Name # Yahya Hakeem

ID # 7804

Subject # PRCD

Section # A

instructor # Engr. fawad Khan

(1) Ans

Given data :-

Height = 20"

Dead load D.L = 1.05 kips/ft

width (b) = 10"

Span = 18'

live load = L.L. 2.47 kips/ft

f'_c = 4000 psi = 4ksi

f_y = 60,000 psi = 60 ksi

Solution :-

As we know that

Step # 1

Effective depth d = h-3

= 20-3 = 17"

Effective cover d = 2.5"

Reinforcement Ratio.

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

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

$$\boxed{\rho_{max} = 0.0180}$$

Step # 2

finding Area of Steel

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

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

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

$$Ast = 0.0180 \times 10 \times 17$$

$$Ast = 3.06\ in^2$$

Step # 3

By formula of design moment

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

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

$$a = \frac{3.06 \times 60}{0.85 \times 4 \times 10}$$

$$a = 5.4''$$

$$Mu_2 = 0.90 \times 3.06 \times 60 \times (17 - 5.4/2)$$

$$Mu_2 = 2362.93\ kipinch$$

Scanned with CamScanner

Moment due to loads

Beam self weight $= \frac{10}{12} \times \frac{20}{12} \times 150$

" $= 208.33$ Lb/ft

Total factor load $= 1.2(1050 + 208.33) + 1.6(2470)$

$= 5461.99$ lb/ft

$= 5.46$ kips/ft

ultimate factored moment $= \frac{WL^2}{8}$

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

$Mu = 2653.56$

Now as

$Mu_2 < Mu$

$2362.92 < 2653.56$

Doubly Reinforcement Required.

Step #4

$Mu_1 = Mu - Mu_2$

$Mu_1 = 2653.56 - 2362.92$

$Mu_1 = 290.64$ kip/inch

Step # 5

Steel area in compression zone will be

$$M_{U1} = \phi \times A'_{st} \times F_y \times (d-d')$$

$$A_{st}' = \frac{M_{U1}}{\phi' \times F_y \times (d-d')}$$

$$A_{st}' = \frac{290.64}{0.90 \times 60 \times (17-2.5)}$$

$$\boxed{A_{st}' = 0.37 \text{ in}^2}$$

Step # 6

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

$$A = 3.06 + 0.37$$

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

Step # 7

we use #8 bar

dia = 8/8 = 1"

$$\text{Area} = \frac{\pi}{4} d^2$$

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

Scanned with CamScanner

No. of bars $= \frac{A_{st}}{\text{Area of 1 bar}}$

$= \frac{3.43}{0.785}$

No. of bars $= 4.36 \cong 5$ bars

So 5 # 8 bar

for Tensile zone

compression steel

use # 6 bars

dia (6/8) = 0.75"

Area = ~~0.44ft~~ $0.44 in^2$

No. of bars $= \frac{A_{st}}{\text{Area of 1 bar}}$

$\frac{0.37}{0.44} = 0.84$

$0.84 \cong 1$ bars

So 1 # 6 bars in compression zone

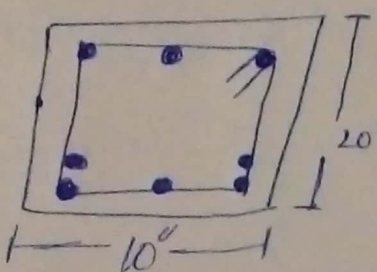
Step # 8

Beam minimum width

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

$= 12.75 > 10''$

in multiple layer.



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

$d = 16.62''$

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

$= 2.25''$

Step # 9

Design moment is given by

$M_d = \phi \times [Ast' \times fy \times (d - d') + Ast - Ast' \times fy \times (d - a/2)]$

~~Md~~ $a = \frac{Ast - Ast' \times fy}{0.85 \times fc' \times b}$

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

$a = 6.15''$

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

$$Md = 2890.46$$

$$Md = 2890.46 > 2653.56$$

Design is ok

Question 2

Ans..

(a) Bond stress:-

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

The stress help in keeping bond b/w reinforcement and concrete together. Bond stress resists any force that tries to pull out the rods from the concrete.

Development length.

Development length can be define as.

The length of the bar required for transfering the stress into the concrete.

In other word Development length is the quantity of the rebar length that as actually required to be enclosed into the concrete to make the desired bond strength b/w two materials and farthermore to produced required stress in the steel at that area.

Why are providing development length

we providing development length because of

• To develop a safe bond between the bar surface and concrete so that no failure due to slippage of bar occurs during the ultimate loading condition

(b) Doubly Reinforced Beams:

Beam reinforced with steel in compression zone and tension zone are called Doubly Reinforced Beam

condition when Doubly Reinforced Beam used

We can used the doubly Reinforced Beam on that condition when the restriction occure in the size beam

for example:

If some one said that the depth of the beam should not be grater than 12" and the external load on beam is very much which can not resist a beam of singly Reinforcement is that condition we used doubly Reinforced Beam

(c)

T Beam	Rectangular Beam
(1) T beam having beam and slap composite section	(1) A rectangular Beam is one which as generally used as compression in top fibre and Tension in bottom fibre of that beam
(2) A T-beam is more economical then Rectangular Beam	(2) Rectangular Beam is less economical than T Beam
(3) T-beam are more often used for more heavy duty or larger space such as	(3) Rectangular beam are more after used in off-ice or commerical buildins. These can be cost in sities

T - beam	Rectangular beam
bridges These are almost always present using Prestress reinforcement	insites using Standard reinforcement.

(d) Effect of Strength Reduction factor on flexural strength:-

in the design of flexural 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.

(e) Design method.

Two methods are wordly used and different for the desiging of concrete 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 certain limit friction of elastic limit.

(*) in this method all load are taken as service load and no factor is applied to increase these serives load.

USD method:-

ultimate strength design method is also known as load factor method for the structural subjected to large external load the ultimate strength is determine by the welestic analysis.

(*) USD method is best for designing different structure method because of the following Reason

(1) As the ultimate strength of the material is considered we will get much standard section for column and beam compare a other method

Question #3

Ans.

Given data:-

Slap thickness = 6"

Total depth (h) = 28"

web width = 14"

Effective depth = 28"-3 = 25"

Span = 32'

c/c distance = 10'

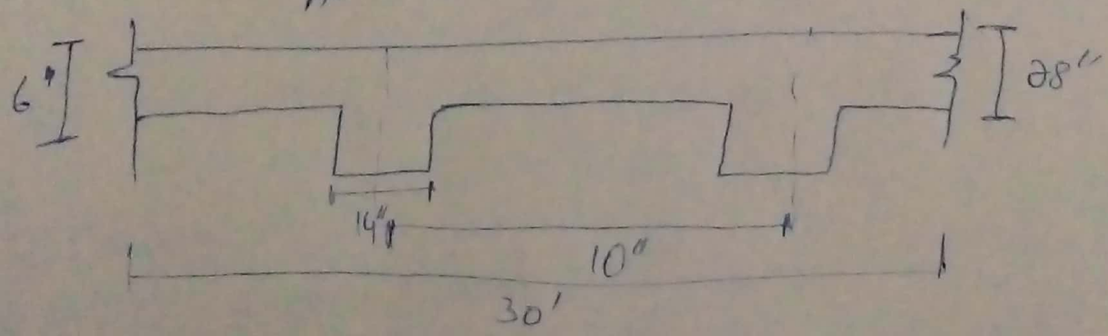
D.L = 50 lb/ft^2.

S.S = 225 lb/ft^2

fy = 60,000 psi

f'c = 4000 psi

Solution:- As we know that



Step #1

$$MU = \frac{wu \times l^2}{8}$$

(i) Beam self weight per feet

wt = b × t × γ_c

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

$w_t = 408.33\ lb/ft$

Total factored load:-

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

$= 909.99\ lb/ft$

$= 0.909\ kip/ft$

Moment:-

$$\frac{wL^2}{8}$$

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

$= 1396.23\ kip/inch$

Effective Breadth

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

(2) c/c distance $= 10(12) = 120''$

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

Step # 3

Rectangular or T-Beam

Trail # 1. let $a - h_f = 6''$

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

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

$Ast = 1.17 in^2$

Trial # 2

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

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

$$= 0.2'' < 6''$$

So Rectangular Beam design.

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

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

Step # 3

$$a = \frac{1.03 \times 60}{0.85 \times 4 \times 96}$$

$$a = 0.18''$$

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

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

Step # 4 Check ρ_{max} and ρ_{min}

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

$$\rho_{max} = 0.018$$

$$\rho_{min} = \frac{200}{Fy}$$

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

$$\rho = \frac{Ast}{b \times d} = \frac{1.03}{14 \times 25} = 0.0029$$

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

$$0.003 < 0.002 < 0.018$$

As ρ is less than ρ_{min}

So

$$\rho = \frac{Ast}{b \times d}$$

$$Ast = \rho_{min} \times b \times d.$$

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

$$Ast = 1.05 \, in^2$$

Step #5

No and selection of Bar

let use #8 then

dia $(8/8) = 1''$

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

No. of bar $= \frac{1.05}{0.785} = 1.3 \cong 2$

So we use 2 # 8 bars.

Step #6

Minimum width.

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

$= 6.75'' < 14''$

So good is one layer

Step # 7 Design moment

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

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

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

$a = \frac{1.57 \times 60}{0.85 \times 4 \times 96} = 0.2''$

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

$= 2111.02$ kip-ins.

As $2111.02 > 1396.23$ Design is OK!