IQRA NATIONAL UNIVERSITY

PESHAWAR

BACH 2015

ID 12430

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B·tech Civil

Date : 24/08/2020

Time : 2 chlock

Q no 1 :-

Solution :-

Given Data

span length = $l = 30 ft$.

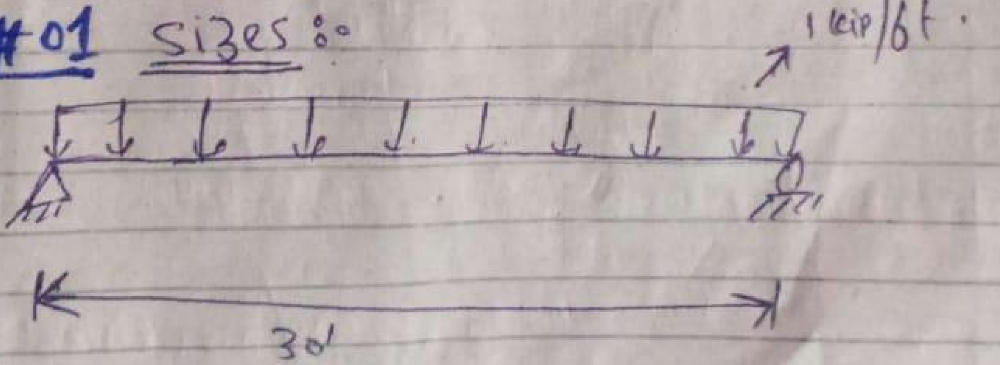
Service live load = 1000 lb/ft = 1 kip/ft.

uniform live load = 1100 lb/ft = 1.1 kip/ft.

f_y = 60,000 psi = 60 ksi

f'_c = 4000 psi = 4 ksi.

Step # 01 Now sizes :-



For 30',

$h_{min} = l/16 = 30'/16 = 22.5''$ OK

Now width of beam = 22.5'' − 1
= 21.5'' (Cased)

Step # 02

self weight of beam = $\gamma_c \cdot b_w \cdot h$

$= 0.15 \times (21.5 \times \frac{30}{144})$

$= 0.671$ kip/ft

$W_U = 1.2W_D + 1.6W_L$

$= 1.2(1+0.671) + 1.6(1.1)$

$= 2.005 + 1.75$

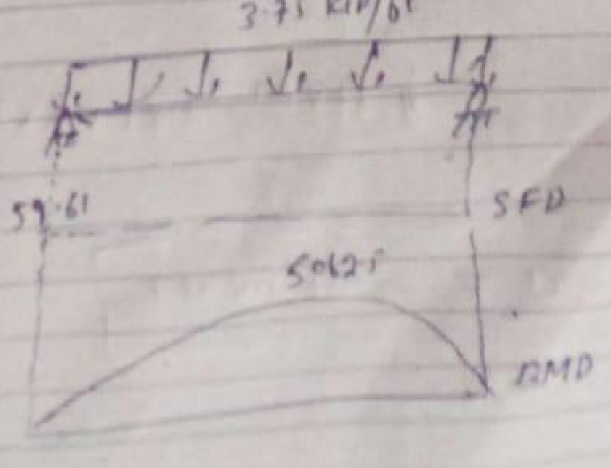
$W_U = 3.75$ kip/ft

Step # 03

Flexural Analysis.

$M_U = \frac{W_U l^2}{8} = \frac{3.75 \times (30)^2 \times 12}{8}$

$\boxed{M_U = 5062.5 \text{ in.-kips}}$



Step # 04

Design of flexure:

$\phi M_n \geq M_u$ (ϕM_n is M_{design})

For $\phi M_n = M_u$

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

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

Let $a = 4''$

$A_s = 5062.5 / 0.9 \times 60 \times \{27.5 - \frac{4}{2}\}$

$\boxed{A_s = 3.67\ in^2}$

Now

$a = A_s f_y / 0.85 f_c' \cdot b_w$

$= 3.67 \times 60 / 0.85 \times 4 \times 21.5$

$\boxed{a = 3.01\ inches}$

2nd trial

$A_s = 3.75\ in^2$

$a = 3.11$

3rd trial

$A_s = 3.77\ in^2$

$a = 3.12\ inc$ so $\underline{OK}$

$\rho_{min} = 3\sqrt{f_c'}/f_y \geq 200/f_y$.

$3 \times \sqrt{4000}/60000 = 0.0031$

$\frac{200}{60000} = 0.003$

$\boxed{\rho_{min} = 0.0031}$

$A_{s\,min} = \rho_{min} \times b_w \times d$

$= 0.003 \times 21.5 \times 27.5$

$\boxed{A_{s\,min} = 1.77\ in^2}$

$A_{s\,max} = 5.9\ in^2$

So $A_{s\,min} < A_{s\,max}$ $\underline{O.K}$

(5)

Step # 05

No of Bar.

10 # 6 bar will provide

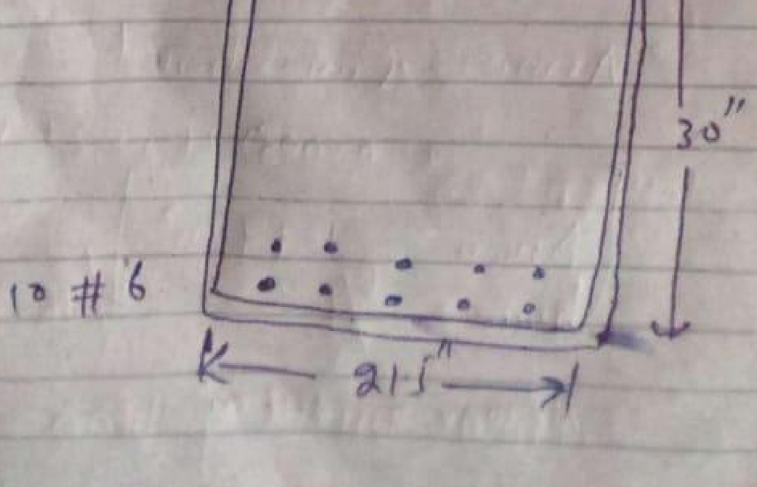
for $4.40\,in^2$ of steel area which is sligtly greater then required.

So

8 # 7 ($4.80\,in^2$) or

6 # 8 (4.74) may be used.

Step # 05 :- ~~Draft~~ Drafting.



QNO #02

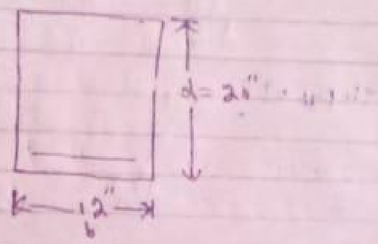
Solution:

Given Data

Flexure demand = 3500 in kip

f_c' = 3 KSI

f_y = 40 KSI



Required

Design Doubly Reinforcement Beam

Now for Solution

Step #01

For ϕM_n

$\rho_{max} = 0.0203$

$As_{max(singly)} = \rho_{max(singly)} \times b \cdot d$

$= 0.0203 \times 12 \times 20$

$= 4.87 \ in^2$

$\phi M_{n(max)\,singly} = \phi A_{max} f_y \left(d - \frac{a}{2}\right) =$

$\boxed{\phi M_{n(max)\,singly} = 2948.88 \text{ in kip}}$

Step # 02

$Mu_{extra} = Mu - \phi M_{max}(\text{singly})$

$= 3500 - 2948.88$

$\boxed{Mu_{extra} = 2551.12 \text{ in kip}}$

Step # 03 From table

$d = 20'' > 12.5''$ and $d' = 2.5''$ so

$d'/d = 0.125 < 0.20$ for $f_y' = 40$ ksi

So it exist in yield

stress in compression steel $= f_s' = f_s$

Also

$\varepsilon_s' = (0.003 - 0.008\, d'/d)$ --- ①

$\varepsilon_s' = \left(0.003 - 0.008 \times \frac{2.5}{20}\right) = 0.002 > \varepsilon_y$

wher $\varepsilon_y = 40/29000 = 0.00137$

As ε_s' is greater then ε_y

So $\boxed{\text{compression steel will yield}}$

3

Step # 04

Calculation of A_s' & A_{st}

$$A_s' = M_{u(extra)} / \{\phi f_s'(d-d')\}$$

$$= 355112 / \{0.90 \times 40(20-2.5)\}$$

$$A_s' = 4.04\ in^2$$

$$A_{st} = A_{s\,max(single)} + A_s'$$

$$= 4.87 + 4.04$$

$$A_{st} = 8.91\ in^2$$ (Tension reinforcement).

Now using of # 8 bars with area A_b

$A_b = 0.79\ in^2$

$$\text{No of bar} = \frac{8.91}{0.79} = 11.2 \approx 12$$

No of bar to provided on compression side

$$\text{is} = \frac{4.04}{0.79} = 5.56 \approx 6$$

Concluded: provide 12 # 8 (in 3 layer) on tension side

Provide 6 # 8 (in 1 layer) on compression side

Step #05

Ensure that $d'/d < 0.2$ (for grade 40)

Now to check

$d = 19.625''$

$d' = 2.375''$

$d'/d = 2.375/19.625 = 0.12 < 0.2$ **O.K**

Step #06 Ductility

$A_{st(max)} = A_{s(max)singly} + A'_s f'_s / f_y$

$A_{smax(singly)} = 4.87\ in^2$

$A'_s = 6 \times 0.79 = 4.76\ in^2$

$A_{st(max)} = 4.87 + 4.76 = 9.636\ in^2$

$A_{st} = 7.9\ in^2$

so

$A_{st} = 7.9\ in^2 < A_{st\,max}$ o.k.

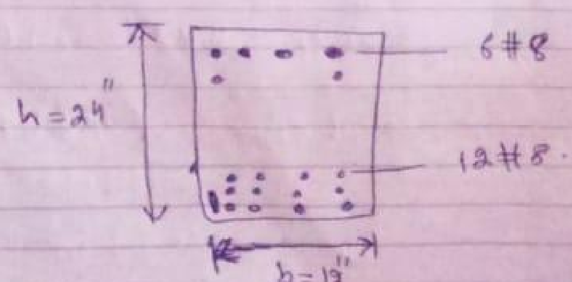
because

$7.9\ in^2 < 9.635$

$\Rightarrow \boxed{A_{st} < A_{st\,max} \text{ so O.K}}$

Step #07 Drafting:

Provide 12 #8 (3 layer) & 6 #8 (1 layer)
tension compression



Question No "3"

Mechanics oF RC Beams under Gravity load.

1:- un-cracked concrete - Elastic stage.

* At loads much lower than the ultimate Concrete remains un-cracked in compression as well as tension and the beavier of steel and concrete both is elastic.

2:- Cracked Conncret (tension zone)- Elastic stage.

* with incese in load Concrete cracked in Compression. Concrete in Compression and steel in tension both behave in elestic manner.

3:- Cracked Concrete (tension Zone) - Inelastic (ultimate strength) stage.

* Concrete is cracked in Concrete in Compression and steel in tension both enters into inelastic range. At Collapse, steel

Compression crushes.

* **Basic Assumptions:-**

→ A plane section before bending remain plane after bending.

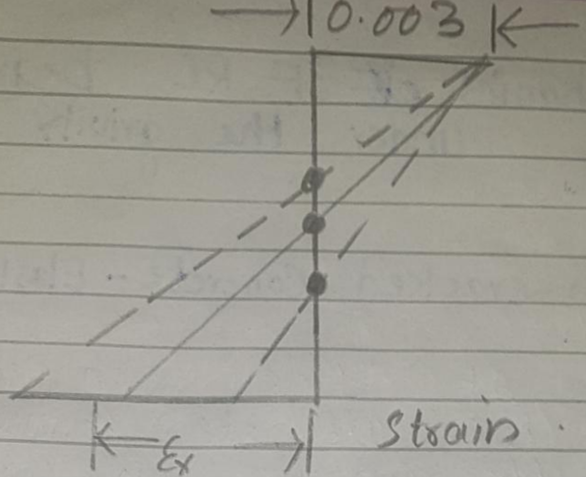
→ stress and strain are approximately proportional up to moderete load (concrete stress $\leq 0.5 f_c$) when the load is incressed the variation in the Concrete Stress in no longer Liner.

→ Tensile strength of Concrete is neglected in the desgn of reinforced Concrete beam.

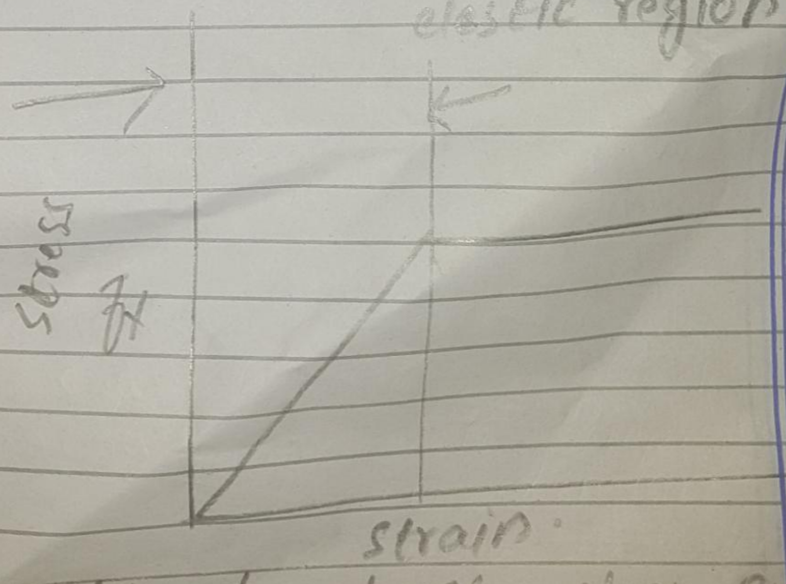
→ The bond b/w the Steel Concrete is perfect and no slip occurs.

→ strain in Concreto and reinforcement Shall be assumed proportional to the distance from neutral axis.

→ The maxium usable Concret Compressive strain extrem fiber is assumed to be 0.003.



→ The steel is assumed to be uniformly strained to the strain exists at the level of the centroid of the steel also of the strain in the steel ε_s is less than yeild strain of the steel ε_y the stress in the steel is $E_s \varepsilon_s$. If $\varepsilon_s \geq \varepsilon_y$ the stress in steel will be equal to f_y.



idealized stress - stran curve.