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PRCD-I

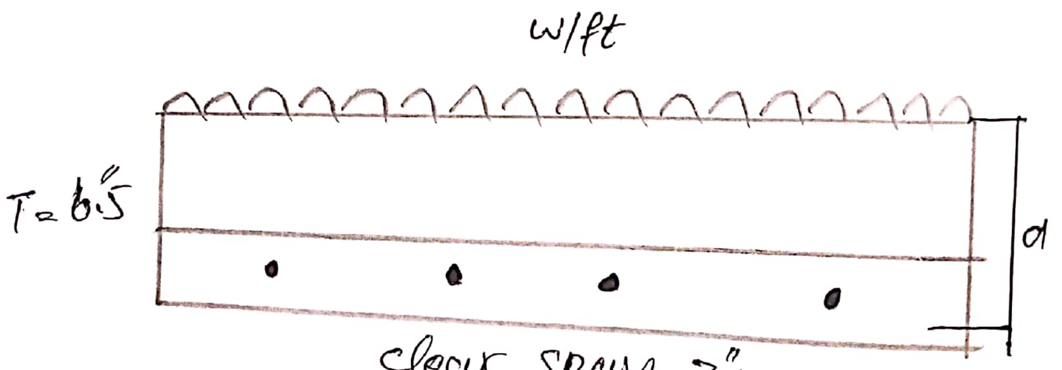
Q - No - 01 ⇒ Given data :-

→ 3 equal Span concrete Slab
→ clear Span b/w Supports = 15 ft
→ factored live load = 160 lb/ft²
→ Service floor finish load = 20 lb/ft²
→ f'_c = 4000 psi
→ f_y = 40 ksi

Solution :-

Step # 01 :- $t_{min} = \frac{L}{28} = \frac{15}{28} \times 12 \neq 6.5''$

Step # 02 :- Effective depth.



3/4 = 0.75

d = T - (clear cover - ½ (d. M.B)

= 6.5 - (0.75 - ½ (4/8))

= 6''

Scanned with CamScanner

Step # 03 :- Self Weight of Slab

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

$$= \frac{6.5}{12} \times 150 = 81.25 \text{ PSf}$$

Step # 04 :- Total factored load

$$W_U = 1.2(81.25 * 20) + 160$$

$$= 281.5 = 0.281 \text{ KSf}$$

Step #-05 :- Ultimate Moment

$$M_U = \frac{W_U \times L^2}{8} = \frac{0.281 \times 15^2 \times 12}{8} = 94.8 K''$$

Step # 06 :- Area of Steel for main

bars by trial and Repeat methods.

Trial # 01 :-

let $a = 0.2 \times T \Rightarrow 0.2 \times 6.5$

$= 1.3$

$$A_S = \frac{M_U}{\phi \times f_y \times (d - \frac{a}{2})} = \frac{94.8}{0.90 \times 60 \times (6 - \frac{1.3}{2})}$$

$$= 0.32 \text{ in}^2/\text{ft}$$

Trial # 02 :- $a = \frac{As \times fy}{0.85 \times f'c \times b} = \frac{0.32 \times 60}{0.85 \times 4 \times 15} = 0.3$

$$AS = \frac{MU}{\phi \times fy \times (d - \frac{a}{2})} = \frac{94.8}{0.90 \times 60 (6 - \frac{0.37}{2})}$$

$$= 0.30 \, in^2/ft$$

$a = 0.35 \qquad AS = 0.30 \, in^2/ft$

Step # 07 :- Area of the Steel for distribution bar

$$As_{min} = 0.0018 \times b \times t = 0.0018 \times 15 \times 6.5$$

$$= 0.17 \, in^2/ft$$

Step # 08 :- Spacing for [redacted] Main bar

$$S = \frac{Ab}{AS} \times 12 = \frac{0.20}{0.30} \times 12 = 8 \approx 8 \cdot \tfrac{1}{2} \; c/c$$

Step # - 09 :- Spacing for Distribution bar.

let try # 4 bar

$$S = \frac{Ab}{AS} \times 12$$

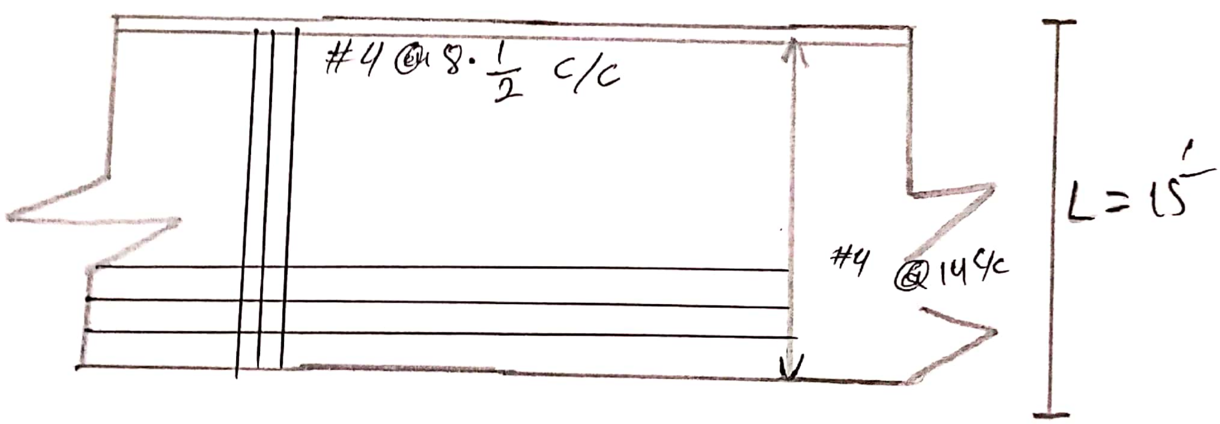
$$= \frac{0.20}{0.175} \times 12 = 13.71 \approx 14$$

Step # 10 = final Summary:-

$f'c = 4$ ksi $f_y = 40$ ksi $t = 6.5$

Main Steel bar # 4 = at $8\cdot\frac{1}{2}$ c/c

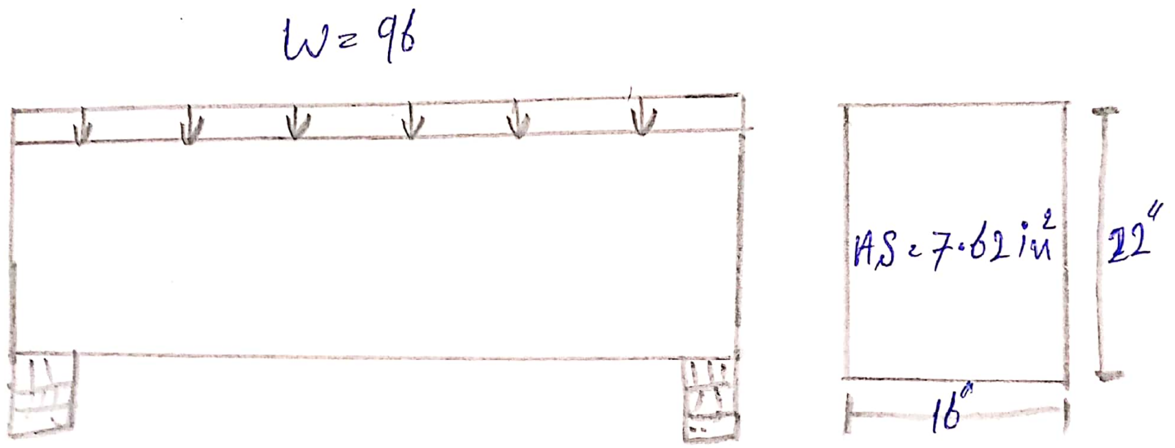
Distribution Steel bar # 4 at 14 c/c



Q No: 02:

A Simple rectangular beam:

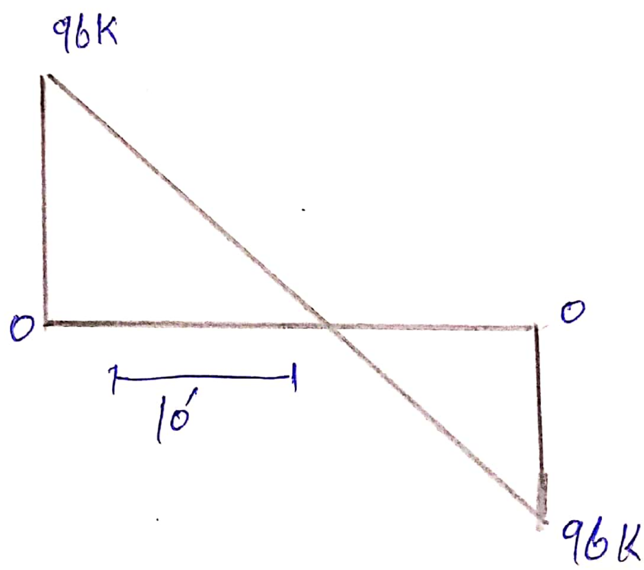
Given data:- width = 16"
d = 22" factored load = 9.41 k/ft
clear span = 20' Tensile steel Area = 7.62 in²



Step # 01:- find the R_1 and R_2

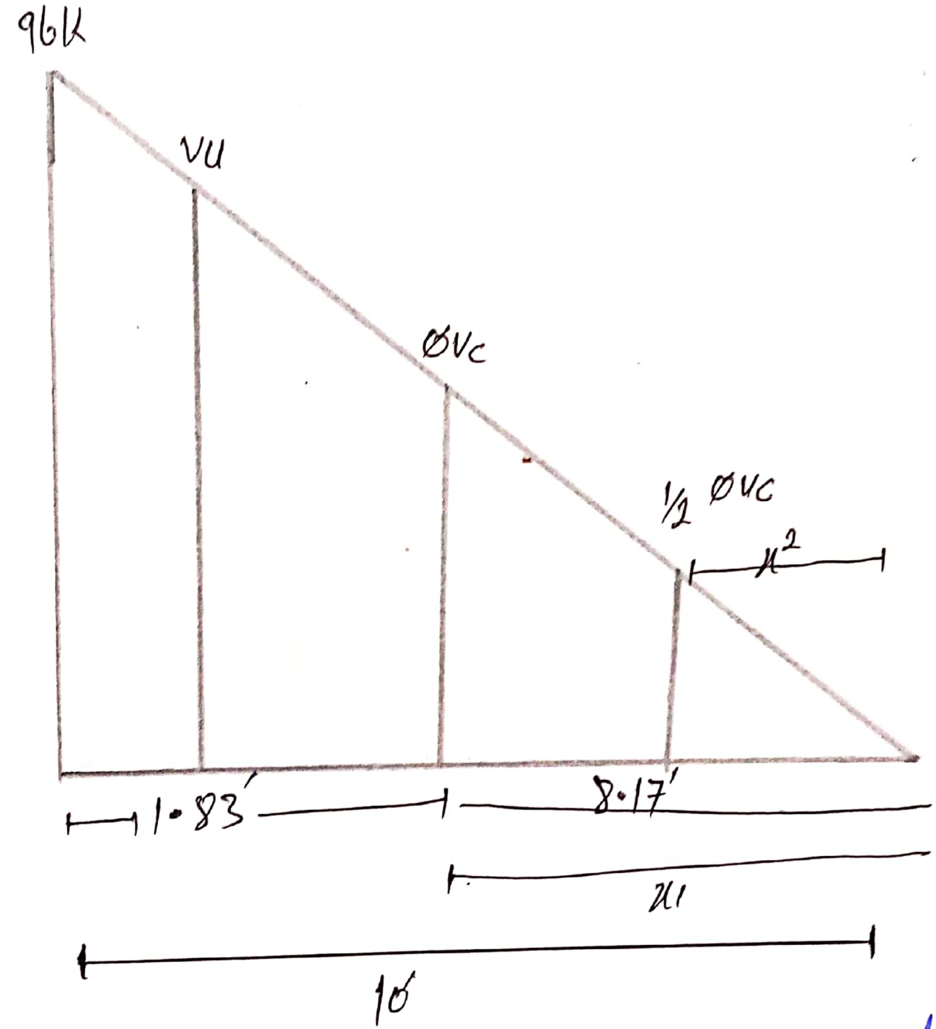
$$= 9.6 \times \frac{20}{2} = 96K$$

Step #02:-



Step # 03 :- find the value of critical stress Vu and it's location.

As we know that critical Section is located at distance "d" from face of Support = 1.83 value of critical Shear at distance "d" by Similarity of Δs



Step # 04 :- find the value of ØVc and $\frac{1}{2}$ ØVc and also it distance from Zero Shear to right Side.

$$\phi V_c = \phi \times 2 \times \sqrt{f_c'} \times b_w \times d$$

$$= \frac{0.75 \times 2 \sqrt{4000} \times 16 \times 22}{1000} = 33.40\,k$$

location of ϕV_c by Similar Δ,s

$$\frac{96}{10} = \frac{33.40}{x_1} \Rightarrow x_1 = 3.47$$

Now $\frac{1}{2}\phi V_c = \frac{33.40}{2} = 16.70\,k$

location of $\frac{1}{2}\phi V_c \Rightarrow \frac{96}{10} = \frac{16.70}{x_2}$

$$x_2 = 1.73$$

Step # 05 :- Values of ϕV_s

$$V_u = \phi V_s + \phi V_c$$

$$\phi V_s = V_u - \phi V_c \Rightarrow 78.43 - 33.40$$

$$= 45.03\,k$$

Step # 06 :- check on section adequacy

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

$$= 133.57\,k$$

i-e

As $\phi V_s < \phi 8\sqrt{f'_c}\, b_w \times d$ Section is allow.

Step # 07 :-

Check on maximum Spacing for stirrups -

$$\phi \times 4\sqrt{f'_c} \times b_w \times d = \frac{0.75 \times 4\sqrt{4000} \times 16 \times 22}{1000}$$

$$= 66.79 \text{ Kip}$$

As $\phi\, 4\sqrt{f'_c}\, b_w d > \phi V_s = 45.03$ K

So mini spacing will be Selected from the following four condition.

① $S_{max} = 24''$ ② $\frac{d}{2} = \frac{22}{2} = 11''$

③ $S_{max} = \frac{A_v \times f_y}{0.75 \times \sqrt{f'_c} \times b_w} = 17.40''$

④ $\frac{A_v \times f_y}{50 \times b_w} = \frac{0.22 \times 60000}{50 \times 16} = 16.50''$

from above four condition least value of spacing for # 3, 2 legged Stirrup will Selected

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

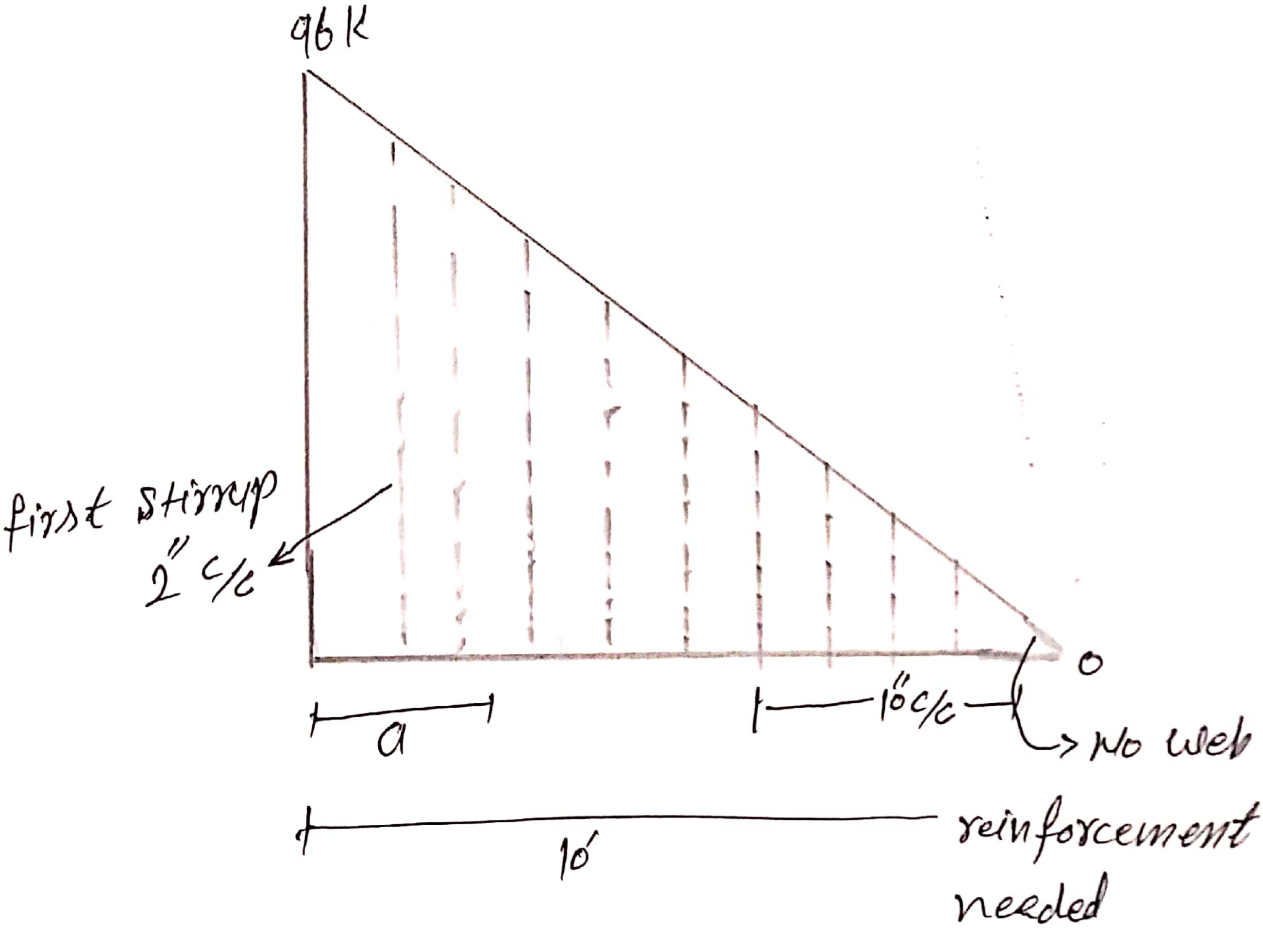
Step # 08 :-

$$S = \frac{\phi \times A_v \times f_y \times d}{V_u - \phi V_c} = \frac{0.75 \times 0.22 \times 60 \times 22}{78.43 - 33.40}$$

$$S = 5'' \; c/c$$

first Stirrup from start $= \frac{S}{2} = \frac{5}{2} = 2.5 \approx 2''$

Step # 09 :-



Question - No - 03 :-

Calculate the axial ultimate ....

design necessary Spirals -

Step # 01 :- find graces area of concrete,

$$Ag = b \times b$$ (since it is square tied column)

$$Ag = 12 \times 12 = 144 in^2 \text{ (Actual)}$$

Step # 02 :- find the Area of Steel

Since AS = 5% of Ag

$$= 0.05 \times 144 = 7.2 in^2$$

Step # 03 :- ultimate load Baring capacity.

$$PU = \phi \times 0.8 [0.85 \times f'c \times (Ag - AS) + AS \times fy]$$

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

$$PU = 466.50 k$$

Step # 04 :-

Sketch and design of Ties

(C/c to distances)

From the below value we always the least value of all thus-

① $16 \times$ dia of long bar $= 16 \times \frac{9}{8}$

$= 18''$

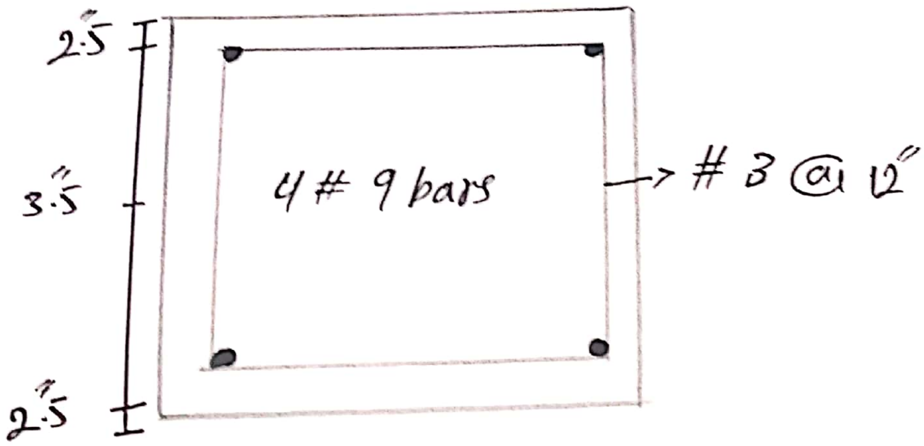
② $48 \times$ dia of tie bar $= 48 \times \frac{3}{8}$

$= 18''$

③ least colum dimension $= 12''$

So C/c distance b/w ties $= 12''$

P-T-O



⊛ Since it is a tied Square colum So there no Spiral Stirrup used the stirrup used is of recta shape due to the specification of the Structure this we will use Tie Stirrups instead -

Question - No - 04 =

Design a Square footing ---- sketch of your final design -

Step # 01:- let $h = 24''$

Step # 02:- total Weight = Wt of Soil + Wt of RL

$= 3 \times 120 + 2 \times 150$

$= 660 \text{ psf} = 0.660 \text{ ksf}$

Step # 03:- Effective Bearing capacity

$q_e = q_a - w$

$q_e = 2.5 - 0.660$

$q_e = 1.84 \text{ ksf}$

Step # 04:- Required Area for foundation.

$$\text{Area} = \frac{\text{Service load}}{q_e} = \frac{100 + 120}{1.84}$$

$= 119.57 \text{ ft}^3.$

Step - #05 :-

Since foundation is Square

$$\text{Area} = b \times b = 119.57 \Rightarrow B = 11$$

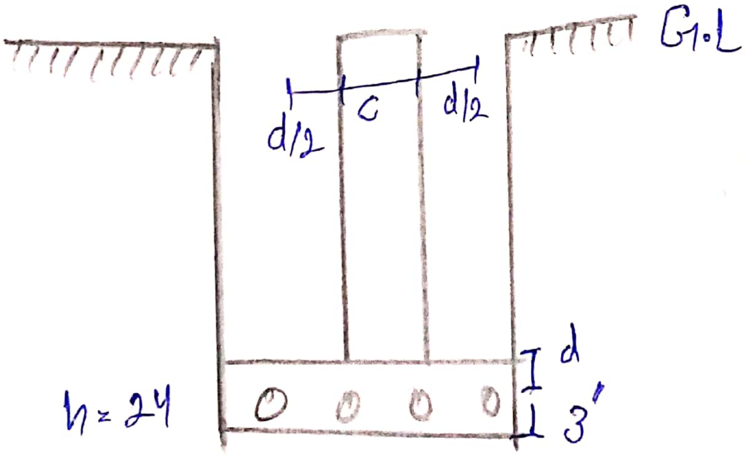
Step - 06 :- upward bearing capacity of Soils-

$$q_{up} = \frac{\text{factored load}}{(B)^2} = \frac{1.2 \times 100 + 1.6 \times 120}{11^2}$$

$$\boxed{q_{up} = 2.58\ K/ft^2}$$

Step - # 07 :- punching Shear

$$b_o = 4 \times (c + d)$$



P-T-O

$d = h - cc - \text{dia of bar} - \frac{1}{2} db$

$= 24 - 3 - 1 - \frac{1}{2}(1) = 19.5''$

Take # 8 bar

dia $= \frac{8''}{8} = 1$

$b'' = 4 \times (16 + 19.5) = 142''$

Step # 8:-

$Vu_2 = qup \times [B^2 - (c+d)^2]$

$= 2.58 \times \left[11^2 - \frac{(16 \times 19.5)^2}{12}\right]$

$Vu_2 = 289.60\,K$

Step # 9:-

$Qup = \frac{\phi \times 4 \times \sqrt{f'c} \times b \times d}{1000}$

$= \frac{0.75 \times 4 \times \sqrt{4000} \times 142 \times 19.5}{1000}$

$= 525.38\,K$

Step # 10:- Beam shear/one way shear check.

$$V_{u1} = q_{up} \times B \left[\frac{B}{2} - \frac{c}{2} - d\right]$$

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

$$V_{u1} = 90.95\,K$$

Step # 11:- Self Shear capacity

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

$$= \frac{0.75 \times 2 \times \sqrt{4000} \times (11 \times 12 - 16)}{1000}$$

$$= 110.04\,K > V_{u1} \Rightarrow OK$$

Step # 12:- Ultimate Moment

$$M_u = \frac{q_{up} \times B}{8} \times (B - c)^2 = \frac{2.58 \times 11}{8} \times \left(11 - \frac{16}{12}\right)^2$$

$$M_u = 331.49\,K' = 3977.93\,K''$$

Step # 13 :- Area of Steel for Mainbars by Trial and Repeat Method

$$As_{min} = 0.0018 \times B \times h = 0.0018 \times (11 \times 12) \times 24$$

$$= 5.70 \ in^2$$

$$As_{min} = \frac{200}{f_y} \times B \times d = \frac{200}{60000} \times (11 \times 12) \times 19.5$$

Step # 14 :- check the main Reinforcement by the following as method.

$$As_{min} = 0.0018 \times B \times h = 0.0018 \times (11 \times 12) \times 24$$

$$As_{min} = 5.7 \ in^2$$

Step #: 15 :-

using # 8 bars

$A_b = 1 in^2$

$$No\ of\ bars = \frac{8.85}{1 in^2} = 9$$

= 9 bars in bars in each direction.