NAME:-

NAVEED AHMAD

I.D: 7880

SECTION:

4B

SEMESTER: 6th

SUBJECT:-

PRCD I

INSTRUTOR:

SIR FAWAD

QUISTION- 1

GIVEN DATA:-

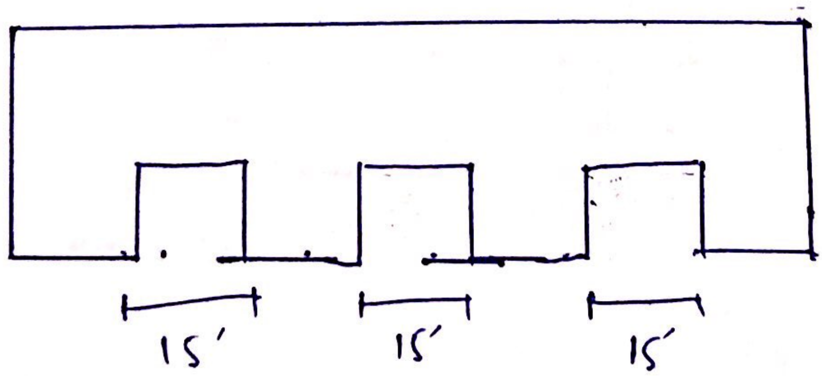
Clear span btw suppor = 15'

Factored live load = 160 lb/ft^2.

Service Floor finish load = 20 lb/ft^2.

$f'c$ = 4000 psi

fy = 40 ksi



STEP 01:

Minimum Thickness

By using formula.

$t_{min} = L/28 = 15/28 \Rightarrow 6.4 \cong 6.5''$

As $f_y \rightarrow 40$ ksi (2)

So we will multiply a factored with this Thickness.

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

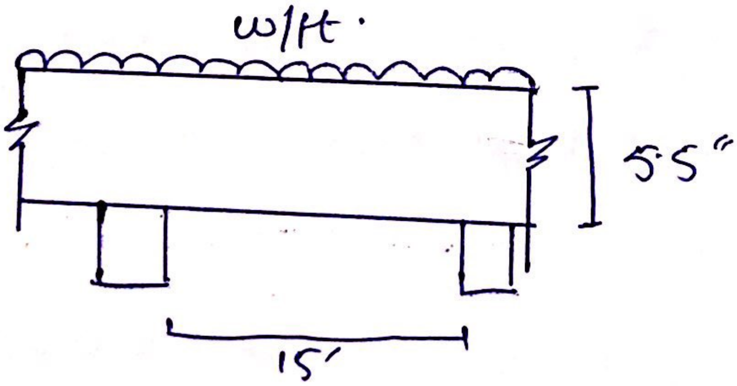
$\left(0.4 + 40/100\right) \Rightarrow 0.8$

Hence the minimum Thickness will be.

6.5×0.8

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

STEP 02:



By Formula.

$d = t - \text{Clear cover} - \frac{1}{2}(\text{dia of main bar})$

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

$d = 4.5$

STEP 03:-

Self weight of slab.

$t/12 + \gamma$ concrete

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

$\Rightarrow 68.75$ lb/ft.

STEP 04:-

Total factored load.

Factored live load = 160 lb/ft^2.

So the factored dead load will be.

$D.L = 1.2 (20 + 68.75) \Rightarrow 106.5$ lb/ft^2

Total factored load = D.L + L.L

106.5 + 160

$\Rightarrow 266.5$ lb/ft^2.

$\Rightarrow 0.2665$ k/ft^2.

STEP 05:-

Ultimate moment.

By using formula.

$M_u = W_u \times L/8 \Rightarrow \frac{0.2665 \times (15)^2}{8} \times 12$

$\Rightarrow 89.94$ kip inch.

STEP 06:-

Area of steel for main bars by trial and repeat method.

TRIAL 01:

Let depth of compression block.

$a = 0.2 \times t$.

$\Rightarrow 0.2 \times 5.5$

$\Rightarrow 1.1''$

$$Ast = \frac{Mu}{\phi \times fy \times (d - a/2)} = \frac{29.94}{0.90 \times 40 \times (4.5 - \frac{1.1}{2})}$$

TRIAL 02:

$$a = \frac{Ast \times fy}{0.85 \times f'c \times b} = \frac{40}{0.85 \times 40 (4.5 - \frac{0.6}{2})}$$

$Ast = 0.59 \text{ inch}^2$.

TRIAL 03.

$$a = \frac{0.59 \times 40}{0.85 \times 4 \times 12} \Rightarrow 0.57''$$

$$Ast = \frac{89.94}{0.90 \times 40 \times (4.5 - \frac{0.57}{2})} \Rightarrow 0.59 \text{ in}^2.$$

So we will use $Ast = 0.59 \text{ in}^2$.

STEP 07:-

Area of steel for distribution renforcemt

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

$0.0002 \times 12 \times 5.5 \Rightarrow 0.132\ in^2$

STEP 08:-

Spacing for main bars.

Spacing $\frac{Ab}{Ast} \times 12$.

we use # 6 bar dia $= (6/8)''$.

Area $= \pi/4\ (6/8)^2 = 0.442\ in^2$.

STEP 09:-

Spacing for distribution bars.

Spacing $= \frac{Ab}{Ast}$.

use # 5 bars so.

dia $= (5/8)''$, Area $\pi/4\ (5/8)^2 = 0.31\ in^2$.

Spacing $= \frac{0.31}{0.132} \times 12 \Rightarrow 2.81'' \cong 28''\ c/c$.

STEP 10:

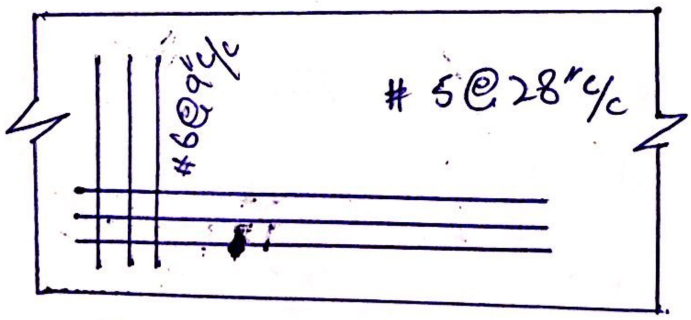
Find Sketch

$f'_c = 4$ ksi

$f_y = 40$ ksi

Main Steel #06 at 9" c/c

distribution steel #05 at 28 c/c.



QUESTION - 21

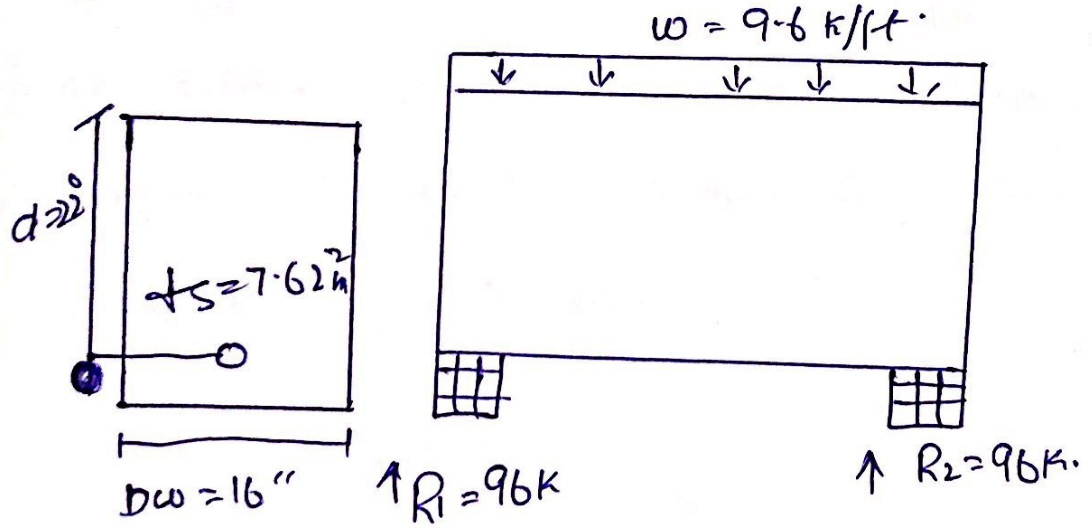
SOLUTION-

Find unit load of beam.

So $D \times \gamma_c$

$\frac{16}{12} \times 150 \Rightarrow 200\,lbs. \Rightarrow 0.2\,k/ft.$

So total factored load $= 9.4 + 0.2 \Rightarrow 9.6\,k/ft$



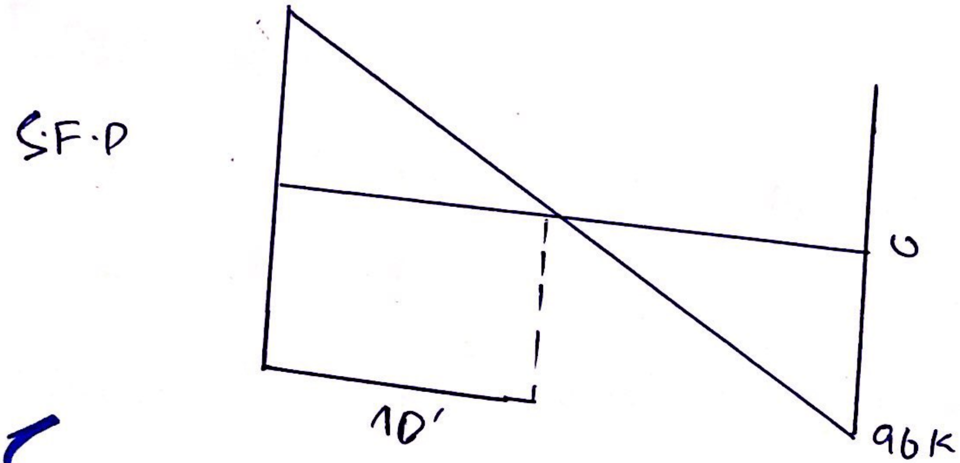
STEP # 01 :-

Find the values of R_1 & R_2.

total load $96 \times \frac{20}{20} = \boxed{196k}$

STEP 02:-

Draw it's shear force diagram

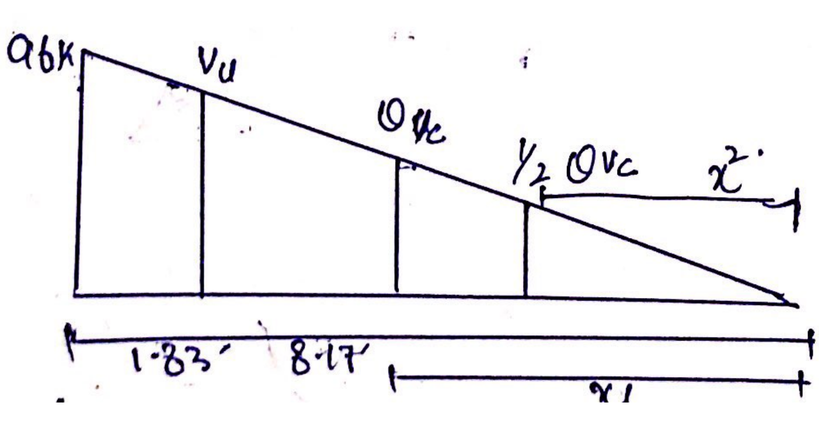


STEP 03

Find the value of critical stress "Vu" and it's location

As we know that criticle section is located at distince "d" from face of Support = d = 22" = 1.83'

value of criticle shear at distince "d" by Smillarty of Triangles.



From similar Δs $\frac{96}{10} = \frac{V_u}{8.17}$.

$V_u = 78.43k$.

STEP 04 :-

Find the value of "ϕV_c" & "$\frac{1}{2}\phi V_c$"
and also its distance from zero shear to right side

$\phi V_c = \phi \times 2 \times \sqrt{f'c} \times b_w \times d \Rightarrow \frac{0.75 \times 2 \sqrt{4000} \times 12 \times 16 \times 2}{1000}$

$\phi V_c = 33.40k$.

Location of ϕV_c by similarity of Δs.

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

$x_1 = 3.48'$

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

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

$x_2 = 1.74'$

STEP 05 :-

Value of ϕV_s ($V_u = \phi V_s + \phi V_c$)

So $\phi V_s = V_u - \phi V_c$

$\phi V_s = 78.43 - 33.40$

$\phi V_s = 45.03k$.

STEP 06:

Cheek on Section adequacy.

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

$\Rightarrow 133.57\ k.$

As $\phi \times 8 \sqrt{f'c} \times bw \times d > \phi V_s$ – It means Section is adequate.

STEP 07:

Cheek on min Spacing for stirrups.

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

$\Rightarrow 66.79\ k.$

As $\phi 4 \sqrt{f'c}$ ~~bwd~~ $bwd > \phi V_s = 45.03\ K.$

Thus maximum Spacing will be Selected from the following four Condition

1) $S_{max} = 24''$
2) $d/2 = 22/2 = 11''$
3) $S_{max} = \frac{A_v \times f_y}{0.75 \times f'c \times bw}$

$$A_v = \frac{\pi}{4}\left(\frac{3}{8}\right)^2 = \frac{0.22 \times 6000}{0.75 \times 4000 \times 16}$$

$A_v = 0.11 \times 2$

$A_v = 0.22$

17.40

4) S_{max} $\frac{A_v \times f_y}{50 \times b_w} \Rightarrow \frac{0.22 \times 60000}{5 \times 16}$

$\Rightarrow$ 16.50.

From the same above four condition, least value of spacing from # 03 U shaped will be Selected So

S_{max} = 11" c/c.

STEP 08: Spacing of stirrup from/at critical section

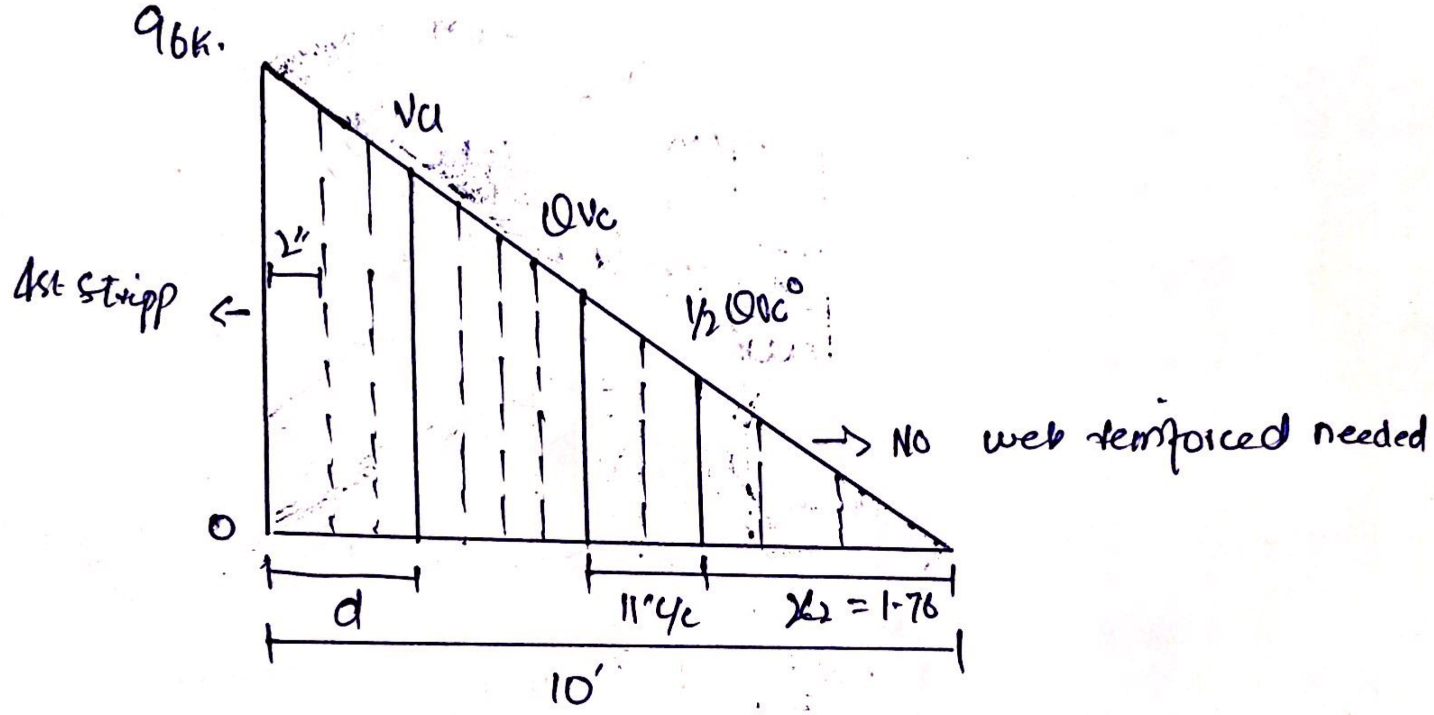
$$S = \frac{\phi \times A_v \times f_y \times d}{V_u - \phi V_c} \Rightarrow \frac{0.75 \times 0.22 \times 60 \times 22}{78.43 - 33.40}$$

$\Rightarrow$ 48.4" ≅ 5" c/c.

STEP 09: Find sketch.

Next page -

Find Sketch.



As we know that first stirrup from face of support

$$\rightarrow \frac{5}{2} = 2.5 \cong 2''$$

QUISTION- 3

SOLUTION:

STEP 01:

Find gross area of concrete

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

$Ag = 12 \times 12 = 144 in^2$ (actual)

STEP 02:

Find the area of steel.

Since $As = 5\%$ of Ag.

$= 0.05 \times 144$

$As = 7.2 in^2$.

STEP 03:

Ultimate load carrying capacity

$Pu = \phi \times 0.80 \times [0.85 \times f'c \times (Ag - As) + As \times fy)$

$0.65 \times 0.85 \times [0.85 \times 4 [144 - 7.2) + 7.2 \times 60)$

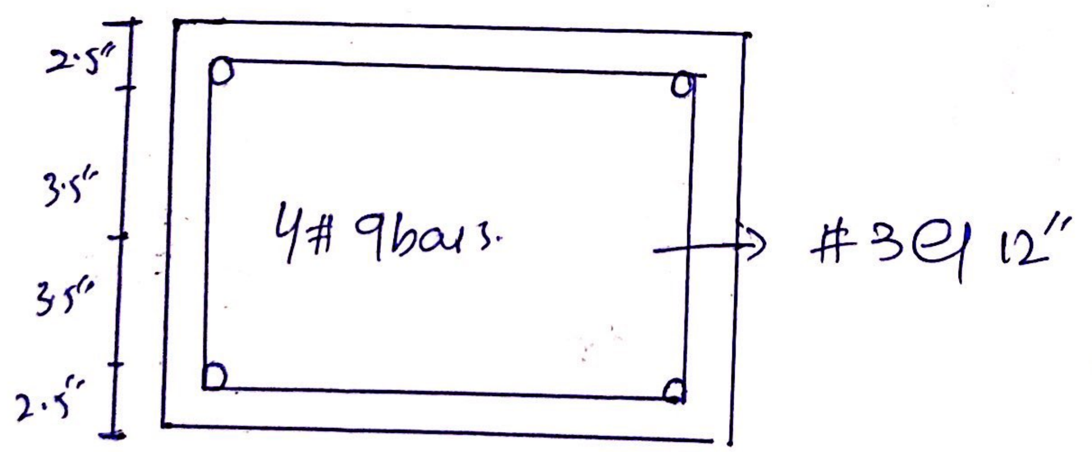
$Pu = 466.50 k.$

STEP 04:

Sketch and design of ties (c/c to distribution. From the ~~above~~ below value we choose the least value of all this

1) 16 x dia of long bar = 16 x 9/8. = 18"
2) 48 x dia of tie bar = 48 x 3/8 = 18"
3) least Coloumn diminsion = 12"

So c/c distance btw. ties = 12"



Since its is a tied square coloumn so there is no spiral stirrup used is of rectangular shape due to specification of the structure thus we will use stirrup insted.

QUESTION 4

SOLUTION-

STEP 01:

Let = $h = 24''$

STEP 02:

total weight wt of soil + wt of R.C

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

$= 660\ psf \Rightarrow 0.660\ ksf$

STEP 03:

Effective bearing capacity

$q_e = q_a - W$

$= 2.50 - 0.660$

$q_e = 1.84\ ksf$

STEP 04:

Required area of for foundation.

$$q_{req} = \frac{\text{Service load}}{q_e} = \frac{100 + 120}{1.84} \Rightarrow 119.57\ ft^2$$

STEP 05:

Since foundation is square.

Areq. = b×b = 119.57 = B ≅ 11′

STEP 06:

upward bearing capacity of Soil

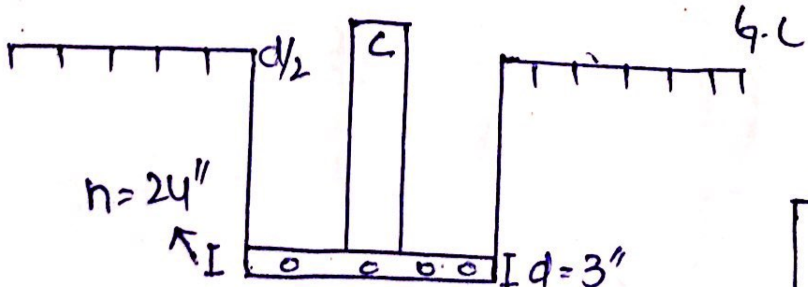
$$q_{up} = \frac{\text{factored load}}{B^2} = \frac{1.2 \times 100 + 1.6 \times 120}{11^2}$$

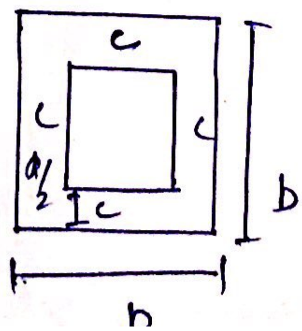
q_{up} = 2.58 k/ft².

STEP 07:

Punching Shear.

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





$d = h - c - c - \text{dia of bar} - \frac{1}{2} d_b$

$\because$ take #8 bar
dia $= 8/8" = 1"$

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

$b_o = 4 \times (16 + 19.5) = 142"$

STEP 08:

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

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

$V_{u_2} =$ [redacted] $289.60k.$

STEP 09:

$\phi V_{cp} = \phi \times 4 \times \sqrt{f'c} \times b \times d$

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

$\phi V_{c/p} = 525.38$

STEP 10:-

Beam shear / one way shear check.

$V_{ui} = q_{up} \times B \times [B/2 - c/2 - d]$

$V_{ui} \Rightarrow 2.58 \times 11 \times [11/2 - \frac{16/12}{12} - 19.5]$

$V_{ui} = 90.95K$.

STEP 11:-

Self shear Velocity

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

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

$\Rightarrow 110.04K > V_{ui} \Rightarrow OK$

STEP 12:

$M_u = \frac{q_{up} \times B}{8} \times (B - c)^2$

$\Rightarrow 2.58 \times 11/8 \times (11 - 16/12)^2.$

$M_u = 331.49K \cong 3977.93K$"

Step 13:

Area of Steel for main bars by trial and repeat method.

Trial 01:

Let $a = 0.2 \times h = 0.2 \times 24 = 4.8''$

$$A_s = \frac{M_u}{\phi \times f_y (d - a/2)} \Rightarrow \frac{3977.93}{0.90 \times 60 \times (11 - \frac{4.8}{2})}$$

$$\Rightarrow 8.56 \text{ in}^2.$$

Trial 02:

$$a = \frac{A_s \times f_y}{0.85 \times f'_c \times b} = \frac{8.56 \times 60}{0.85 \times 3 \times 11 \times 12} \Rightarrow 1.53''$$

$$A_s = \frac{3977.93}{0.90 \times 60 \times (11 - \frac{1.53}{2})} \Rightarrow 7.197 \text{ in}^2.$$

Trial 03:

$$a = \frac{7.197 \times 60}{0.85 \times 3 \times 11 \times 12} = 1.28''$$

$$A_s = \frac{3977.93}{0.90 \times 60 (11 - 1.28/2)} = 7.7 \text{ in}^2$$

So that area $= 7.7 \text{ in}^2$.

STEP 14:

Check The main reinforcement by the following 03 method.

a) As min $0.0018 \times B \times h = 0.0018 \times (11 \times 12) \times 24$

$\Rightarrow 5.70 \ in^2$.

b) As min $= \frac{200}{fy} \times b \times d = \frac{200}{60000} \times (11 \times 12) \times 19.5$

$\Rightarrow 8.58 \ in^2$

c) As min $= \frac{3 \times \sqrt{f'c}}{fy} \times B \times d = \frac{3 \times \sqrt{3000}}{60000} \times (11 \times 12) \times 19.5$

$\Rightarrow 7.05 \ in^2$.

From above value the greater value will be selected this As min $= 8.58 \ in^2$

STEP 15:

using # 8 bar.

No of bars $= \frac{As}{Ab} = \frac{8.58}{0.783} \Rightarrow 10.92$.

11 bars in each direction