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7876
section :
"A"
semester :
6th
subject :
Plain and Rainforcment conret — I

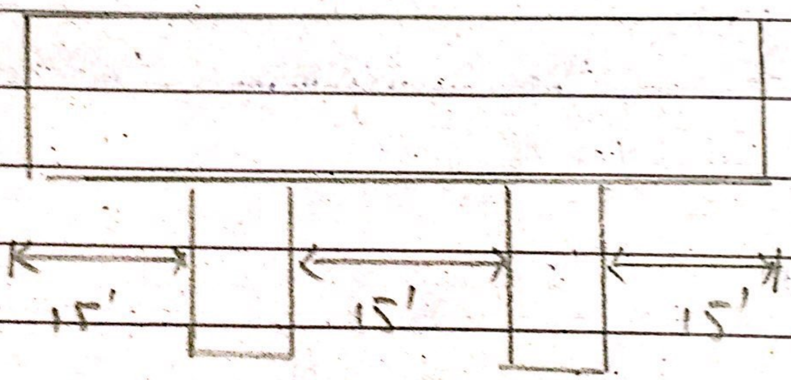
Final Tearm

Q.No: 1

Given Data

1. 3 equal spans concrete slab
2. Service floor finish load = 20 lb/ft^2
3. Factored live load = 160 lb/ft^2
4. Clear span B/W supports = 15 ft
5. f'_c = 4000 psi
   f_y = 40 ksi

Solve:



Step # 1 Minimum thickness

By formula

$$t_{min} = L/28$$

$t_{min} = \frac{15}{28} = 6.6$

$t_{min} \cong 6.5''$

As

$f_y \rightarrow 40$ ksi

so we will multiply a factor with thickness

$\text{Factor} = \left(0.4 + \frac{f_y}{100}\right)$

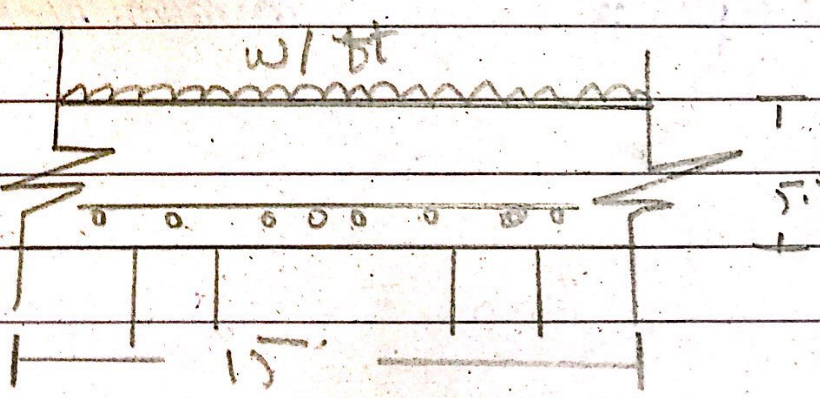
$= 0.4 + \frac{40}{100}$

$= 0.8$

Hence the minimum thickness will be 6.5×0.8

$t_{min} = 5.2 \cong 5.5''$

Step # 2 Effective Depth



By formula

$d = t - \text{clear cover} - \frac{1}{2}(\text{dia min bar})$

$= 5.5 - 0.75 - \frac{1}{2}(5/8)$

$d \approx 4.5''$

⇒ Step # 3 Self weight

By Formula

$= \frac{t}{12} \times \gamma_{concrete}$

$= \frac{5.5}{12} \times 150$

$= 68.75 \text{ lb/ft}^2$

Step # 4 Total factor load:

Factored live load = 160 lb/ft^2

dead load factor = D.L

D.L = 1.2 (20 + 68.75)

D.L = 106.5 lb/ft^2

Total factor load = D.L + LL
= 106.5 + 160
= 266.5 lb/ft²
= 0.2665 k/ft²

Step # 5 Ultimate Moment

we have the formula

$$Mu = \frac{Wu \times L^2}{8}$$

$$Mu = \frac{0.2665 \times 15^2}{8} \times 12$$

$Mu = 89.94$ kip-in

Step # 6

Area of steel For Main Bar By Trial and Repeat Method

Trail # 01

depth of compression block

$a = 0.2 \times d$

$a = 0.2(5.5)$

$a = 1.1''$

$$Ast = \frac{Mu}{\phi \times fy \times (d - a/2)}$$

$$= \frac{89.94}{0.90 \times 40\ (4.5 - \frac{1.1}{2})}$$

$$AST = 0.63\ in^2$$

⇒ **Trail #02**

$$a = \frac{Ast \times fy}{0.85 \times f'c \times b}$$

$$a = \frac{0.63 \times 40}{0.85 \times 4 \times 12} = 0.62\ in^2$$

$$Ast = \frac{Mu}{\phi \times fy \times (d - \frac{a}{2})}$$

$$= \frac{89.94}{0.90 \times 40 \times (4.5 - \frac{0.6}{2})}$$

~~Ast = 0.69~~

$$\boxed{Ast = 0.59\ in^2}$$

Trail # 03

$$a = \frac{0.59 \times 40}{0.83 \times 4 \times 12}$$

$$a = 0.57''$$

$$Ast = \frac{89.94}{0.90 \times 40 \times (4.5 - \frac{0.57}{2})}$$

$$= 0.59 in^2$$

We use $AsT = 0.59 in^2$

Step # 07

Area of steel for distribution reinforced

we have formula

$$A_{min} = 0.002 \times b \times t$$ For grad 40 steel

$$= 0.002 \times 12 \times 55$$

$$= 0.132 in^2$$

P.T.O

Step # 8

Spacing for Min bar

By Formula

Spacing $\frac{A_b}{A_{st}} \times 12$

we use #6 bar dia $(6/8")$

Area $= \frac{\pi}{4}(6/8)^2 = 0.442\ in^2$

Step # 09 Spacing fo dimtion Bar

Spacing $= \frac{A_b}{A_{st}}$

we use #5 bar So

dia $= (5/8)^2$

Area $= \frac{\pi}{4}(5/8)^2$

$= 0.31\ in^2$

Spacing $= \frac{0.31}{0.132} \times 12 = 28.1$

Spacing = [redacted] 28.1 c/c

Spacing ≃ 28[redacted] c/c

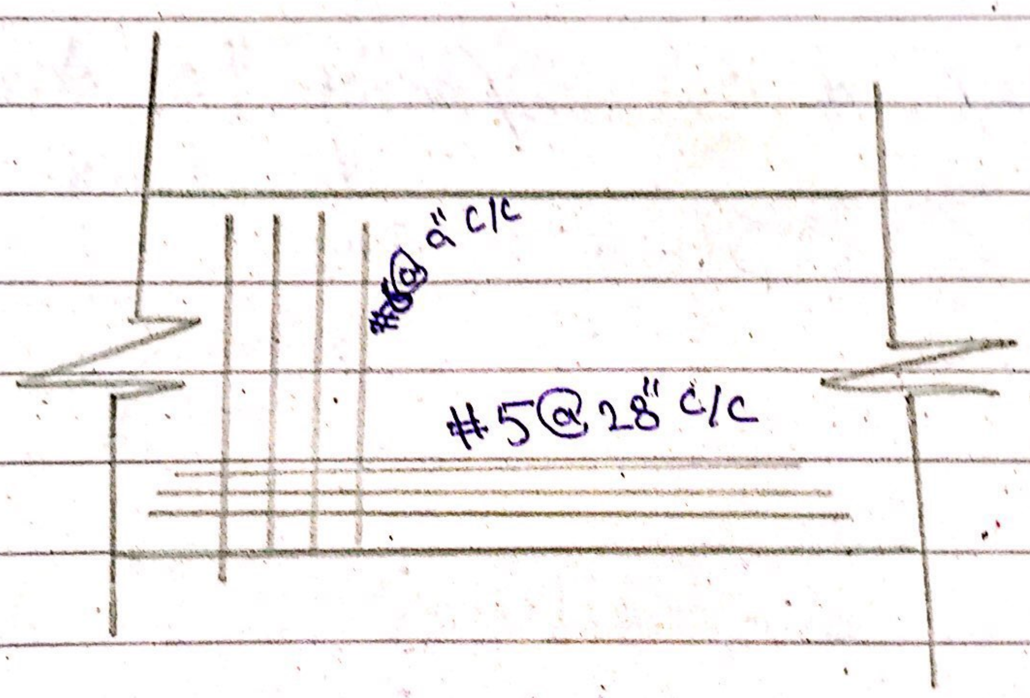
Step # 10

Find Sketch

$f'_c = 4$ ksi , $f_y = 40$ ksi

Main steel #6 at 9" c/c

Distribution steel #5 at 28" c/c



Pag — 9 7876

QNo: 2

Solve

first find the unit load of Beam

so. $b \times \gamma_c$

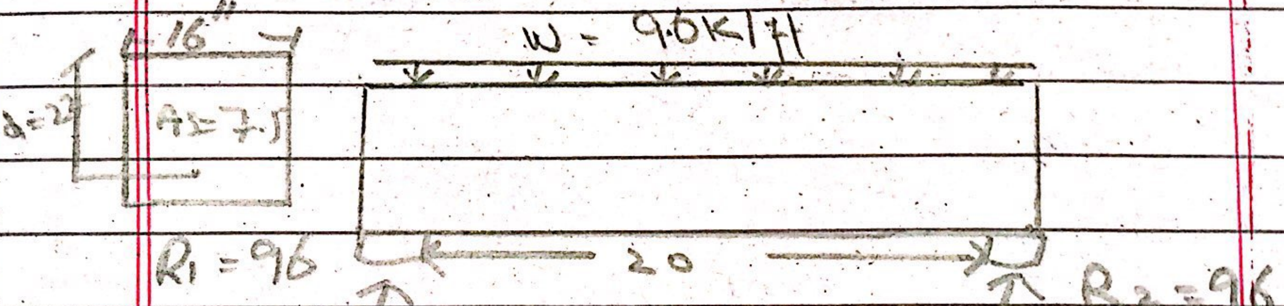
$= \frac{16}{12} \times 150$

$= 200\ lb/ft$

$= 0.2\ k/ft$

Total factor load = 9.4 + 0.2

= 9.6 k/ft

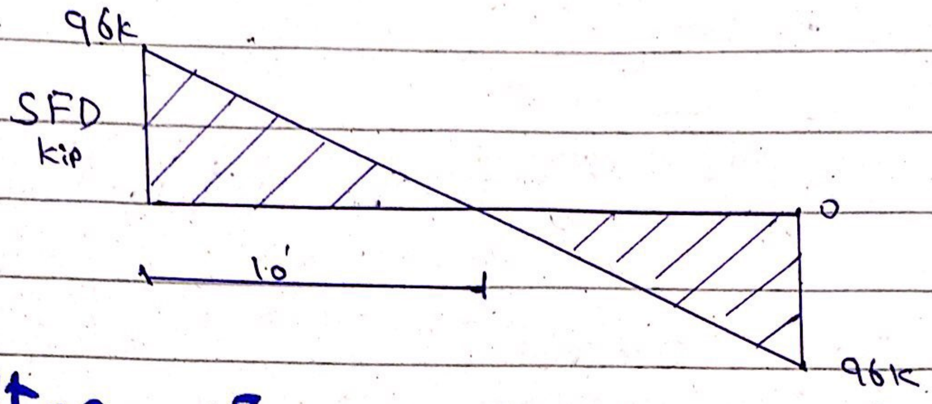


Step # 1 Value of R_1 & R_2

Total load = $9.6 \times \frac{20}{2}$ = 96

T.L = 9.6K

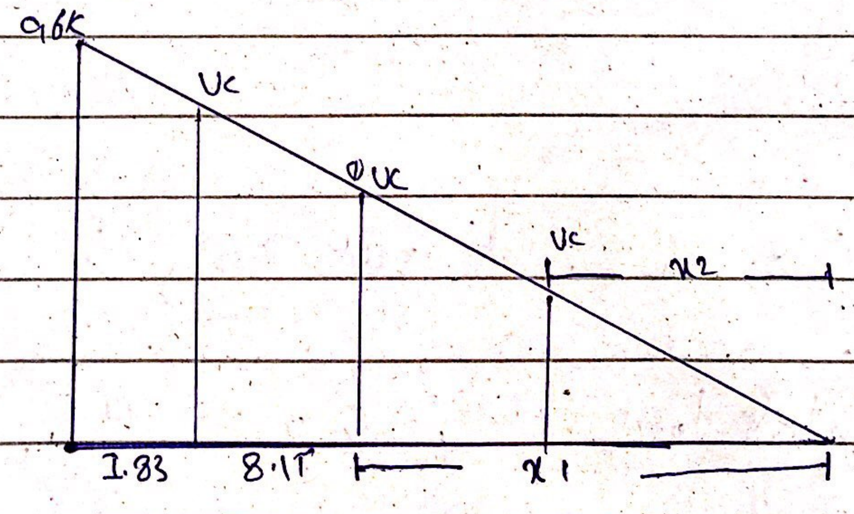
Step # 2 Draw its shear force diagram



Step # 3

Value of critical stress "Vu" and location

We know that critical loction is located distance "d" from face of support d = 22" = 1.83' value of critical shear at at distane d Similarty triangles



7876

From simil △'s $\frac{96}{10} = \frac{V_u}{8.17}$

$V_u = 78.43K$

Step#04

Finding value of ϕV_c and $\frac{1}{2}\phi V_c$ its distanc from zero shear right side

$\phi V_c = \phi \times 2 \times \sqrt{f'c} \times b_w \times d$.

$= \frac{0.75 \times 2 \times \sqrt{4000} \times 16 \times 22}{1000}$

$\phi V_c = 33.40K$.

Loction of ϕV_c by similrity of △'s

$\frac{96}{10} = \frac{33.40}{x_1}$

$\boxed{x_1 = 3.48}$

Now

$\frac{1}{2}\phi V_c = \frac{33.40}{2}$

$= 16.70$

P.T.O

Location of $1/2 \phi V_c$

$$\frac{96}{10} = 16.70$$

$$x_2 = 1.74'$$

Step # 5

Finding valu of ϕV_c ($V_u = \phi V_s + \phi V_s$)

$$\phi V_c = 78.43 - 33.40$$

$$\phi V_s = 45.03$$

Step # 6 Check Section Adequacy

$$\phi \times 8 \times \sqrt{f'c} \times b_w \times d = \frac{0.75 \times 8 \times \sqrt{4000} \times 16 \times 22}{1000}$$

$$= 133.57 K$$

$133.57 > \phi V_s$

So section is adequity

P.T.O

Step - 7 Checkin The mini space for stirrup

$\Phi \times 4 \times \sqrt{Fc} \times bw \times d = \frac{0.75 \times 4 \times \sqrt{4000} \times 16 \times 22}{1000}$

$= 66.79K > \Phi Us = 44.03\ K$

So maximum spacing will be slected from follwing 4 condision

① $S_{max} = 24''$

② $\frac{d}{2} = \frac{22}{2} = 11''$

③ $S_{max} = \frac{Av \times fy}{\sqrt{0.75} \times \sqrt{fc} \times b}$

$\because Av = \frac{\pi}{4}\left(\frac{3}{8}\right)^2$ $\boxed{Av = 0.11 \times 2 = 0.22}$

$S_{max} = \frac{0.22 \times 60000}{0.75 \times \sqrt{4000} \times 16}$

④ $S_{max} = \frac{Av \times ft}{50 \times bw}$

$$S_{max} = \frac{0.22 \times 60000}{50 \times 16}$$

$$S_{max} = 16.50$$

From above 4 condions least value of spacing value #3 U shape will be slected

So $S_{max} = 11'' \, c/c$

Step # 08

Spacing the Stirrup from the cirtical section

$$S = \frac{\phi \times A \times f_y \times d}{V_u - \phi V_c}$$

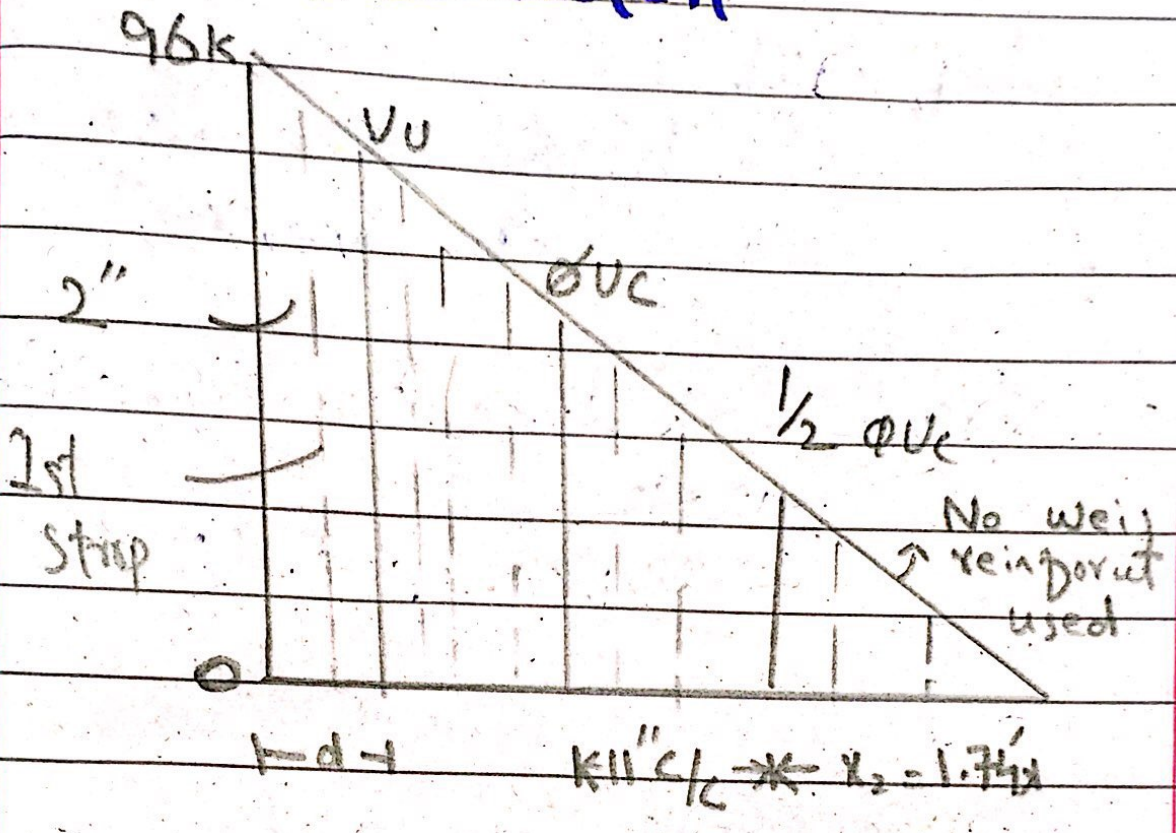
$$= \frac{0.75 \times 0.22 \times 60 \times 22}{78.43 - 33.40}$$

$$S = 4.84 \cong 5'' \, c/c$$

7876

Step # 09

Final - Sketch



We know that the first stirrup from face of support $= \frac{5}{2} = 2.5''$

$= 2.5 \approx 2''$

QNo: 3

Step – 01

Find gross area of concreat

$A_g = b \times b$ (since it is squared colum)

$= 12 \times 12$

$= 144 in^2$ (Actual)

Since A_s

$= 5\%$ of A_g

$= 0.05 \times 144$

$A_s = 7.2 in^2$

Step # 03

Ultimat load carrying capacity

$P_U = \phi \times 0.80 (0.85 \times f'_c \times (A_g - A_s) + A_s \times f_y)$

$P_U = 0.65 \times 0.80 [0.85 \times 4 (144 - 7.2) + 7.2 \times 60]$

$= 0.65 \times 0.80 [0.85 \times 4 (144 - 7.2$
$+ 7.2 \times 60]$

$Pu = 466.50$ K

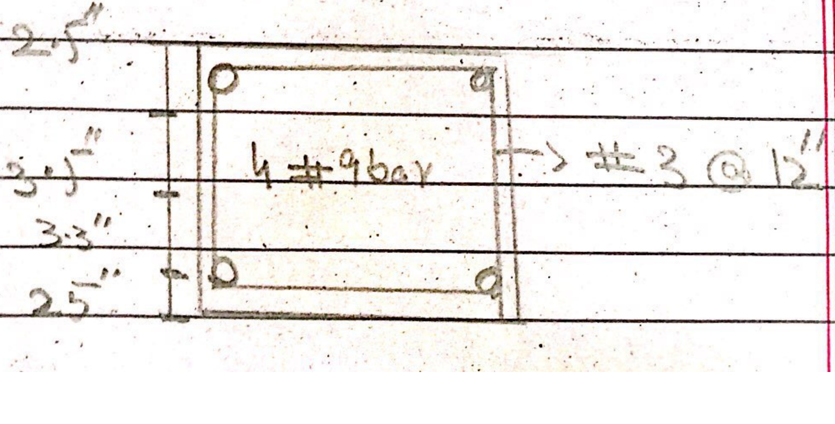
Step_04 Sketch design of Tie (C/C to distanc)

From the below value we choose the least value of all thes

① 16 x dia of long bar = 16 x 9/8
= 18"

② 48 x dia of the bar = 48 x 3/8
= 18"

③ Least coloum diameteon = 12"
So C/C distanc b/w tie = 12"



Since it is a tied squence volmn so there is no spirrup used. The stirrup used is of rectongular shape due to the stirrup insted.

QNo: 4

Given Data

Colum dimention → square col
16" x 16"

Dead load = 100 kip
Live load = 120 kip

Base of footing below grade
= 5

Allowable soil pressure = 2.50 k/ft²

$f'_c = 3$ ksi
$f_y = 60$ ksi

Unit weight of soil
$\gamma_s = 120$ lb/ft³

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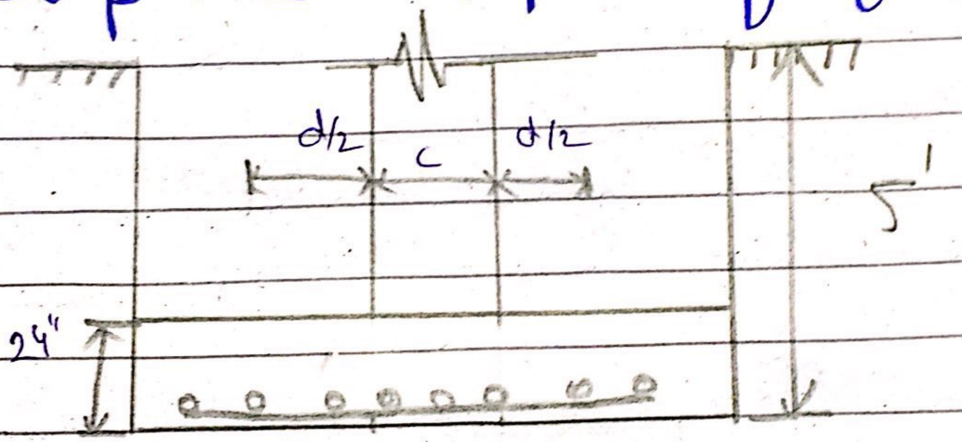
20 7876

Assuming depth of foundation
as h = 24"

Step # 1 Depth of foundation



Step # 2 Total Weight

Total weight = wt of soil + Wt of Reinforced cc

Total weight = (3 x 120) + (2 x 150)

= 660 lb/ft

= 0.660 k/ft

PTO

Step # 3

Effective Bering Sopsty

$q_{effictive}$ = q_{all} − Total weight
= 2.50 − 0.660
184 K/ft²

⇒ Step #4 Required Area

Area regyrd = Serves load / q_c

A = (100 + 120) / 1.84

A = 119.56 ft²

⇒ Step − 5 Foundation Dimension

Since foundion is squar

Area(required) = B×B = √119.56

B = 10.9'' or 10' − 9?
B = 10.9 or B = 11'

Step # 6
Upward Bearing capacity

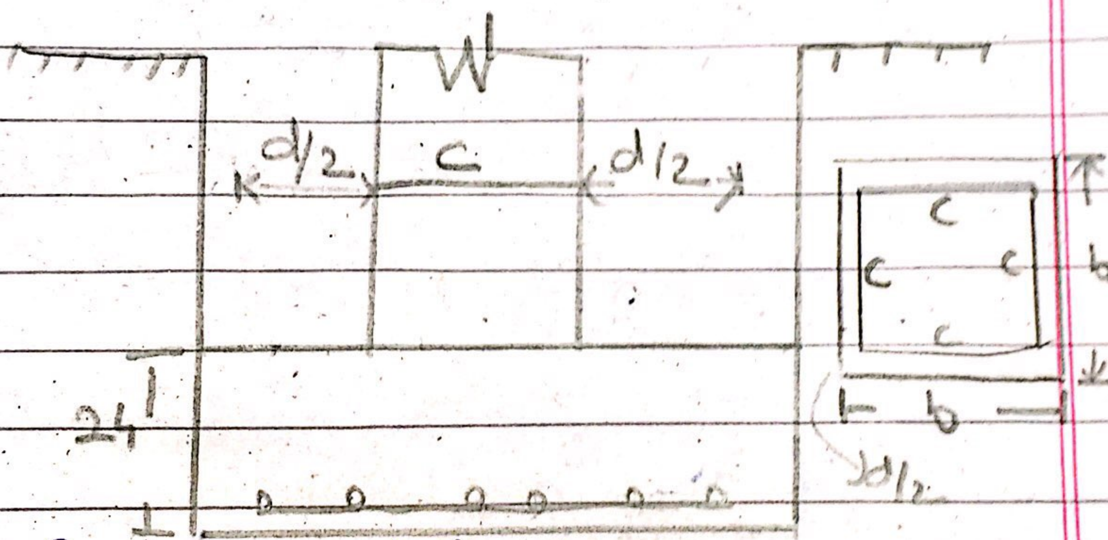
q (upward) = Factored load / B^2

$= \frac{1.2(100) + 1.6(120)}{(11)^2}$

q(upward) = 2.58 k/ft²

Step # 7 Punching shear

$b_o = 4(C + d)$



Effective depth (d)

d = h − clear cover − dia of bottom − ½ dia of top

$d = 24 - 3 - (1) - \frac{1}{2}(1)$

d = 19.5"

8 we use

So the puching shear will

$b_o = 4(16'' + 19.5)$

$b_o = 142''$

Step #8 (Value of V_{u_2})

By formula

$V_{u_2} = q_{up} \times [B^2 - (c+d)^2]$

$= 2.58[(11)^2 - (16' + 19.5)^2]$

$V_{u_2} = 289.60$ kips

Step # 9

Value of ϕV_{cp}

By formula

$\phi \times 4 \times \sqrt{f'_c} \times b_o \times d$

$= \dfrac{0.75 \times 4 \times \sqrt{3000} \times 142 \times 19.5}{1000}$

$= 454.9915$

Step – 10

Beam shea check

By formula

$$V_{u_1} = q_{up} \times B \times \left[\frac{B}{2} - \frac{c}{2} - d\right]$$

$$V_{u_1} = 2.58 \times 11 \times \left[\frac{11}{2} - \frac{16/12}{2} - \frac{19.5}{12}\right]$$

$$V_{u_1} = 91.05$$

Step – 11 self sher capcity

$$\phi V_c = \phi \times 2 \times \sqrt{f'_c} \times B \times d$$

$$\frac{0.75 \times 2 \times \sqrt{3000} \times (11 \times 12) \times 19.5}{1000}$$

$$\phi V_c = 211.47 > V_{u_1}$$

it is ok!