Pg# 1

7845

NAME :— SALMAN RASHID

ID :— 7845

SUBMITTED To :— Engr. Fawad Khan

SUBJECT :— PRC Design-1

SECTION :— "B"

MODULE :— "6th"

DaTa :— 21-04-2020

QNo 1: A ractangular beam....

.... Draw Sketch of your final design.

Given data:

Live load = 1.05 kip/ft

Dead load = 2.47 kip/ft

F_y = 60000 Psi

f'_c = 4000 Psi

d = h−3 = 20−3 = 17″

d′ = 2.5″

$h = 20''$, $w = 10''$

Sol:-

we should solve such Problems Step wise.

Step#1:

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

Put values we get

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

by calculating

$$\boxed{\rho_{max} = 0.0181}$$

Step #2:

Now find "Area of the steel."

So

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

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

Put value

$$= 0.0181 \times 10 \times 17$$

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$A_{st} = 3.077 \text{ in}^2$

Step # 3 :

~~Desgin~~ "Desgin factored moment"

than:

$\Rightarrow M_{V2} = \phi \times A_{st} \times f_y \times \left(d - \frac{a}{2}\right)$

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

by Putting values we get

$a = \frac{3.08 \times 60}{0.85 \times 4 \times 10}$

$a = 5.4''$

$\Rightarrow M_{V2} = 0.90 \times 3.08 \times 60 \times \left(17 - \frac{5.4}{2}\right)$

$\Rightarrow M_{V2} = 2378.38 \text{ K}$

Now To find moment from given load:-

Beam self wt = $b \times t \times \gamma_c$

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

Beam Self wt = 208.33 lb

Total factored load:

$\Rightarrow 1.2 D L + 1.6 L.L$

$\Rightarrow 1.2(1050 + 208.33) + 1.6(2470)$

$\Rightarrow 5461.996$ lb/ft

$\Rightarrow$ Ultimate factored moment $= \frac{wL^2}{8}$

Sol

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

$$= \boxed{2653.56 \text{ K}''}$$

Thus

$$2378.38 < 2653.56$$

$\Rightarrow$ It would be doubly designed beam.

Step # 4 :

We know that

$$M_{u_1} = M_u - M_{u_2}$$

Put the values

$$2653.26 - 2378.38$$

$$\boxed{M_{u_1} = 275.18 \text{ K}''}$$

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Step #5 :

Now

$$M_{u_1} = \phi \times A_s' \times f_y \times (d - d')$$

$$\Rightarrow A_s' = \frac{M_{u_1}}{\phi \times f_y \times (d - d')}$$

by Putting value we get

$$\frac{275.18}{0.90 \times 60 (17 - 2.5)}$$

$\therefore M_{u_1} = 275.18$

$$\boxed{A_s' = 0.35 \text{ in}^2}$$

Step # 06 :

Now we find

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

Putting values

$$3.08 + 0.35$$

$\therefore A_{st} = 3.08$

$\therefore A_s = 0.35$

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

So the line is with tenshion ~~steel~~ zone of steel

Step # 07 :

Now we find the ~~sot of~~ "Selection of bars".

i => For tensil steel we take No. 8 having area (0.7850)

Sol

=>

$$\text{No. of bars} = \frac{A_s}{A_b} = \frac{3.43}{0.785} \Rightarrow \boxed{4.36 \approx 5 \text{ bars}}$$

ii) For compression steel:

take ~~No.~~ 6 area of $0.442 \, in^2$

$$\Rightarrow \text{No of bars} = \frac{A_s'}{A_b}$$

$$= \frac{0.35}{0.442} = \boxed{0.79 \approx 1}$$

Step # 08 :

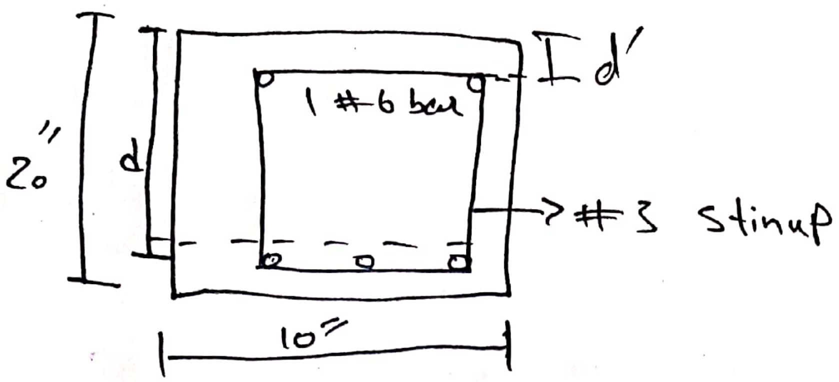
Now we find ("Beam Minimum width")

Sol

$$\Rightarrow b_{min} = (2 \times 1.5) + 2(3/8) + \left(5 \times \frac{8}{8}\right) + (4 \times 8/8)$$

by calculation :

$$\boxed{b_{min} = 12.75'' > 10''}$$



Now :

$\Rightarrow d = 20 - 1.5 - 3/8 - 8/8 - \frac{1}{2}(8/8)$

$d = 16.624"$

Step #09 :

Now we find "Designed Moment"

Sol

$\Rightarrow M_d = \phi \times \left[A_s' \times f_y \times (d - d') + (A_s - A_s') \times f_y \times (d - a/2) \right]$

$\Rightarrow a = \dfrac{(A_s - A_s') \times f_y}{0.85 f_c' \times b}$

Put value

$a = \dfrac{(5 \times 0.784 - 1 \times 0.44) \times 60}{0.85 \times 4 \times 10}$

$a = 6.16"$

Now Put in (Md) formula:

$$\Rightarrow 0.90 = \left[1 \times 0.42 \times 60 \times (16.623 .226) + (5 \times 0.785 - 1 \times 0.44) \times 60 \times \left(16.625 - \frac{6.15}{2}\right)\right.$$

using calculation

$$\boxed{Md = 2891.5443}$$

$$\Rightarrow Md = 2891.5443 > 2653.56 k'$$

Design is ok!

QNo:02

(ii) **Bond Stress** ⇒ The Stress Which is acting on the Outer interface of Steel to the Surrounding Concrete is Called bond Stress. This help in Keeping bond b/w reinforcement & Concrete together.

⇒ **Development length:** A development length can be defined as that "The amount of reinforcement (bar) length needed to be embaded or Project into the Column to establish the desire bond Strength b/w the Concrete & Steel.

B: Condition doubly reinforced beam:

⇒ When the Cross Section of the beam is fixed.

⇒ When movement to be Carried by the beam is more then the blanced moment.

⇒ In Case of a Continous beam.

⇒ The portion of the beam over middle Support in Contineous T-beam has to be designed as doubly reinforced Section.

→ When dimension of the beam are restricted for architectural or structural purpose.

ii) C: **T. Beam:**.

→ T. beam is more economical then rectangular beam

→ In case of T. beam Slap and beam are connected with one another and act as a one member.

→ it consist of T-shaped structure

→ Analysis is required when

$d > hf$

d = depth

hf = Slab thickness

⇒ **Reectangular beam** → Rectangular beam is less economically Then T. beam

→ In Case of rectangular beam Slab hasbeen placed on the beam and there is no connection b/w Slab & beam.

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⇒ It is most ~~Economically~~ commonly used in office / Commercial buildings.

⇒ Analysis is required when:

$$a \leq h_D$$

When

$a =$ depth

$h_f =$ heign of flange

D **effective of Strength Induction factor on flexural derived Strength:**

⇒ The flexusal Strength of reinforced concrete beam Strengthed with a carbon fiber reinforced players plates which fails by intermidiate cracks depending is avalated.

⇒ The effect is due to higher depending resistance in the first Case where the Comparision of the Strength Reduction factor with Experimental data & factor Proposed for that

P.T.O

Design Methods:

→ It is a procedurs techniques aids, or tool for desigining.
The after a member of different kinds of effivities that a designier migth use with an overall design process
→ three methods of Structral design.

QNO: 3
PROBLEM:

Given data

C/c distance = 10'
Span = 32'
Slab thickness = 6"
web width (w) = 14"
Total depth (h) = 28"

Effective depth = (h-3) = 28-3 = 25"

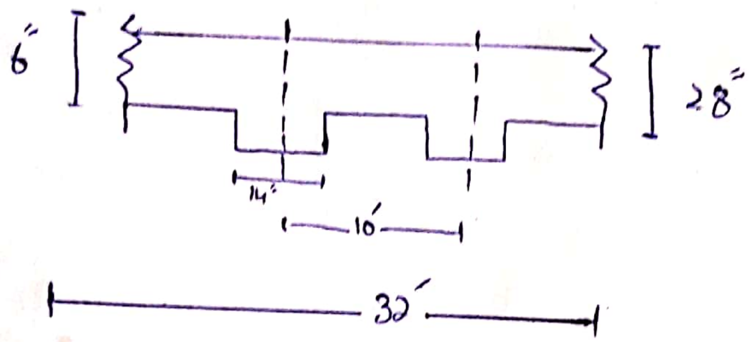
D.L = 50 lb/ft²

S.S = 225 lb/ft²

f_y = 60,000 Psi

f'_c = 4000 Psi

Solution :



Step # 01 :

We know that

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

i) Beam Self weight Per feet :

⇒ $w_t = b \times t \times \gamma_c$

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

⇒ $w_t = 408.34$ lb/ft

=> **Total Factored load :**

We know that

$\Rightarrow 1.2\,(50 + 408.34) + 1.6\,(225)$

$\Rightarrow 909.90 \text{ lb/ft}$

$\Rightarrow \boxed{0.909 \text{ kip/ft}}$

Step # 02 :

Moment

So

$\Rightarrow \dfrac{wl^2}{8}$

$\Rightarrow \dfrac{0.909 \times (32)^2}{8} \times 12$

$= \boxed{1396.23 \text{ kip/in}}$

=> **Effective Breath :**

i) $16(h_f) + b_w = 16(6) + 14 = \boxed{110''}$

ii) c/c distance $= 10(12) = \boxed{120''}$

iii) Span/4 $= 32/4 \times 12 = \boxed{96''}$

So

$\boxed{b_e = 96''}$

Step # 03 :

Ractangular or T- Beam :

We take trails

Trail # 1

Let

$\Rightarrow a = h_f = 6''$

Now

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

Put values

$$= \frac{1396.23}{0.90 \times 60 (25 - 6/2)}$$

$$\boxed{A_{st} = 1.17 \ in^2}$$

$\Rightarrow$ Takes **Trail # 2** :

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

Put value

$$= \frac{1.17 \times 60}{0.85 \times 4 \times 96} = \boxed{0.2'' < 6''}$$

So Rectangular Beam Design:

$$\Rightarrow A_{st} = \frac{1396.23}{0.90 \times 60 \times (25 - \frac{0.2}{2})}$$

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

Takes Trial # 3 :

$$a = \frac{1.03 \times 60}{0.85 \times 4 \times 96} \Rightarrow \boxed{0.18''}$$

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

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

Step # 04 :

⇒ check ρ_{max} & ρ_{mini}

⇒ First of all for (ρ_{max})

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

$$\boxed{\rho_{max} = 0.018}$$

For ρ_{mini} :

$$\rho_{mini} = \frac{200}{fy}$$

$$\Rightarrow \rho_{mini} = \frac{200}{60.000} \Rightarrow \boxed{0.003}$$

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

$$\boxed{\rho = 0.0029}$$

$$\Rightarrow \rho_{mini} < \rho < \rho_{max}$$

$$0.003 < 0.002 < 0.018$$

As we know that

$\Rightarrow \rho$ is less than ρ_{min}

So

$$\rho = \frac{Ast}{b \times d} \Rightarrow Ast = \rho_{min} \times b \times d$$

$$\Rightarrow Ast = 0.003 \times 14 \times 25$$

$$\boxed{Ast = 1.05 \text{ in}^2}$$

Step # 5

Now we takes # & 4 "Selection of bars"

Let we take "#8"

dia = (8/8) = 1"

Area = 0.785 m^2.

Now

$\# \text{ of bars} = \frac{1.05}{0.785}$

= 1.3 ≈ 2

Then we use 2 #8 bars

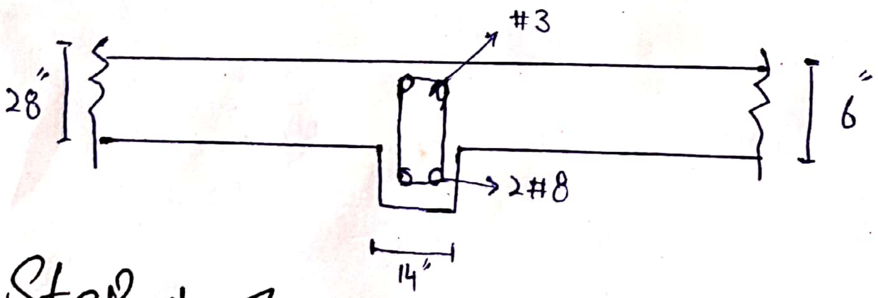
Step #06 :

Now we find "minimum width"

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

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

Than good in one layer



Step #07 :

Design Moment

So

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

To find Area of steel

Area of steel = Area of 1 bar × No. of bars

Put the values

$\Rightarrow 0.785 \times 2 = 1.57\ in^2$

Area of steel = 1.57 in²

Now

$$a = \frac{1.57 \times 60}{0.85 \times 4 \times 96}$$

$a = 0.2''$

Than

$\Rightarrow Md = 0.90 \times 60 \times 1.57 \times (25 - (0.2/2))$

Md = 2111.02 kip-in

As

2111.02 > 1396.23

So

Design is okay!

THE END