NAME:

NAVEED AHMAD

I.D:

7880

SECTION:

4B

SUBJECT:

PRCD I

SUBMITTED TO:

SIR FAHAD

ASSIG:

01.

DATE:

26/6/2020.

QUISTION- 1.

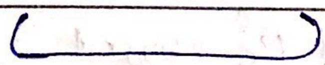
STIRRUP :-

Strip are closed loop bars tied at regular interval in beam reinforcement to hold the bar in position

TYPES:

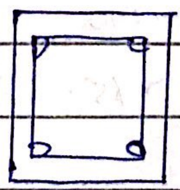
1) **SINGLE LEGED:**

Singal leg stirrup have rarely been used because they are mostly used when binding two rods



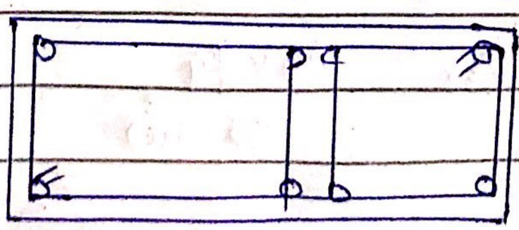
2) **TWO LEGGED:**

It's most commonly and widely used minimum 4 bars are required.

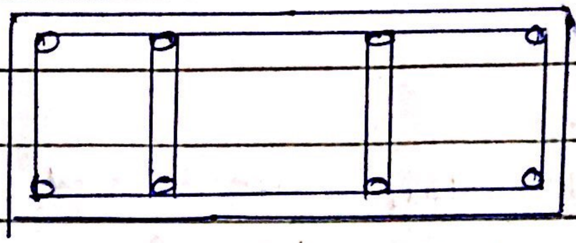


3) **FOURED LEGGED:**

Used in case of web reinforcement



4> SIX LEGGED:



ACI CODE PROVISION FOR SHEAR DESIGN.

Critical section at a ~~design~~ distince "d" from the face of support.

1> SHEAR STRENGTH CAPACITY OF CONC:-

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

2> MINIMUM WEB REINFORCEMENT:-

If $V_u \le \phi \times V_c$ No web reinforcement req.

$$A_{v\,min} = \frac{0.75 \times \sqrt{f'c} \times b_w \times s}{f_y} \quad \text{OR} \quad A_{v\,min} = \frac{50 \times b_w \times s}{f_y}.$$

Also from formulas

max capacity $S_{max} = \dfrac{A_v \times f_y}{0.75 \times \sqrt{f'c} \times b_w}$ or

$$S_{max} \quad \frac{A_v \times f_y}{50 \times b_w}$$

First stirrup is provided at a distance ~~d from face~~ S/2

Shear at criticle section is represented by "Vc"

Between criticle section "Vu" an "ΦVc" spacing btw web reinforcment can be find by following formula

$$S = \frac{\Phi \times A_v \times f_y \times d}{V_u - \Phi V_c}$$

V_s = Shear forced carried by web reinforcement / Stirrups.

According to ACI codes.

If $V_s \leq 4 \times \sqrt{f'c} \times b_w \times d$, The max spacing of stirrups will be smallest of the following four condition.

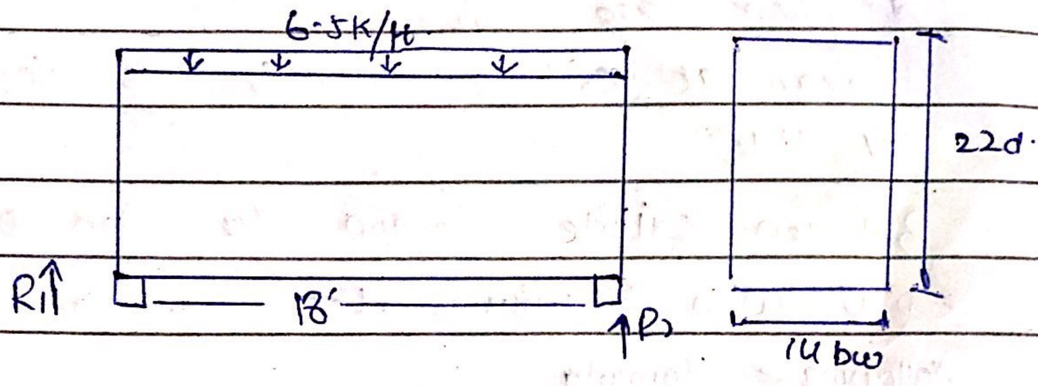
① 24" ② d/2.

③ $S_{max} = \frac{A_v \times f_y}{0.75 \times \sqrt{f'c} \times b_w}$ ④ $S_{max} = \frac{A_v \times f_y}{50 \times b_w}$.

If $V_s > 4 \times \sqrt{f'c} \times b_w \times d$ max spacing will be halved.

If $V_s > 8 \times \sqrt{f'c} \times b_w \times d$ Then either increase Gross sectional dimension or decrease.

QUESTION - 2.



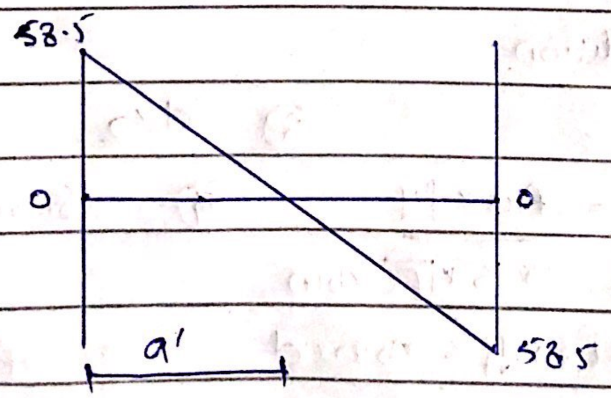
STEP 01:

Find values of R_1 and R_2

total load 6.5 K/ft = 6.5 x18/2 ⇒ 58.5.

STEP 02:

Draw shear force diagram



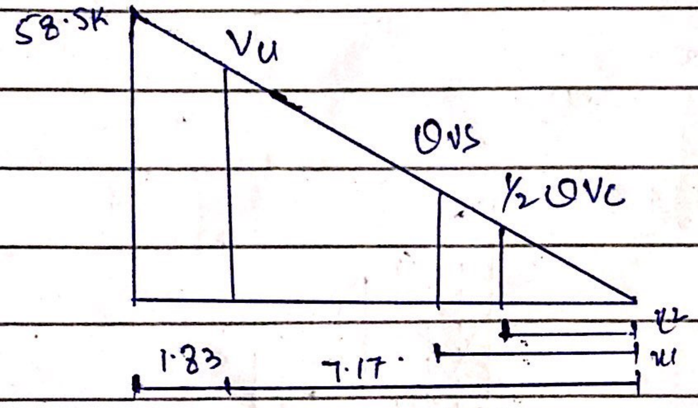
STEP 03:

Find the value of criticle shear Vu and find it's location

As we know that section is located at distance "d" from face of support = d=22"

=1.83'

Value of critical shear at distince 'd'
by similarty of triangle



$$\frac{58.5}{9} = \frac{Vu}{7.17} \qquad Vu = 46.605$$

STEP 04:

Find the value of ΦVc & and also it's distince from zero shear to right side

$$\Phi Vc = \Phi \times 2 \times \sqrt{F'c} \times b_w \times d$$

$$\Rightarrow \frac{0.75 \times 2 \sqrt{4000} \times 14 \times 22}{1000}$$

$$\Phi Vc = 29.219K$$

location of ΦVc by similarity of triangle -

$$\frac{58.5}{9} = \frac{29.219}{x1} \Rightarrow$$

$$\rightarrow x_1 = 4.995'$$

Now $\frac{1}{2} \phi V_c = 14.6095K$.

Location of $\frac{1}{2} \phi V_c$ by similarity of

Δ triangle $\frac{58.5}{9} = \frac{14.6095}{x_2} \Rightarrow x_2 = 2.247'$

STEP 05:

Value of ϕV_s.

$V_u = \phi V_s \; \phi V_c$

$\phi V_s = V_u - \phi V_c$

$= 46.605 - 29.219 \Rightarrow 17.386.$

STEP 06:

Check on section adequency.

$\phi \times 8 \times \sqrt{f'c} \times b_w \times d$.

$= \frac{0.75 \times 8 \times \sqrt{4000} \times 14 \times 22}{1000} = 116.87.$

$\phi V_s < \phi 8 \sqrt{f'c}\, b_w d$

It means section is adequate.

STEP 07:

Check on maximum spacing

To stirrups.

$\phi \; 4 \times \sqrt{f'c} \times b_w \times d$.

$\frac{0.75 \times 4 \times \sqrt{4000} \times 14 \times 22}{1000}$

$\Rightarrow 58.438K.$

As $0.4\sqrt{f'c}\ b_w d > \phi V_s$

So maximum spacing will be selected from the following four conditions using #3, 2 legged stirrup

1) $S_{max} = 24$

2) $d/2 = 22/2 = 11.$

3) $S_{max} = \dfrac{A_v \times f_y}{0.75 \times \sqrt{f'c} \times b_w} = \dfrac{0.22 \times 60000}{0.75\sqrt{4000} \times 4} = 19.8$

4) $S_{max} = \cancel{\dfrac{0.22 \times 6000}{50 \times 14}}$

$S_{max} = \dfrac{A_v \times f_y}{50 \times b_w} = \dfrac{0.22 \times 60000}{50 \times 14} = 18.857.$

From above four conditions least value of spacing for #3, 2 legged stirrup will be selected.

STEP 08:

Spacing of stirrup from central section.

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

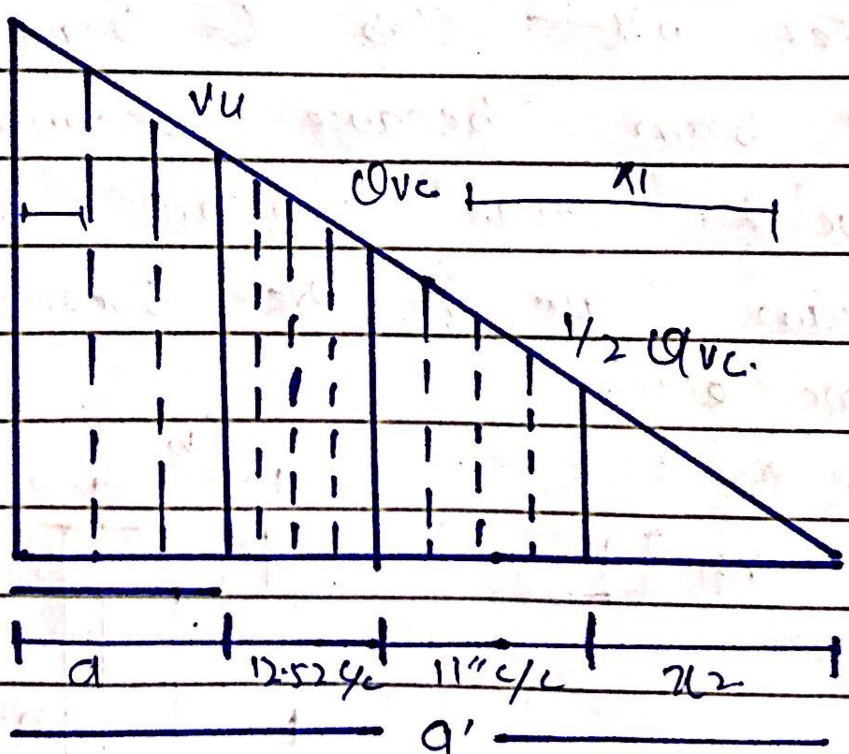
$$\Rightarrow \frac{0.75 \times 0.22 \times 60000 \times 22}{46.605 - 29.219.}$$

$S = 12.52$ c/c.

Step 09.

Final sketch.

$$S = \frac{12.52}{2} = 6.2$$

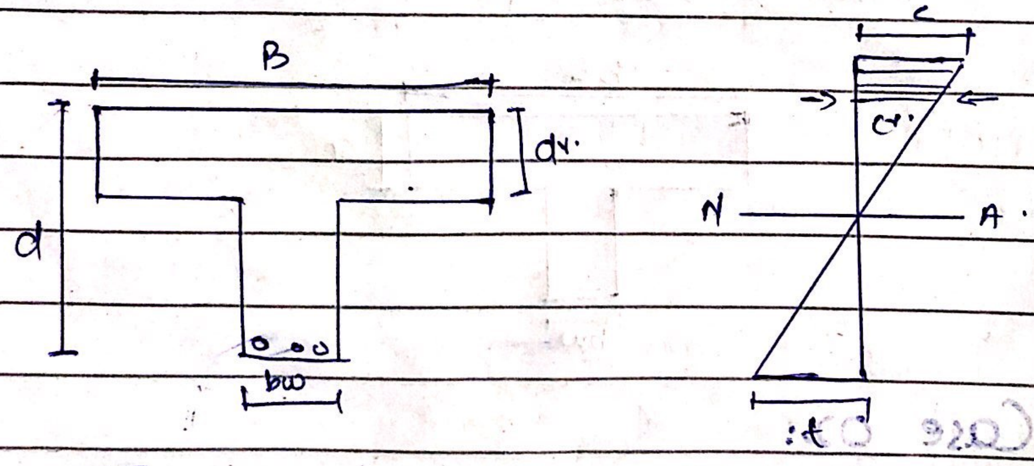


QUESTION - 3

T- BEAM:

Beam consists of flange and rib in the form of T, generally made of RC concrete or metal.

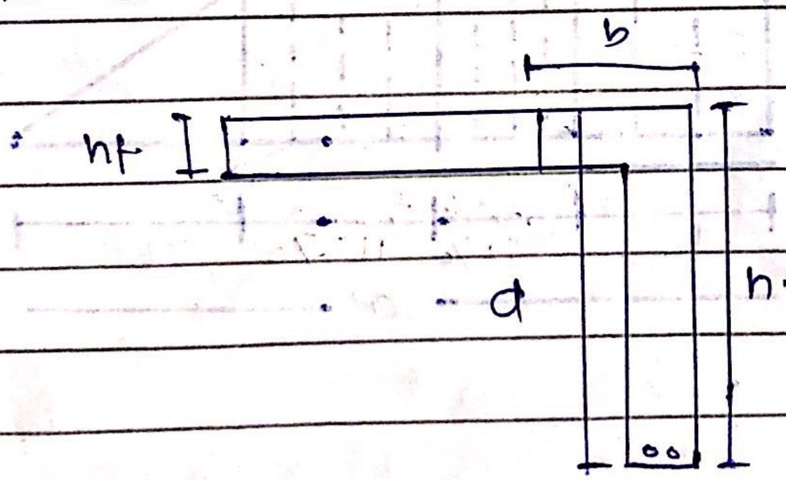
Top part of slab which acts along the beam to resists the compressive stress is called flange. The part which lies below the slab and resists the shear stress is called rib.



T-beam and stress - distribution diagram.

L- BEAM:

The end beam which have slab on one side only act's as L-beam in most of the reinforced concrete structure concrete slabs are beams cast monolithic in a floor consisting of several beams cast monolithically with a slab, the intermediate beam acts as T-beam. whore. as beam at top of the cornors of the walls or beams around stair case or lift opening are called L- beam. Thus L- beam and T- beam from a part of floor system together with slab - L- beam are typical floor beam because because of the reduced overall structure depth. the beam are in pre- stressed or renforced Concrete.

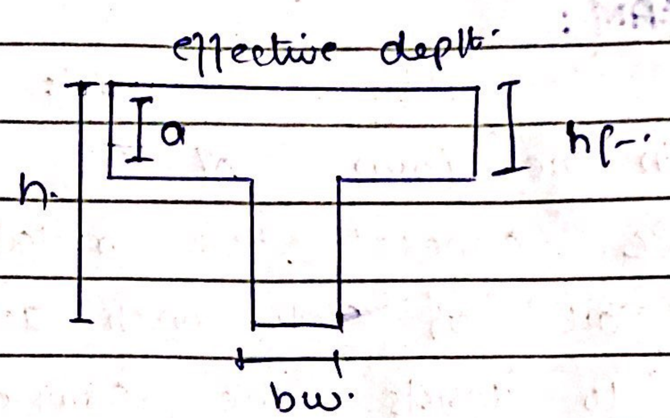


Floxural Strength analysis for T-Beam.

There are two cases in two beam analysis for T beam

Case 01:

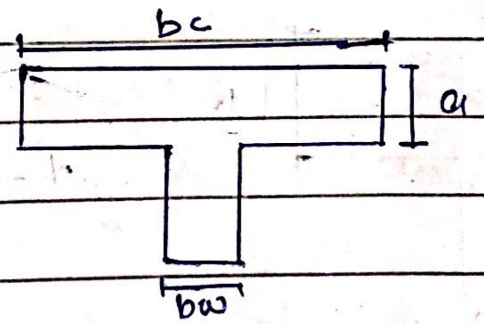
$a \le h_f$.



$b = b_e$

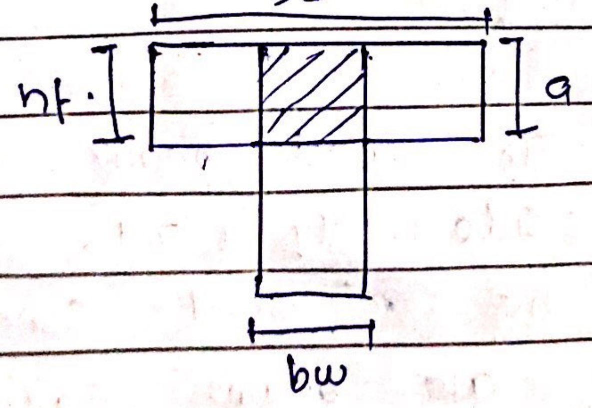
$M_n = A_{sw} \times f_y \times (d - a/2)$

$M_n = 0.85 \times f'_c \times b_w \times a \times (d - a/2)$

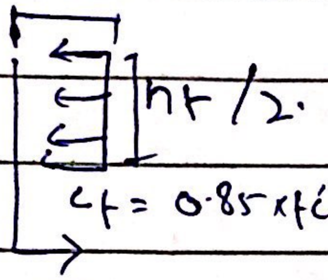


Case 02:

$a > h_f$.



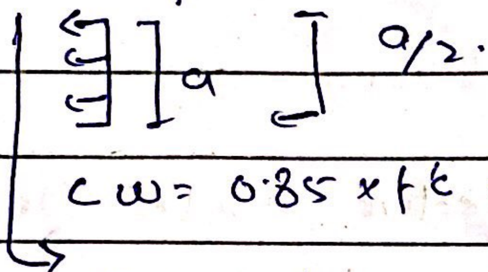
0.85 × f'c.



$C_f = 0.85 \times f'c \times (b_e - b_w) h_f \times d - h_f/2)$

$T_1 = A_{sf} \times f_y$

0.85 × f'c.



$C_w = 0.85 \times f'c \times b_w \times a \times (d - a/2)$

$T_2 = A_{sw} \times f_y = (A_s - A_{sf}) f_y$

Total Tensile stress Area = $A_s = A_{sf} \times A_{sw}$

$M_n = M_{n1} + M_{n2}$

$M_{n1} = A_{sf} \times f_y \times (d_y - h_f/2).$

$\Rightarrow 0.85 \times f'c \times (b_e - b_w) h_f \times a - h_f/2)$

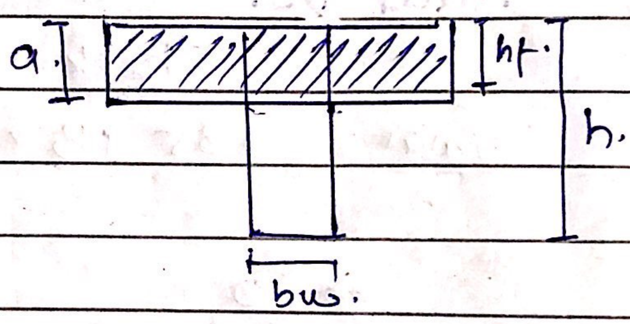
$M_{n2} = A_{sw} \times f_y \times (d - a/2) = \cancel{0.85}$

$\Rightarrow 0.85 \times f'c \times b_w \times a \times (d - a/2)$

QUISTION - 4

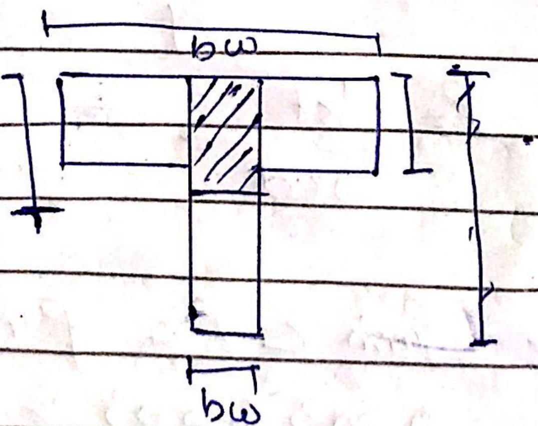
CASE I:-

In case I ($a \leq hf$) which show that the height of compression block is less than or upto flange level. It's indication is that the beom is rectengular and it will be analysed by rectengular beom analysis method.



CASE II:

In case II ($a > hf$) which shows that the height of compression block is more than the flange level and it indicate that the below will be analysed by T-beam analysis method.



Moment.

$Mn = Mn_1 + Mn_2$.

$Mn_1 = Asf \times fy \times (dy - hf/2)$

$Mn_2 = Asw \times fy \times (d - a/2)$

QUISTION - 5

DATA :

$f'_c = 3ksi$,
$fy = 60ksi$
Factored moment $= 5800$ k-inch 5.3 k/ft

STEP 01.

Calculate effective width "be"

1) $16 \times hf + bw \Rightarrow 16 + 3.5 + 10 = 66"$
2) c/c distince $\Rightarrow 9 \times 12 = 108"$
3) span/4 $\Rightarrow 16/4 \times 12 = 48"$

be $= 48"$

STEP 02 ::

Check wether rectengular or T-beam analysis is req.

Trial 01:

Let $a = hf = 3.5"$

$$Ast = \frac{Mu}{\phi \times fy \times (d - a/2)} = \frac{5800}{0.90 \times 60(18 - 3.5/2}$$

$\Rightarrow 6.609$

Trial 02:

$$a = \frac{A_s \times f_y}{0.85 \times f'_c \times b_e} = \frac{5.609 \times 60}{0.85 \times 3 \times 42} \Rightarrow 3.23$$

$$A_{st} = \frac{5200}{0.90 \times 60 (18 - 3.23/2)} \Rightarrow 6.55$$

Trial 03:

Check ρ_{max} and ρ_{min}

$$\rho_{max} = 0.85 \times B \times \frac{f'_c}{f_y} \left(\frac{\varepsilon_u}{\varepsilon_u + \varepsilon_t} \right)$$

$$\Rightarrow 0.85 \times 0.85 \times \frac{3}{60} \left(\frac{0.003}{0.003 \times 0.005} \right)$$

$$\Rightarrow 0.0135$$

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{6000} = 0.003$$

$$\rho = \frac{A_{st}}{b \times d} = \frac{6.55}{10 \times 18} = 0.03$$

$\rho_{min} < \rho < \rho_{max}$

$0.003 < 0.03 > 0.0135$

So $\rho_{max} = \dfrac{A_{st}}{b \times d}$

$A_{st} = \rho_{max} \times (b \times d)$

$= 0.013 \times (10 \times 18)$

$A_{st} = 2.34\ in^2$

STEP 04:

Design it as doubly reinforce beam.

$M_{U2} = \phi \times A_{st} \times f_y \times (d - a/2)$

For a, $a = \dfrac{A_{st} \times f_y}{0.85 \times f'_c \times b} \Rightarrow \dfrac{2.34 \times 60}{0.85 \times 3 \times 10} \Rightarrow 5.72$

$M_{U2} = 0.90 \times 2.34 \times 60 \times (18 - 5.72/2)$

$M_{U2} = 1913.09\ K'' < M_U = 5800\ K''$

STEP 05:

Find value of M_{U1}

$M_{U1} = M_U - M_{U2}$

$= 5800 - 1913.09$

$= 3886.9096\ K''$

$M_{U1} = \phi \times A's \times f_y \times (d - d')$

$A_s = \dfrac{3886.9096}{0.90 \times 60 \times (12.25)} \Rightarrow 4.643\ in^2$

STEP 06:

Total steel area.

$A_s = A_{st} + A'_s$

$2.34 + 4.643 \Rightarrow 6.98\ in^2.$

STEP 07:

Selection of bars.

A) For Tension of bars.

For tension zone.

using bar # 10 Area = $1.227\ in^2$.

no of bars = $\frac{6.98}{1.227}$

$\Rightarrow 5.688 \approx 6$ # 10 bars.

B) For compression zone.

using # 6 Area = $0.44\ in^2$.

No of bars = $\frac{4.643}{0.44}$

$\Rightarrow 10.55 \cong 11$ bars.

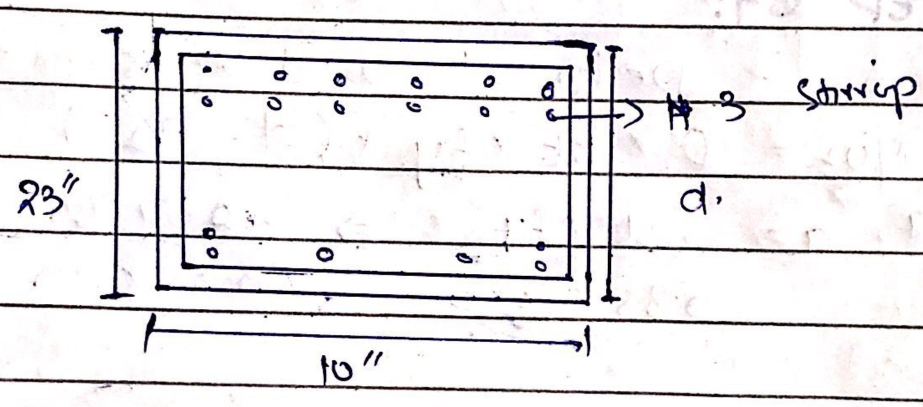
STEP 08:

Check minimum width

$b_{min} = 2 \times 1.5 \times 2 + 3/8 + 6 \times 10/8 + 5 \times 10/8$.

$17.5'' > 10''$

Not good in one layer, must be provided in two layers.



STEP # 09:

Design moment.

$$a = \frac{(A_s - A'_s) f_y}{0.85 \times f'_c \times b} \Rightarrow \frac{(6 \times 1.227 - 11 \times 0.44)\,60}{0.25 \times 3 \times 10} \Rightarrow 5.934$$

$$M_d = 0.90 \left[(11 \times 0.44) \times 60 (19.625 - 3) + 6.98'' - 4.643) \times 60 \times (16.658) \right]$$

$M_d = 6447.316k > M_u = 5800\ k$

design is fine.

QUESTION - 6

DATA:

b = 14"   Mu = 600 kin
h = 26"   f'c = 4ksi
fy = 60ksi   d = 22"
Assume d' 2.5"

STEP 01:

Check the capacity of selection as single reinforced beam:

$$\rho_{max} = 0.85 \times B \times \frac{f'c}{fy}\left(\frac{\varepsilon_u}{\varepsilon_u + \varepsilon_y}\right)$$

$$= 0.85 \times 0.85 \times \frac{4}{60}\left(\frac{0.003}{0.003 + 0.005}\right)$$

$\Rightarrow$ 0.018.

STEP 02:

$$\rho_{max} = \frac{Ast}{b \times d}$$

So $Ast = \rho_{max} \times b \times d$
$= 0.018 \times 14 \times 22 \Rightarrow 5.544\ in^2$

Scanned with CamScanner

Step 03:

$M_{u2} = \phi \times A_{st} \times f_y \,(d - a/2)$

But first $a = \dfrac{A_{st} \times f_y}{0.85 \times f'_c \times b}$

$\Rightarrow \dfrac{5.544 \times 60}{0.85 \times 4 \times 24}$

$a = 6.988''$

$M_{u2} = 0.90 \times 5.544 \times 60 \times (22 - 6.988/2)$

$M_{u2} = 5540.26\ k'' < 6000\ k = M_u$

Design a section as doubly reinforced

Step 04:

$M_{u1} = M_u - M_{u2}$

$6000 - 554.25$

$M_u = 459.74\ k''$

Step 05:

$M_{u1} = \phi \times A'_s\, f_y \times (d - d')$

So $A'_s = \dfrac{M_{u1}}{\phi \times f_y\,(d - d')}$

$$A's = \frac{459.74}{0.90 \times 60 \times (22.25)}$$

$$A's = 0.43\ in^2.$$

STEP 06:

Total area of steel:

$As = Ast + A's.$

$= 5.544 + 0.43.$

$\Rightarrow 5.98\ in^2.$

This steel area should be provided in tensile zone as tension reinforced.

STEP 07:

Selection of Bars.

As For tension steel.

Let try # 8 bars Area $= 0.785\ in^2.$

No of bars $= \frac{As}{Ab} = \frac{5.98}{0.785} \Rightarrow 7.62.$

$7.61 \approx 8$ bars.

B :

For compression steel

Let try # 6 bars , area = 0.44.

No. of bars = $\frac{A's}{Ab}$ = $\frac{0.43}{0.44}$

0.97 ≈ 1 # 6. bars.

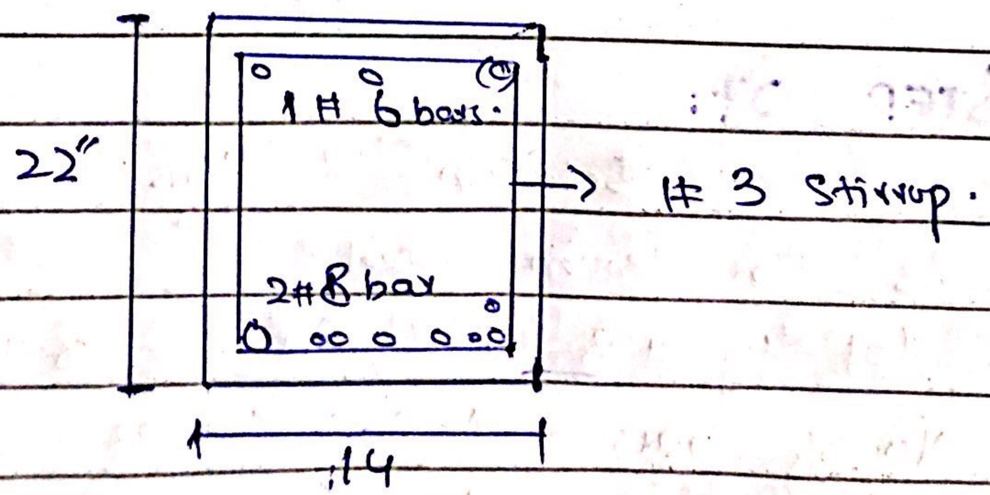
STEP 08:

Check minimum width

b min = 2 x 1.5 + 2 x 3/2 + 8 x 8/8 + 7 x 8/8.

→ 18.75" > 14"

Not good in one layer.



STEP 09:

Design moment

$$M_d = \varphi \left[A'_s \times f_y \times (d - d') + (A_s - A'_s) f_y \left(d - \frac{a}{2}\right)\right]$$

$$a = \frac{(A_s - A'_s) f_y}{0.85 \times f'_c \times b} \Rightarrow \frac{(8 \times 0.785 - 1 \times 0.44) \times 60}{0.85 \times 4 \times 14}$$

$$a = 7.361''$$

$$M_d = 0.90 \left((1 \times 0.44)\, 60 \times (22 - 2.5) + (8 \times 0.785 - 1 \times 0.44)\, 60 \times \left(22 - \frac{7.361}{2}\right)\right)$$

$$\rightarrow 6882.47 > M_U = 6000$$

Design is fine.