0.65$

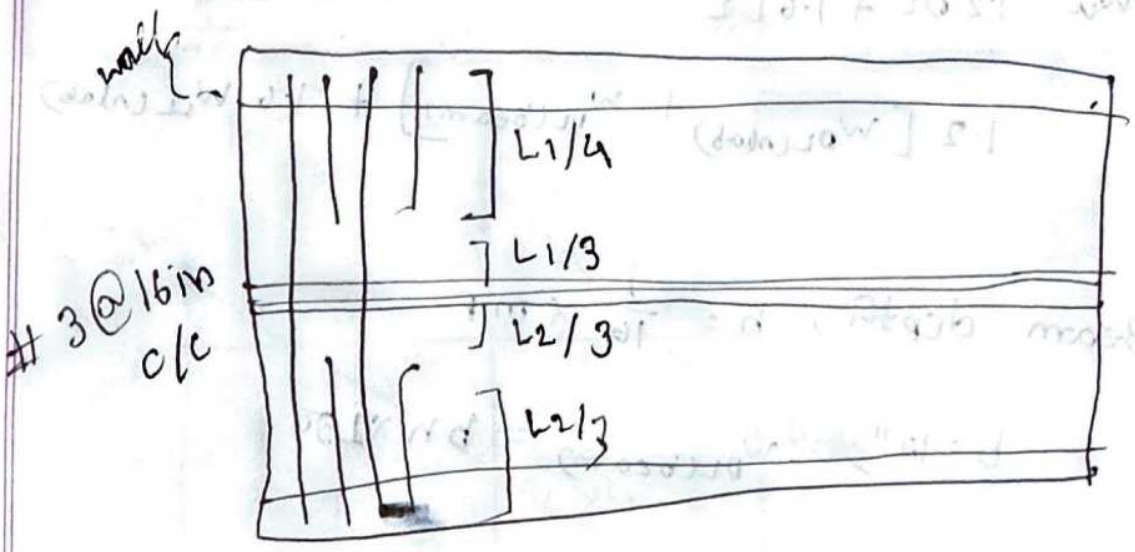
main → cm.

. main bars → min (3 t_s, 18")

. temp-shn. bas → min(5 t_s, 18")



bar 6" into wall


wall
L1/4
L1/3
#3@16in c/c
L2/3
L2/3

Beam design

① $W_u = 1.2\,DL + 1.6\,LL$

$= 1.2\,[W_{DL(slab)} + W_{DL(beam)}] + 1.6\,W_{LL(slab)}$

Beam depth, $h = \frac{1}{16} \times M.F$

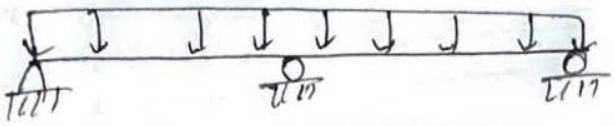
$b = 10''$; $W_{DL(beam)} = bh \times 150$

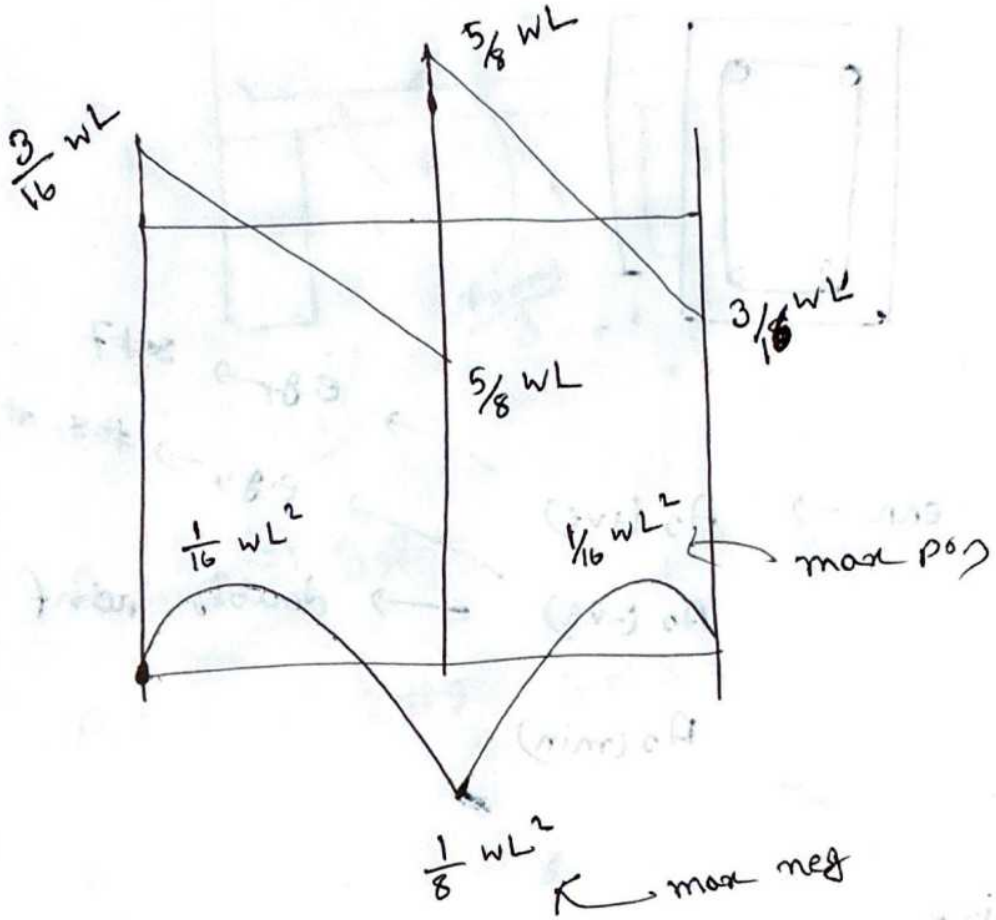
Trapezium area $= \frac{1}{2}(a+b)h$

$$W_{LL(slab)} = \frac{\text{Tributary area} \times \text{slab LL from prev}}{\text{Total beam len}}$$

$$W_{DL(slab)} = \frac{T.A \times \text{slab D.L}}{\text{Total beam len}}$$

SFD exact nat^n diagram inconnect





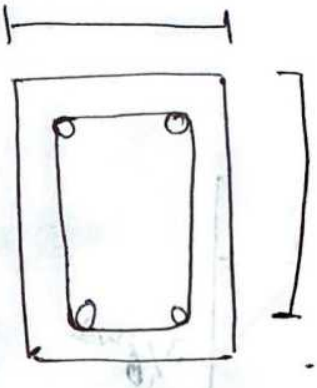
Check thickness

$$d_{req} = \sqrt{\frac{M_u}{\phi \rho b f_y \left(1 - 0.59 \frac{\rho f_y}{f_c'}\right)}}$$

Clear cover 2.5"

$d_{prov.} - 2.5$

Check T beam or rect. beam [rect provided in report]



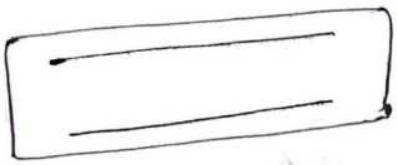
Trial err → A_s (+ve) → e.g. ~~3#7~~

A_s (-ve) → e.g. → #8, #7

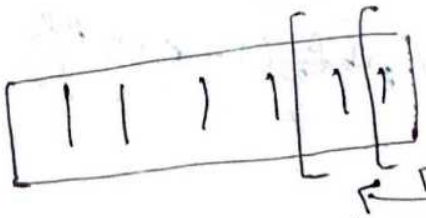
A_s (min) → doubly reinf

Detailing

(i)

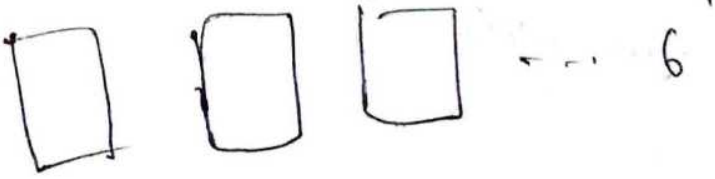


(ii)

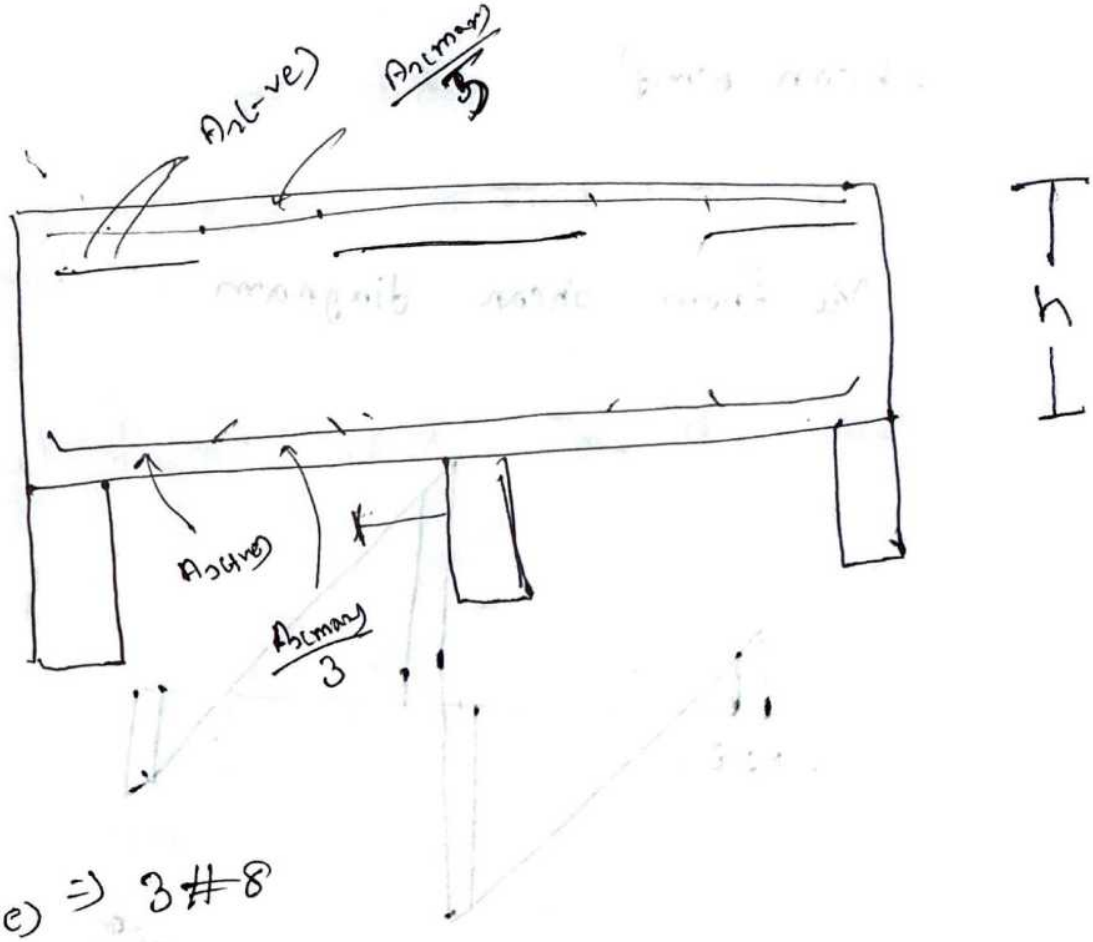


Shear

(iii)



... 6 section

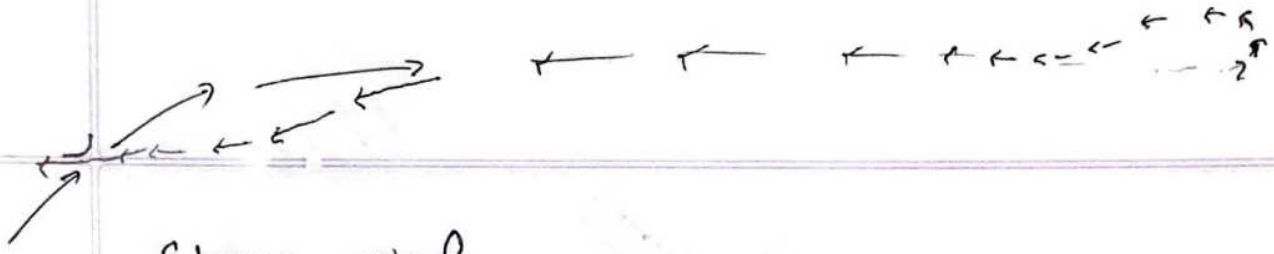


$A_s(+ve) \Rightarrow 3\#8$

$A_s(-ve) \Rightarrow 2\#9 \ , \ 3\#8$

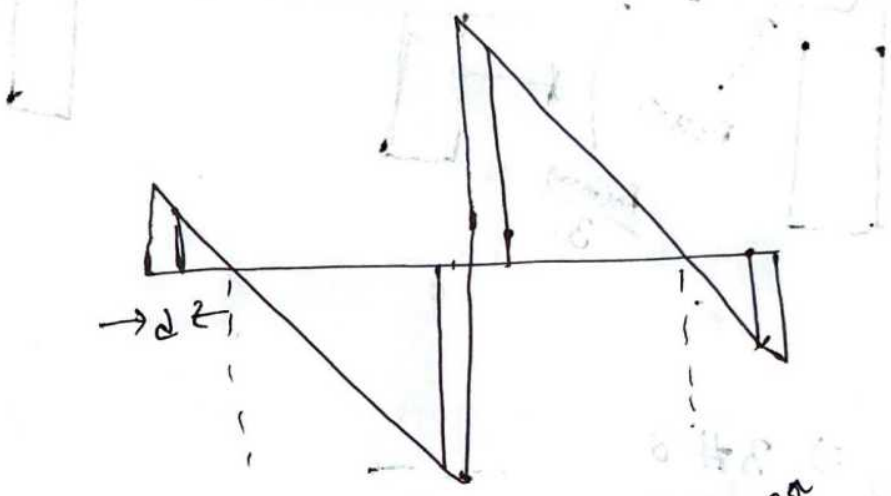
$\frac{A_{s(max)}}{3} \Rightarrow 3\#8 \longleftarrow$ min reinf

$\frac{A_{s(max)}}{5} \Rightarrow 2\#8$



Shear reinf

V_u from shear diagram



V_u → $s_1 = \dfrac{\phi A_v f_y d}{V_u - \phi V_c}$ ← 2 × area → 8"

ϕV_c

$\dfrac{\phi V_c}{2}$ → $s = d/2$ → 11"

$s_2 = \dfrac{\phi A_v f_y d}{V_u - \phi V_c}$ → 7" ← for middle

s_{max} = $d/4$

8 × smallest main bar dia

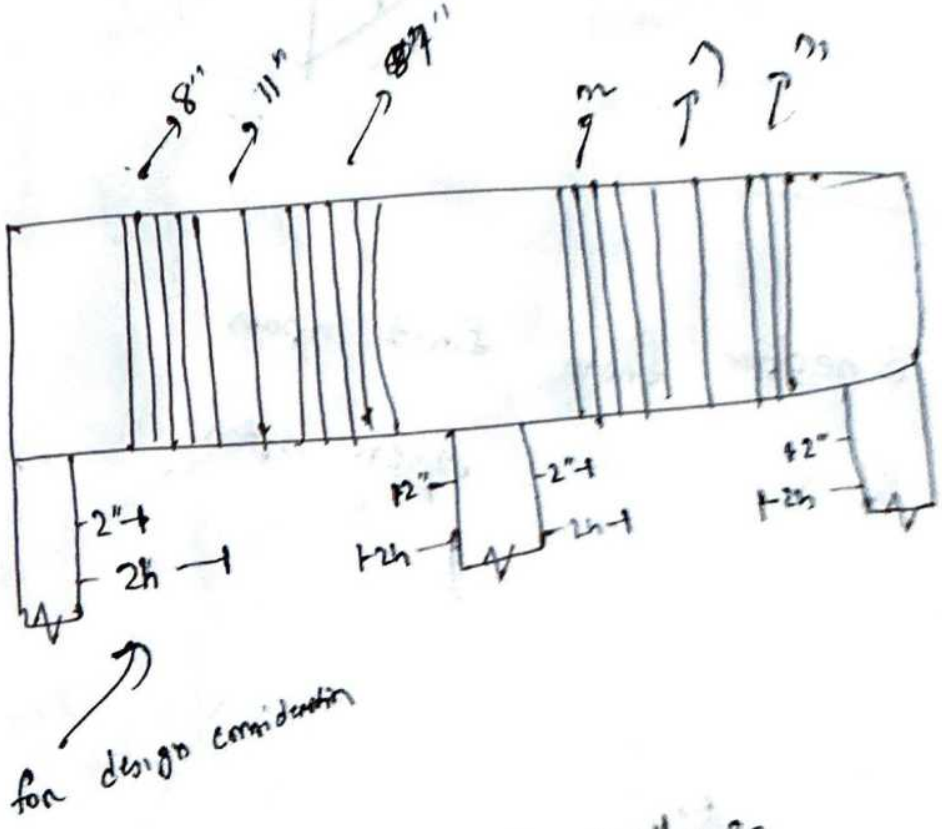
24 × stirrup dia

300 mm = 11.81"

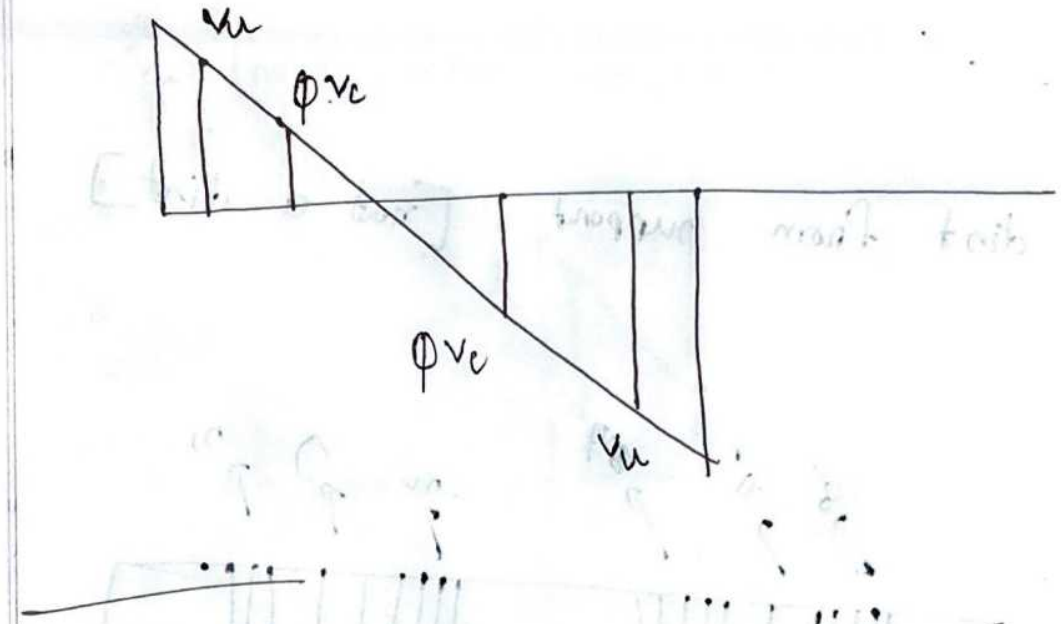
} min

show dist' on diagram [calc not needed]

2" dist from support [not d dist]



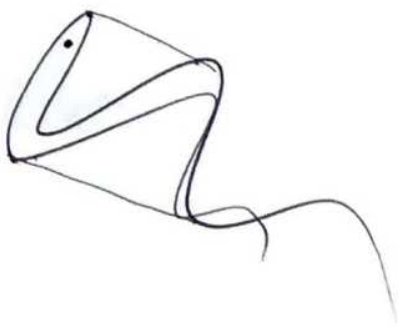
use corresponding V_u values



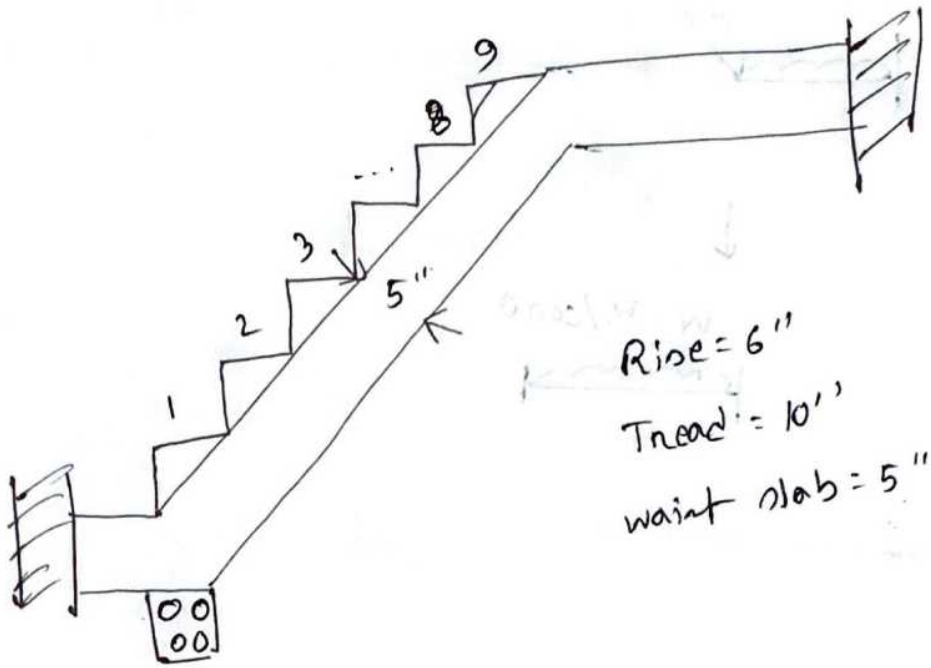
3 section from first span

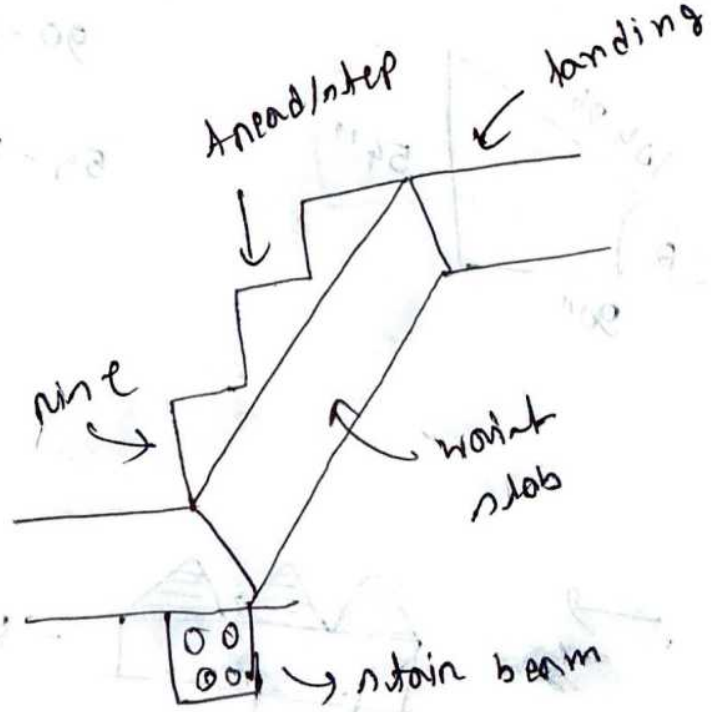
3 " " other span



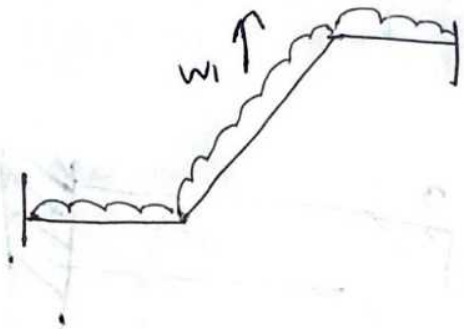


Staircase



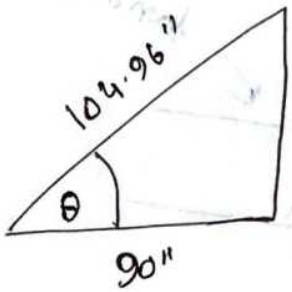


[one for our case]



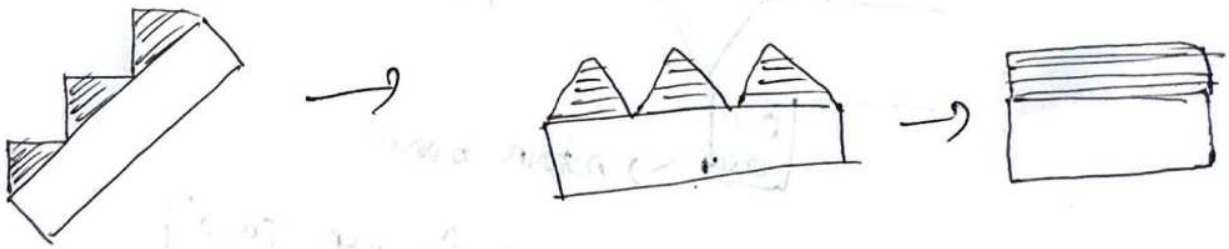
$W_2 = W_1 / \cos\theta$

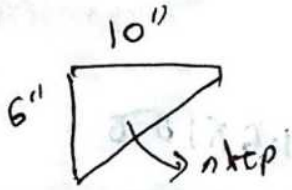




90 → 10×9

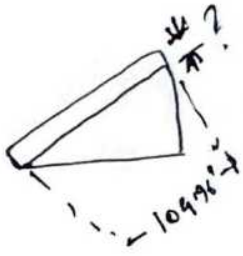
54 → 6×9





Area $= \left(\frac{1}{2} \times 6 \times 10\right) \times 9$

$= 270 \square''$



Thickness $= \frac{\text{Area}}{\text{len}}$

$= 2.57''$

dang $= 5 + 2.57 = 7.57''$



2.5" + 5" = T = 7.57"

Self wt $= \frac{7.57}{12} \times 150$

$\rightarrow$ Wu

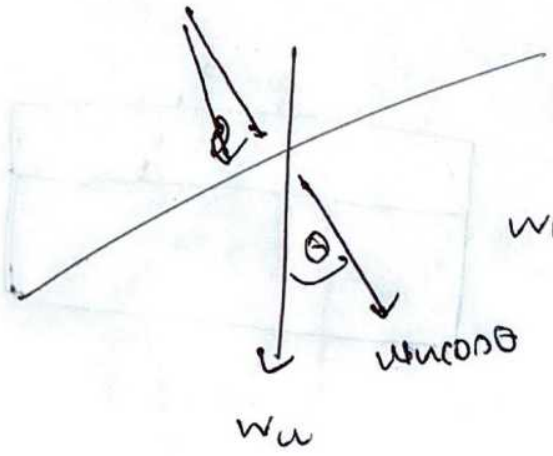
$=$

$W_{inclined} = 1.2DL + 1.6LL$

$= 1.2(94.63 + 25) + 1.6 \times 100$

$= 303.56$ psf

F.F. & LL. consider same in report



$W_{inc} = W_u \cos\theta$

$W_u = \frac{W_{inc.}}{\cos\theta}$

$$\text{Moment} = \frac{wL^2}{8}$$

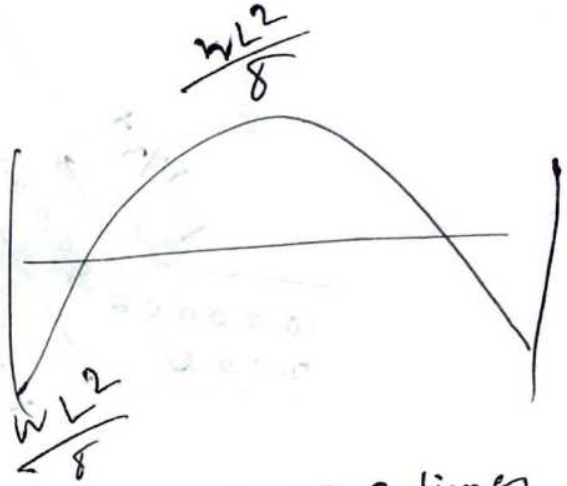
$$= \frac{354.01 \times 7.5^2}{8} \qquad [90''/12 \rightarrow 7.5']$$

$$=$$

$d_{prov.} = t_{avg} - 1 = 7.5 - 1 = 6.5''$

$d_{req} = \ldots$

prov > req ✓



Reinf

$$A_s = \frac{M_u}{\phi f_y (d - a/2)}$$

trial → 2 times

$$a = \frac{A_s f_y}{0.85 f_c' b}$$

$A_{s\,min} = 0.0018\,bt = 0.0018 \times 12 \times 7.5$

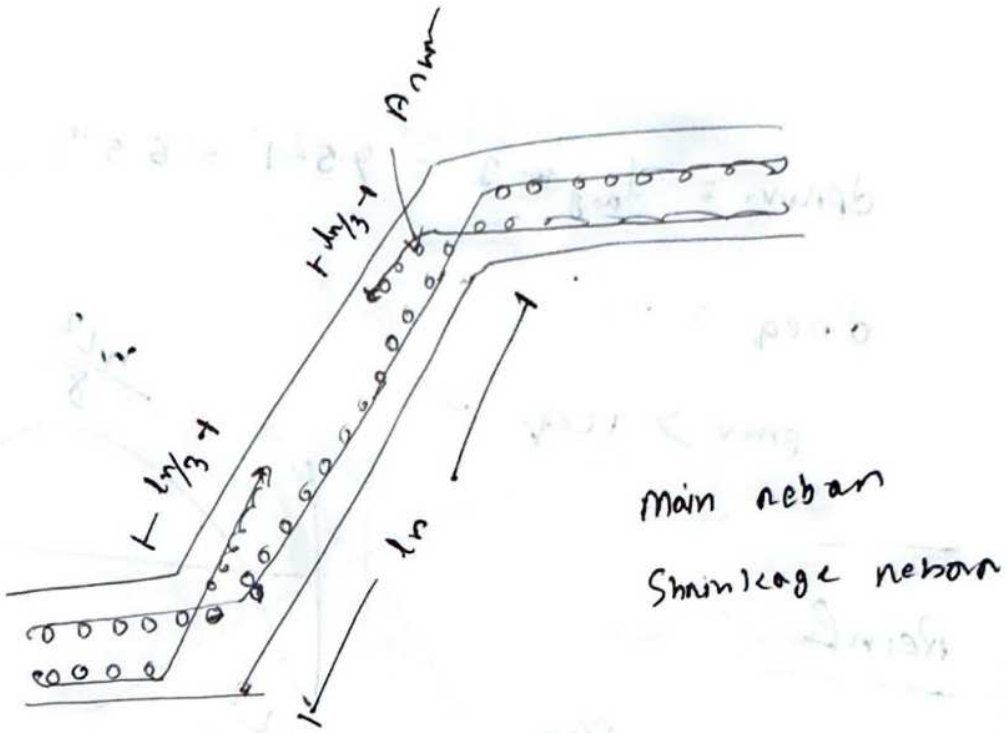
$s_{max} = 1.5t$

$s = \frac{12 \times A_b}{A_s}$ $\quad s_{max} = 3t$ or 18

5t for 18 for shrinkage

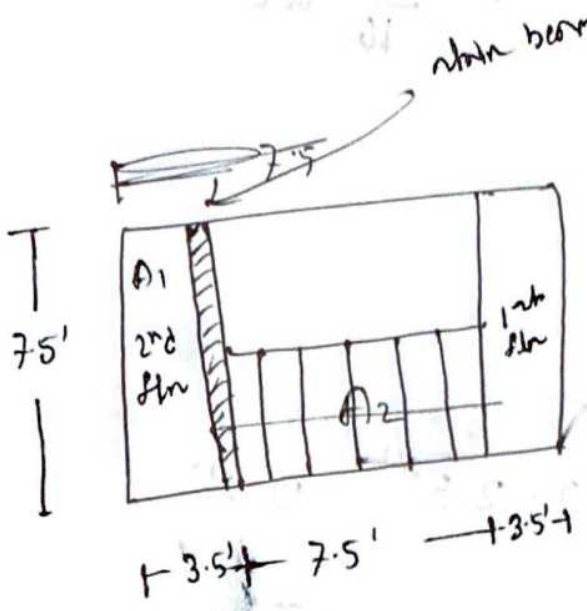
Shrinkage reinf

Reinf



~~Rein~~

Stair beam:



Assumed beam dim → 10" × 12"

def = 12 − 2.5 = 9.5 in

$\gamma_w = \frac{10}{12} \times \frac{12}{12} \times 150 = \cdots$

Load from stair:

$$\frac{52.5 \times w_u}{7.5'}$$

Total Ld: Load from stair + SW (1-2)

Area = $A_1 + A_2$

$= (3.5 \times 7.5) + (3.5 \times 7.5)$

$= 52.5\ ft^2$

Pos mmnt $= \frac{1}{14} wL^2$

Neg mmnt $= \frac{1}{16} wL^2$

M_{max} —

dreq

dprov → $12'' - 2.5'' = 9.5''$

—

$A_{s\,min} = \max \begin{cases} \frac{3\sqrt{f_{ck}(psi)}}{f_y(psi)} bd \\ \frac{200}{f_y(psi)} bd \end{cases}$

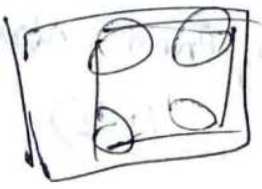
usually single bar can cover both

$M(+ve) \rightarrow A_s(+ve)$ } = —

$M(-ve) \rightarrow A_s(-ve)$

... Details —

Stirrups not needed



$d_{req} > d_{prov}$

$t_z \rightarrow$

self wt $\rightarrow$

$m \rightarrow$