Day M T W T F S

Date ___/___/___

Name : Atif ali

ID # 7886

Subject : PRCD-I

Section : "B"

Semester : 6th

Submitted to : Engr Fawad khan

Q#01

Ans Given data:-

Beam live load (L.L) = 2.47 Kips/ft
Beam Dead load (D.L) = 1.05 Kips/ft
Span of beam = 18ft
Width of the Beam = 10"
depth of the beam = 20"
f_y = 60000 psi = 60 Ksi
f'_c = 4000 psi = 4 Ksi

Solution:-

Step#01

Calculate effective depth (d)

h − 3 = 20 − 3 = 17"

Step#02

Calculate effective cover (d')

Assume d' = 2.5

Step#03

Reinforcment ratio

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

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

$$\rho_{max} = 0.0180625$$

Step #04

Calculate area of steel

As we know that

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

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

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

$$A_{st} = 0.0180625 \times 10 \times 17$$

$$A_{st} = 3.070625\ in^2$$

Step #05

By formula of design moment

$$M_{u2} = \phi \times A_{st} \times f_y \times \left(d - \frac{a}{2}\right)$$

First we will find the value of (a)

$$a = \frac{A_{st} \times f_y}{0.85 \times f'_c \times b}$$

$$a = \frac{3.07 \times 60}{0.85 \times 4 \times 10} = 5.42''$$

$$M_{u2} = 0.90 \times 3.07 \times 60 \times \left(17 - \frac{5.42}{2}\right)$$

$$M_{u2} = 2368.99 \text{ Kips} - \text{inch}$$

Moment due to given load

$$\text{Beam Self Weight} = b \times t \times \gamma_c$$

$$= \frac{10}{12} \times \frac{20}{12} \times 150$$

$$= 208.33 \ lb/ft^3$$

Total Factored load

$$W_T = 1.2 \, D.L + 1.6 \, L.L$$

$$= 1.2(1050 + 208.33) + 1.6(2470)$$

$$= 5461.99 \ lb/ft$$

$$= 5.46 \ Kips/ft$$

Step#06

Ultimate factored moment

$$M_u = \frac{W \times L^2}{8} \times 12$$

$$= \frac{5.46 \times 18^2}{8} \times 12$$

$M_u = 2653.56$

As we have

$M_u > M_{u2}$

$2653.56 > 2368.99$

=> Design of a Section is Doubly Reinforcement

Step # 07

To find M_{u1}

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

$M_{u1} = 2653.56 - 2368.99$

$M_{u1} = 284.57$ Kip - inch

Step # 08

As we know that

$M_{u1} = \phi \times A_s' \times f_y \times (d - d')$

$$A_s' = \frac{M_u'}{\phi \times f_y \times (d - d')}$$

$$A_s' = \frac{284.57}{0.90 \times 60 \times (17 - 2.5)}$$

$A_s' = 0.36 \text{ in}^2$

This is the steel area in compression zone.

Total Steel area

$A_s = A_{st} + A_s' = 3.07 + 0.36$

$A_s = 3.43 \text{ in}^2$

Step # 09

Selection of bars

(A) For Tensile steel:-

Let try #08 bars having

Area $= 0.785 \text{ in}^2$

$$\text{Number of bars} = \frac{A_s}{A_b} = \frac{3.43}{0.785}$$

$$= 4.369 \approx 5 \text{ bars}$$

So 5 #08 bars in tensile

(B) For Compression steel:-

Let try #06 bars having

Area $= 0.44 \text{ in}^2$

Number of bars $= \frac{As'}{Ab} = \frac{0.36}{0.44}$

$= 0.81 \approx 1$ bars

So 1 #06 bar in Compression

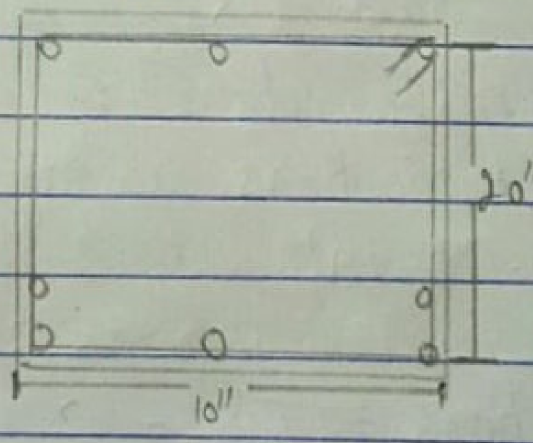
Step #09

check on Minimum width of beam:-

$b_{min} = 2(1.5) + 2(3/8) + 5(8/8) + 4(8/8)$

$= 12.75'' > 10''$

=> Not good in one layer



=> Effective depth $(d) = 20 - 1.5 - 3/8 - 8/8 - 1/2(8/8)$

=> Effective cover $(d') = 1.5 + 3/8 + 1/2(6/8)$

$d' = 2.25''$

Step # 10

Design moment

$Md = \phi \times [As' \times fy \times (d - d') + (Ast - As't) \times fy + (d - a/2)]$

As we know that

$a = \frac{(Ast - As't) \times fy}{0.85 \times fc' \times b}$

$a = \frac{(5 \times 0.785 - 1 \times 0.44) \times 60}{0.85 \times 4 \times 10} = 6.15$

$Md = 0.90 [(1 \times 0.44 \times 60 \times (16.62 - 2.25) + 5 \times 0.785 - 1 \times 0.44 \times 60 \times (16.62 - \frac{6.15}{2}]$

$Md = 2890.46$

- As $Md = 2890.46 > 2653.56$ K''
  So the design is OK

Q#02
(a)

Ans **Bond Stress:-**

The stress which is acting on the outer interface of steel to the surrounding concrete is called bond stress.

=> The resulting stress of bond is called bond stress.

=> This stress help in keeping bond between reinforcement and concrete togather.

=> Bond stress result any force that tries to pull out the rods from the concrete.

=> When you try to pull out the reinforcement bar from hardened concrete then bond stress resist the bar to come out.

Development length:-

The necessary length b/w the point of max stress in a bar and the end of a bar is called development length.

=> The length of bar required to transfer the force in the bar to surrounding Concrete through bond is called development length.

Reason for providing development length:

-> To develop a safe bond between the bar surface and Concrete so that no failure due to slippage of bar occure during the ultimate loading condition.

-> Also the extra length of the bar provided as development length is responsible for transfering the stresses development in any section of the adjoing section.

Q# 02

(b)

Ans We can used the doubly reinforced beam on that condition Whe the restriction occure in

the size of beam.
=> For example if someone said that the depth of beam is very much which can not resist a beam of singly reinforcement in that condition we used ~~bar~~ doubly reinforced beam.

Q#09 (C) Ans

T- Beam	Rectangular beam
-> In case of T-beam slab and beam are connected with one another and act as a one member.	-> In case of Rectangular Beam slab has been placed on the beam so there is no connection b/w slab and beam.
-> T-beam are mostely used and heavy duty and large space such is bridge.	-> Rectangular Beam are mostely use in commercial building.
-> T-beam are more economical Than R-Beam	-> Rectangular Beam are less economical Than T-Beam.

Q#02
(d)
Ans The design of Fluxural strength the strength reduction factor decrease from tension control section to compression. controlled section to increase safty with decreasing ductility this show to determine the reduction factor for flexural strength of reinforcement concrete.

Q#02
(e)
Ans **Designing method:-** Two Methods are worldly used for the designing of concrete and different structure member.

(1) ASD method
(2) USD Method

1) ASD Method:- ASD Method is also known as working stress

design method. It is based on the principle that stresses developed in the structural member should not exceed a certan limit.
-> In this method all load are taken as service load and no factor is applied to increase there service load.

2) USD Method:-

-> Ultimate strength design method is also called as load factor method.
-> For the structure subject to large external load the ultimate strength is determine by the inelastic analysis.
=> USD method is best for designing different structural method because of the following reason.
(i) As the ultimate strength of the material is considered we will get much stander section to other method.
=> USD method is more economical.

Q#03

Ans **Given data:**

c/c distance = 10'

Length = 32'

thickness of slab (hf) = 6"

Beam web width (b_w) = 14"

Total depth (h) = 28"

Effective depth = 28" − 3" = 25"

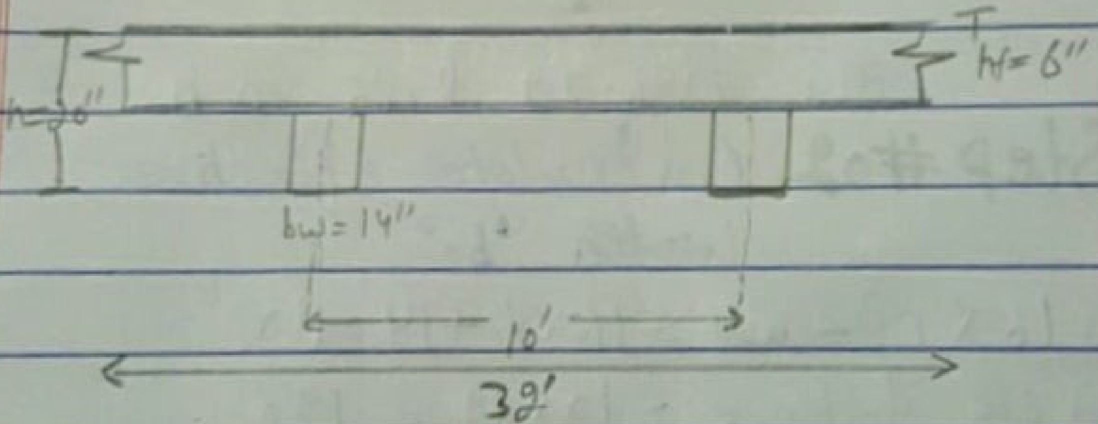
Dead load = 50 lb/ft²

live load (L.L) = 225 lb/ft²

f_y = 60000 psi = 60 ksi

f_c' = 4000 psi = 4 ksi

Solution:-



Step #01 Ultimate factored moment

$$M_u = \frac{W_u \times l^2}{8}$$

W_u = Total factored load

Find self weight per feet:-

$$W_t = b \times t \times \gamma_c$$

$$= \frac{14}{12} \times \frac{28}{12} \times 150$$

$$= 408.33 \text{ lb/ft}$$

Find total factored load

$$W_u = 1.2\, D.L + 1.6\, D.L$$

$$W_u = 1.2(50 + 408.33) + 1.6(225)$$

$$W_u = 909.96 \text{ lb/ft}$$

$$W_u = 0.909 \text{ Kips/ft}$$

Now moment:-

$$M_u = \frac{W_u \times l^2}{8}$$

$$= \frac{0.909 \times (32)^2 \times 12}{8}$$

$$M_u = 1396.22 \text{ Kips-inch}$$

Step #02 Calculate effective width "be"

(1) $16 \times h_f + b_w = 16 \times 6 + 14 = 110''$

(2) c/c distence $= 10 \times 12 = 120''$

(3) Span/4 $= 32/4 \times 12 = 96''$

So, $\boxed{b_e = 96''}$

Step #03 Check Whether Rectangular or T. beam

Trail #01. Let, $a = hf = 6$

$$A_{st} = \frac{Mu}{\phi \times fy + (d - a/2)} = \frac{1396.23}{0.90 \times 60 \times (25 - 6/2)}$$

$$A_{st} = 1.175 \, in^2$$

Trail #02.

$$a = \frac{As \times fy}{0.85 \times fc' \times be}$$

$$a = \frac{1.175 \times 60}{0.85 \times 4 \times 96}$$

$$a = 0.21'' < 6''$$

=> So Rectangular Beam Design

$$As = \frac{1396.23}{0.90 \times 60 \times (25 - 0.21/2)} \Rightarrow \boxed{As = 1.03 \, in^2}$$

Trail #03

$$a = \frac{As \times fy}{0.85 \times 4 \times 96} = 0.18''$$

$$A_{st} = \frac{1396.23}{0.90 \times 60 \left(25 - \frac{0.18}{2}\right)}$$

$$\boxed{A_{st} = 1.03 \, in^2}$$

Step #04 check ρ_{max} and ρ_{min}:-

$$\rho_{max} = 0.85 \times \beta \times \frac{fc'}{fy} \times \left(\frac{\varepsilon u}{\varepsilon u + \varepsilon t}\right)$$

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

$$\rho_{max} = 0.018$$

$$\Rightarrow \rho_{min} = \frac{200}{fy} = \frac{200}{60000} = 0.003$$

$$\Rightarrow \rho = \frac{A_{st}}{b \times d} = \frac{1.03}{14 \times 25}$$

$\Rightarrow \rho = 0.00294$

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

$0.003 > 0.00294 < 0.018$

As we know that

ρ is less than ρ_{min}

So,

$\rho = \frac{A_{st}}{b \times d} \Rightarrow A_{st} = \rho \times b \times d$

$A_{st} = 0.003 \times 14 \times 25 = 1.05 \ in^2$

Step # 05, Selection and No of bars..

Let try #08 Main bar having area of one # 10 bar $= 1.27 \ in^2$

$\Rightarrow$ No. of Bars $= \frac{A_{st}}{A_b} = \frac{1.05}{0.785}$

$= 1.3 \approx 2$

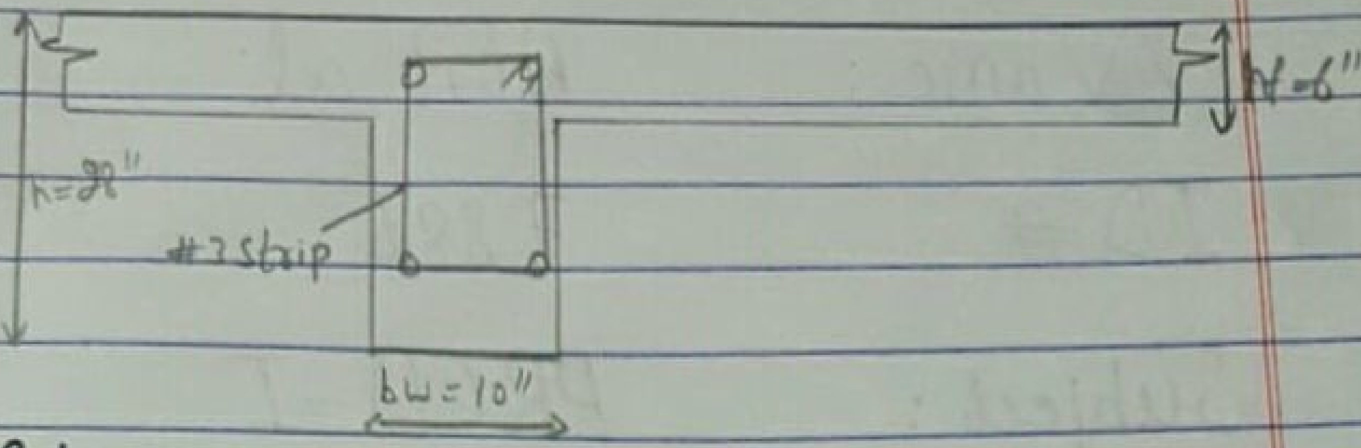
So, take 2 #08 Main bars.

Step # 06, Check on Minimum Width

$b_{min} = 2 \times 1.5 + 2 \times (3/8) + 2(8/8) + 1(8/8)$

$b_{min} = 6.75'' < 14''$

$\Rightarrow$ So good in one layer



Step #07

Design moment

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

But first find "A_{st}" & "a"

A_{st} = Area of one bar × No of bars

$$A_{st} = 0.785 \times 2 = 1.57 \text{ in}^2$$

$$a = \frac{A_{st} \times f_y}{0.85 \times f'_c \times b_e} = \frac{1.57 \times 60}{0.85 \times 4 \times 96}$$

$$\boxed{a = 0.2''}$$