P # 1

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Qno # 1

Given data !

$w = 10''$

$h = 20''$

$D.L = 1.05 \, k/ft$

$LL = 2.47 \, k/ft$

$f_y = 60000 \, psi$

$f'_c = 4000 \, psi$

$d = h - 3 \Rightarrow 20 - 3 = 17''$

$d' = 2.5''$

Solution :

First of all we solve the first step !

So.

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Step # 1

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

Put value:

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

by calculator:

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

Step # 02

Now we find "Area of steel".

So

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

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

Put value:

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

$$\Rightarrow \boxed{Ast = 3.077 \ in^2}$$

Step # 03:

Now we solve the "Design Factored Moment" than!

$$\Rightarrow Mu_2 = \phi \times Ast \times fy \times \left(d - \frac{a}{2}\right)$$

$$\Rightarrow a = \frac{Ast \times fy}{0.85 f'c \cdot b}$$

Put value:

$$a = \frac{3.08 \times 60}{0.85 \times 4 \times 10} = \boxed{5.4''}$$

$$\Rightarrow Mu_2 = 0.90 \times 3.08 \times 60 \times \left(17 - \frac{5.4}{2}\right)$$

$$\Rightarrow \boxed{Mu_2 = 2378.38 \ k''}$$

NOW!

we find the moment of the given load:

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

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

~~Beam self wt~~ $\Rightarrow$ 208.33 lb

$\Rightarrow$ ~~Total Factored load~~ !

$\Rightarrow 1.2DL + 1.6L.L$

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

$\Rightarrow 5461.996$ lb/ft

Total factored load $= 5.46$ k/ft

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

So!

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

$$= \boxed{2653.56 \ k''}$$

Thus!

$$2378.38 < 2653.56$$

$\Rightarrow$ it should be doubly designed Beam.

Step # 04:

We know that !

$$\Rightarrow \quad M_{U1} = M_U - M_{U2}$$

Put the value:

$M_U = 2653.56$
$M_{U2} = 2373.38$

$$= 2653.56 - 2378.38$$

$$\boxed{M_{U1} = 275.18\ k''}$$

Step # 05

Now !

$$M_{U1} = \phi \times A_s' \times f_y \times (d - d') .$$

$$\Rightarrow \quad A_s' = \frac{M_{U1}}{\phi \times f_y \times (d - d')}$$

Put the value:

$M_{U1} = 275.18$

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

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

Step # 6

Now We Find :

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

Put value.

$A_{st} = 3.08$
$A_s' = 0.35$

$$= 3.08 + 0.35$$

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

Thus The line is in th Tension zone of steel.

Step # 07.

Now we find the 'selection of Bars'.

i ⇒ For tensile steel: we take # 8 having area (0.785 in)

So!

$$\Rightarrow \# \text{ of bars} = \frac{A_s}{A_b} = \frac{3.43}{0.785} \Rightarrow \boxed{4.36 \approx 5 \text{ bar}}$$

ii) ⇒ For compression steel:

take # 6 area of $0.442 in^2$.

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

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

Step # 08

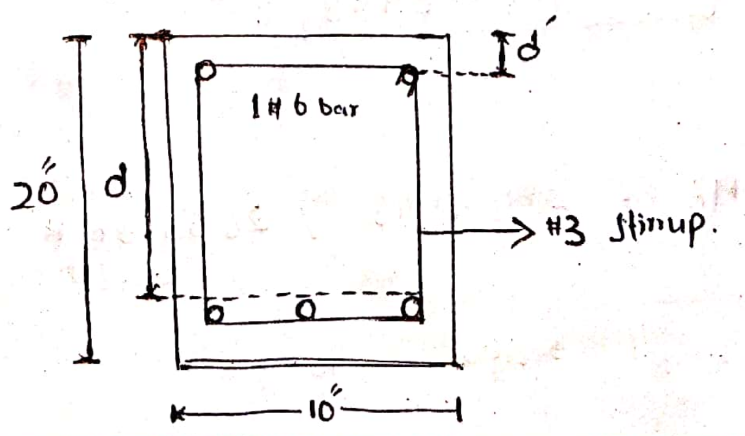
Now we find "Beam Minimum width").

So!

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

by calculator:

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



Now:

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

$$\boxed{d = 16.624''}$$

$$\Rightarrow \quad d' = 1.5 + 3/8 + \tfrac{1}{2}(6/8)$$

$$\boxed{d' = 2.26''}$$

Step # 09:

Now we find " Designed Moment ".

So!

$$\Rightarrow \quad M_d = \phi \times \left[A_s' \times f_y \times (d - d') + (A_s - A_s') \times f_y \times \left(d - \frac{a}{2}\right)\right].$$

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

Put value!

$$\Rightarrow \quad a = \frac{(5 \times 0.784 - 1 \times 0.44) \times 60}{0.85 \times 4 \times 10} = \boxed{6.16''}$$

No Put in (M_d) Formula.

$$\Rightarrow \quad 0.90 = \left[1 \times 0.42 \times 60 \times (16.623 - 2.26) + (5 \times 0.785 - 1 \times 0.44) \times 60 \times \left(16.625 - \frac{6.15}{2}\right)\right.$$

using calculator!

$$\boxed{M_d = 2891.5443}$$

$$\Rightarrow \quad M_d = 2891.5443 > 2653.56 \text{ k}''.$$

Designed is ok!

Q NO # 23

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"

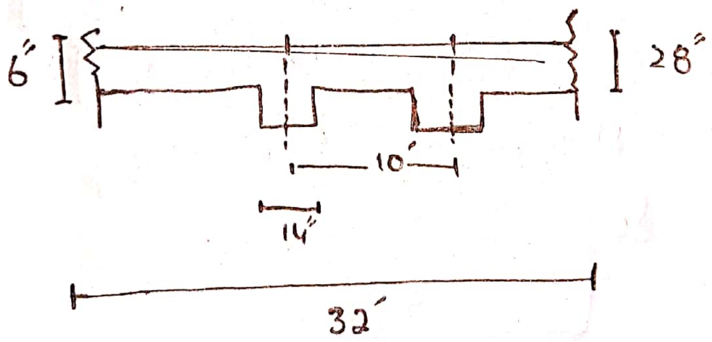
D.L = 50 lb/ft²

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 Wt Per Feet:

$\Rightarrow$ Wt = $b \times t \times \gamma_c$

$\frac{14}{12} \times \frac{28}{12} \times 150$ $\Rightarrow$ Wt = 408.34 lb/ft

⇒ **Total Factored load :**

We know that !

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

$$\Rightarrow 909.90\ lb/ft$$

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

Step # 02

Moment :

So

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

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

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

⇒ **Effective Breadth :**

i: $16(hf) + bw = 16(6) + 14 = \boxed{110''}$

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

iii: $span/4 = 32/4 \times 12 = \boxed{96''}$

So !

$$\boxed{be = 96''}$$

Step # 03

Rectangular or T- Beam :

We take Trail #.

Trial # 1 :

Let :

$$\Rightarrow a = hf = 6''$$

Now:

$$Ast = \frac{Mu}{\phi \times fy \times (d - a/2)}$$

Put value:

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

$$\boxed{Ast = 1.17 \ in^2}$$

⇒ Takes Trial # 2:

$$a = \frac{Ast \times fy}{0.85 \times f'c \times b}$$

Put value

$$= \frac{1.17 \times 60}{0.85 \times 4 \times 96}$$

$$= \boxed{0.2'' < 6''}$$

So Rectangular Beam Design:

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

$$\boxed{Ast = 1.03 \ in^2}$$

Takes Trial # 3:

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

$$Ast = \frac{1396.23}{0.90 \times 60 (25 - 0.18/2)} \Rightarrow \boxed{1.03 \ in^2}$$

Step # 04

⇒ check ρ_{max} & ρ_{mini}

⇒ First of all for (ρ_{max}):

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

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

⇒ <u>For ρ_{mini}</u>:

⇒ $\rho_{mini} = \frac{200}{fy}$

⇒ $\rho_{min} = \frac{200}{60,000}$ ⇒ $\boxed{0.003}$.

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

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

⇒ $\rho_{min} < \rho < \rho_{max}$.

$0.003 < 0.002 < 0.018$.

As we know that:

⇒ ρ is less than ρ_{min}

So:

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

~~Ast = 0.003 x~~ ⇒ $Ast = 0.003 \times 14 \times 25$

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

Step # 05

Now we Takes # of "Selection of bars".

Let :

we Take "# 8"

dia $= \left(\frac{8}{8}\right) = 1''$

Area $= 0.785\ in^2$

Now

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

$$= \boxed{1.3 \approx 2}$$

Than we use 2 # 8 bars.

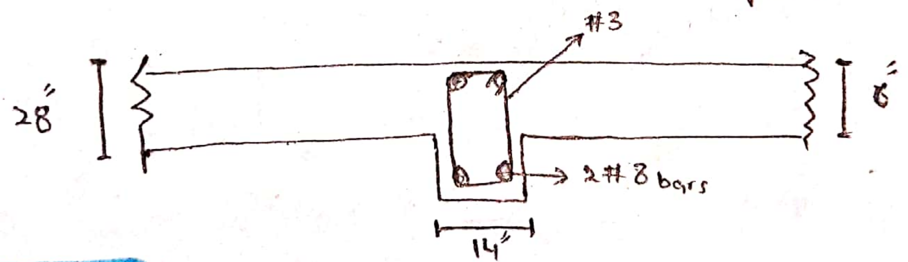
Step # 06

Now we find "minimum width".

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

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

Than good in one layer.



Step # 07

Design Moment :

So

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

First we Find Area of steel.

$\Rightarrow$ 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 in^2

NOW :

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

using calculator !

$a = 0.2''$

Than :

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

M_d = 2111.02 kip-in

As :

2111.02 > 1396.23

So :

Design is ok !

XXX XXX XXX

P.T.O

QNO 2

ii. a: **Bond stress:**

⇒ The stress which is acting on The outer interface of steel to the surrounding concrete is called bond stress. This stress helps 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 embedded or Project into the column to establish the desired bond strength b/w the concrete & steel.

ii): B: **Condition doubly reinforced beam:**

→ When the cross Section of the beam is fixed.

→ When moment to be carried by the beam is more than the balanced moment.

→ In case of a continous beam.

→ The Portion of the beam over middle support in continous T-beam has to be designed as doubly rainforced section.

- when dimension of the beam are restricted for architectural or structural purpose.

III: C:

T. Beam:

- T-Beam is more economical then rectangular beam.
- In case of T-Beam slab & beam are connected with one another & act as a one member
- It consist of T-shaped structure.
- Anaylsis is requried when.

  $a > h_f$

  a = depth

  h_f = slab thickness.

⇒ Rectangular Beam:

- Rectangular beam is less economically then T-Beam.
- In case of rectangular beam slab has been placed on the beam & there is no connection b/w slab & beam.

→ It is most commenly used in office/ commercial buildings.

→ Analysis is requried when:

$$a \leq h_D$$

where

a = depth

h_f = heign of flange

D : Effective of strength induction Factor on flural flerusal strength:

→ The flerusal strenght of reinforced concrete (Rc) beams strengthened with a carbon fiber reinforced polymer plate which fails by intermediate cracks depending is avalated.

→ The effect is due to higher depending resistance in the first case where the comparision of the strenght Reduction factor with experimental Data & Factor Proposed for That.

P.T.O

e : **Design Methods:**

→ It is a Procedurs techniques aids, or tool for designing. They offer a number of different kinds of efficivities that a designer might use with in an overall design Process.

→ three methods of structral design.

i. working Stress.