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ID #

7876

Section: "A"

Semester:

"6th"

Subject:

PRCD-I

Mid Exams

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Q No 1

Data ;

Dead load = 1.05 Kips/ft

live load = 2.47 Kips/ft

span = 18'

f'_c = 4000 psi

f'_y = 60,000 psi

Kilo = 1000

f'_c = 4 ksi

f'_y = 60 ksi

Width = 10"

Height = 20"

Solve :

Step – 1

=> Effective depth = h – 3

d = 20 – 3

d = 17"

=> Effective Cover

d' = 2.5"

⇒ Reinforcement Ratio

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

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

$\rho_{(max)} = 0.7225(4/60)\left(\frac{0.003}{0.008}\right)$

$\rho_{(max)} = 0.018$

⇒ Step – 2

Area of steel required 70)

Formula
as we know that

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

cross mulipicatio

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

$A_{st} = 0.018(10 \times 17)$

$A_{st} = 3.06\ in^2$

Step – 3

As by the design Moment

$M_{u_2} = \phi \times A_{st}(f_y)(d - a/2)$

$$a = \frac{A_{st} \times f_y}{0.85(f'c)(b)}$$

$$= \frac{3.06 \times 60}{0.85 \times 4 \times 10} = 5.4''$$

$a = 5.4''$

$$M_{u_2} = 0.90(3.06)(60)(17 - 5.4/2)$$

$$M_{u_2} = 2362.9 \text{ Kip-inch}$$

Moment due to given Load

$$\text{Beam weight} = \frac{10}{12}\left(\frac{20}{12}\right)(150)$$

$$= 208.33 \text{ lb/ft}$$

Total Factor Load

$$\text{Total factor load} = 1.2(1050 + 208.33) + (1.6(2470))$$

$$= 5461.9$$

$$\text{Total factor load} = 5.462$$

$$\text{Ultimate Factor moment} = \frac{WL^2}{8}$$

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

$$M_u = 221.13(12)$$

$$M_u = 2653.56$$

So

M. Zeshan Shahid
ID#7876

As,

$M_{u_2} < M_u$

$2362.92 < 2653.56$

Step-4

$M_{u_1} = 2653.56 - 2362.92$

$M_{u_1} = 290.64$ kip-inch

Step-5

as formula Steel Area in coprission zone

$M_{u_1} = \phi (A'_{st})(f_y)(d - d')$

$$A'_{st} = \frac{M_{u_1}}{\phi (f_y)(d - d')}$$

$$= \frac{290.64}{0.90(60)(17-2.5)}$$

$A'_{st} = 0.37\,in^2$

Step-6

$A_{st} = A_{st} + A'_{st}$

$= 3.06 + 0.37$

$A_{st} = 3.43\,in^2$

M. Zeshan Shahid
ID 7876

Step – 7

We Use #8 bars

Area = 0.785 in^2

No of bars = $\frac{Ast}{\text{Area of 1 bar}}$

= $\frac{3.43}{0.785}$

= 4.36 ≅ 5 bars

So 5 #8 bars

Compression steel:

Use #6 bar

dia (6/8) = 0.75"

No of bars = $\frac{A's t}{\text{Area of bar}}$ ∴ Area 0.44 in^2

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

= 0.84 ≅ 1 bar

1 #6 bar in Compression zone

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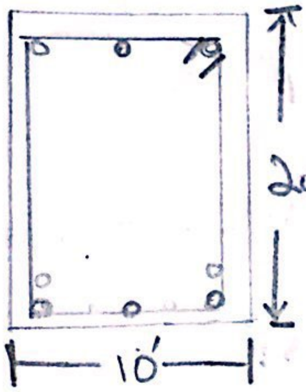
ID 7876

Step – 8

Minimum Width

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

$= 12.75'' > 10''$



⇒ 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

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

$$a = \frac{(A_{st} - A_{st}') \times f_y}{0.85 \times f_c' \times b}$$

M. Zeshan Shahid
ID# 7876

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

$$a = 6.15''$$

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

$$= 0.9 \left[379.368 + 3.925 - 357.588 \right]$$

$$As \quad Md = 2890.46$$

$$Md = 2890.46 > 2653.56$$

So design is okay!

M. Zeshan Shahid
ID # 7876

Q:2 (a)

Ans (a)

Bond stress:

Bound stress is stress at the surface of reinforcing bar which prevent movement m bettween bar and surrounding concrete

OR

The Force of adhesion per unit area of contact between concrete two bounded surface area such as concrete and steel reinforceing bar. is called Bond stress.

M. Zeshan Shahid
7876

Development Length:

The minimum length of steel rod that is inserted inside concrete column to ensure sufficient adhesion force between concrete and steel

OR

Development length creat a surface safe bond between bar surface and concrete it also ensures during ultimate load condition the reinforcement bar should not sleep through the complete it transfer stress from beam to column

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ID 7876

Qu: 2 (b)

Ans: 2 (b)

Doubly reinforced beam:

⇒ It has less depth and width as compared to single reinforced beam and resists more load and moment. It is used in heavy structure for heavy load.

⇒ Doubly reainforced beams are provied in order to increase the moment carring capacity of the section

⇒ To ensure safety against reversal of stresses in the structure due to winds force, seismic force and temperature stresses.

⇒ Minimum compression reinforcement is provided to hold the Shear Reinforcement stirrups in position and for increasing the ductility of beam

M. Zeshan Shahid
ID 7876

Q: 2 (c)

Ans: (c)

Difference

T. Beam	Rectangular Beam
1 The beam whose in crossaction area in T-shape called T Beam. It conected or sport the slab with center of the slab.	1 A rectangular beam is one which is used a compression in top fibre and tention in bottum fibre of that beam. It is in Rectangular shape
2: A T beam is more economical then ratangular Beam.	2 A ractangular beam is cheaper expancive then T beam
3: The resistanc of T-beam is higher for positive movment beam because the flange section wold be in compression but the negtive momunter it yeild same strenth an equlent Beam.	3: The rectangular section only depepends on the location of reinforcement to yield the flexural capacity

Q No: 2 (d)

Ans: 2 (d) **Strength reduction Fector:**

The ratio of elastic strength to yeil strength is called strength reduction fector

It is used to reduce the calculated strength of structure member to account uncertainties arises from matrial used, inaccurate of design calculated and inaccraies the placing of steel and any other fector

It is denoted by ∅

Effect on flexural strength

When designing a section to resist the moment which is caused by load. then the strength reduction factor shows the strength in terms of percentage.

It represent the uncertainty in ~~per~~ determining the member's behavior to the types of stresses which is subjected.

For example:- The design process of beam we commonly take $\phi = 0.85$ for the ~~torsion~~ torsion. It show that 85% of the strength is consider here and the rest of 15% for occidental purposes.

QNo: 2 (e) Desining Method

There are three methods of stuctural design i-e Working stress, limit state and ultimate load method of structural design.

These design methods are used rainforced concrete as well as steel structure design.

1) Ultimte Strength Design Method

In the strength design method the increaed load and reduced strength of the matrial considered but the both based scientific relationale.

e.g it is quit possible then during the life span of structure dead and live Loads increase.

M. Zeshan Shahid
ID 7876

Stress Design Method (ASD)

In working stress or Allowable stress design method the matrial strength is knowingly taken less then actual e.g half of the actual to provide a factor of safity equal to 2.0.

Best for use:

Ultimate strength design method is best for use in designing different structurers member because

=> It is economicaly good, its result in more econmical.

=> Easy to use and understanding

=> Also easy to change the load and sthrenth.

Q No: 3

Ans: 3

Given Data

Web width = 14"
Slab thikness = 6"
Total depth = 28"
Effective depth = 28" − 3"
" = 25"
C/C distane = 10'
Span = 32'
D.L = 50 lb/ft²
S.S = 225 lb/ft²
fy = 60,000 psi
f'c 4000 ksi

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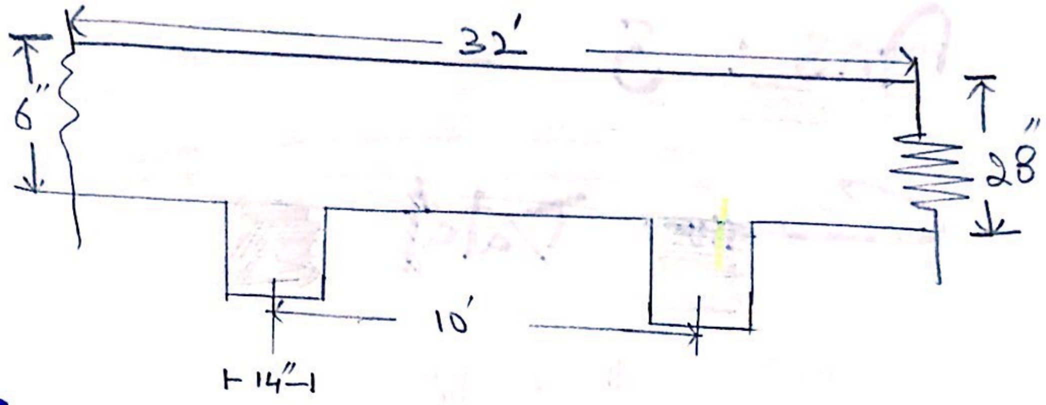
ID 7876

Solve:



Step – 1

We Know

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

⇒ Beam self weight per feet

$wt = b(t)\gamma_c$

$= 14/12 \,(28/12)\,(150)$

$Wt = 408.3 \text{ Lb/ft}$

Total Force Load:

$= 1.2(50 + 408.3) + 1.6(225)$

$= 549.996 + 360$

$= 909.99$

$= 0.909 \text{ ksi}$

1000 = kilo

M. Zeshan Shahid
ID # 7876

⇒ Moment:

As we know that

$$m = \frac{wl^2}{8}$$

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

$$= 1396.23$$

⇒ Effective Breadth:

① $16(h_f) + b_w = 16(6)+4$
$= 110''$

② Span ⇒ $\frac{span}{4}$

$$= \frac{32}{4} \times 12$$

$$= 96''$$

③ C/C distance $= 12(10)$
$= 120''$

So now $b_e = 96$

M. Zeshan Shahid
ID# 7876

Step – 3

Rectanguler oR T-Beam

Trail – 1 So Let we get $a = h_f = 6''$

So Now as formula

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

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

$$= \frac{1396.23}{1188}$$

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

Now T – 2

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

$$= \frac{1.17 (60)}{0.85 \times f'_c \times b} = \frac{1.17 \times 60}{0.85 \times 4 \times 96}$$

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

So T – beam design

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M. Zeshan Shahid
ID 7876

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

$$= \frac{1396.23}{1344.6}$$

$$= 1.03 \text{ in}^2$$

Trial 3

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

$$= 0.18$$

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

$$= \frac{1396.23}{1345.14}$$

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

Step – 4

Now ρ_{max} and ρ_{min}

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

$$\rho_{max} = 0.85 (0.85)(4/60)(0.375)$$

$$\rho_{max} = 0.018$$

M.Zeshan Shahid
ID 7876

Now

$\Rightarrow \rho_{(min)} = \frac{200}{fy}$

$= \frac{200}{60,000}$

$\rho_{min} = 0.003$

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

$= \frac{1.03}{14 \times 25}$

$\rho = 0.0029$

So that

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

$0.003 < 0.002 < 0.018$

As we already know that

ρ is less then ρ_{min}

So

$\rho = \frac{A_{st}}{B \times d}$

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

$= 0.003 \times 14 \times 25$

$A_{st} = 1.05 in^2$

Age-22 7 M. Zeshan Shahid
7876

Step-5

No. & Selection of Bar

Let we use #8 bar then

dia = (8/8) = 1",

Area = 0.785 in²

now

No of bars = $\frac{1.05}{0.785}$

= 1.3 ≃ 2

want to get 2 #8 bars

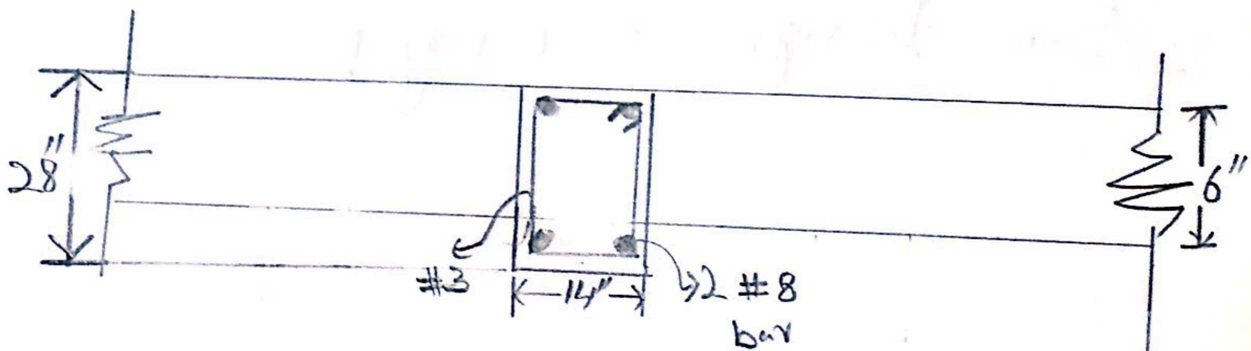
step-6

Minimum Width

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

= 6.75 < 14"

It's good in one Layer



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ID # 7876

Step – 7

Desig Moment

$Md = \phi \times f_y \times Ast \, (d - a/2)$

Area of steel = Area of 1 bar X No of bars
= 0.785 X 2
= $1.57 \, in^2$

Now

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

= 0.2"

So

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

$Md = 2111.02$ kip – inch

As 2111.02 > 1396.23

So Design is Okay!