Iqra National University

Submitted To :— Engr:- Humaira Arshad

Submitted By :— Nouman Khan

I.D :— 5856

Subject:- Reinforced Concrette Structures:—

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Step #12:

Distribution bars placement

Distribution Bars

$A_{dist} = 0.0018bh = 0.0018 \times 62 \times 12 = 1.34 in^2$

No of bars = A_{dist}/A_b =

$1.34/0.31 = 4.32 \approx 5$ bars

Step#7 check the shear capacity ϕV_c

Shear capacity $\phi V_c = \phi 2 \sqrt{f'c}\, b d$

$0.75 \times 2 \times \sqrt{3500} \times 12 \times 8.5/1000$

$\phi V_c = 9.05$ kips

since $\phi V_c > V_u$ the footing depth is ok otherwise chose thickness repeat previous steps.

Steps: 8: calcule maximum moment M_u.

$M_u = \frac{q_u b k^2}{2} = 6.19 \times 1 \times (25/12)^2/2$

$= 13.43$ ft-kips per ft

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Q 1:

Ans: **Solution:-**

Step No 1

For 20' length, $h_{min} = l/16 = 20 \times 12/16 = 15''$

For grade 40, we have. $h_{min} = 15'' \times 0.4 + \frac{40,000}{100,000}$

$= 12''$

However we select 18" deep beam

Generally the min beam width 12"

width of the beam taken as 12"

The final ~~selection~~ selection of beam size depends several factors specifically availability formwork close enough to the previous value

so that $A_s = 2.90 in^2$ ok

step-4

Design for flexure:

$A_{s min} = 0.27\, f'_c / f_y)\, b_w d = (0.27 \times 3/40)$

$\times 12 \times 15.5 = 3.76 in^2$

$A_{s max} = 0.93 < A_s\ 2.90 < A_{s max}\ 3.76)$ o.k

step-4:

$V_u = 20.63$ kips

$\phi V_c = \phi\, 2\sqrt{f'_c}\, b_w d$

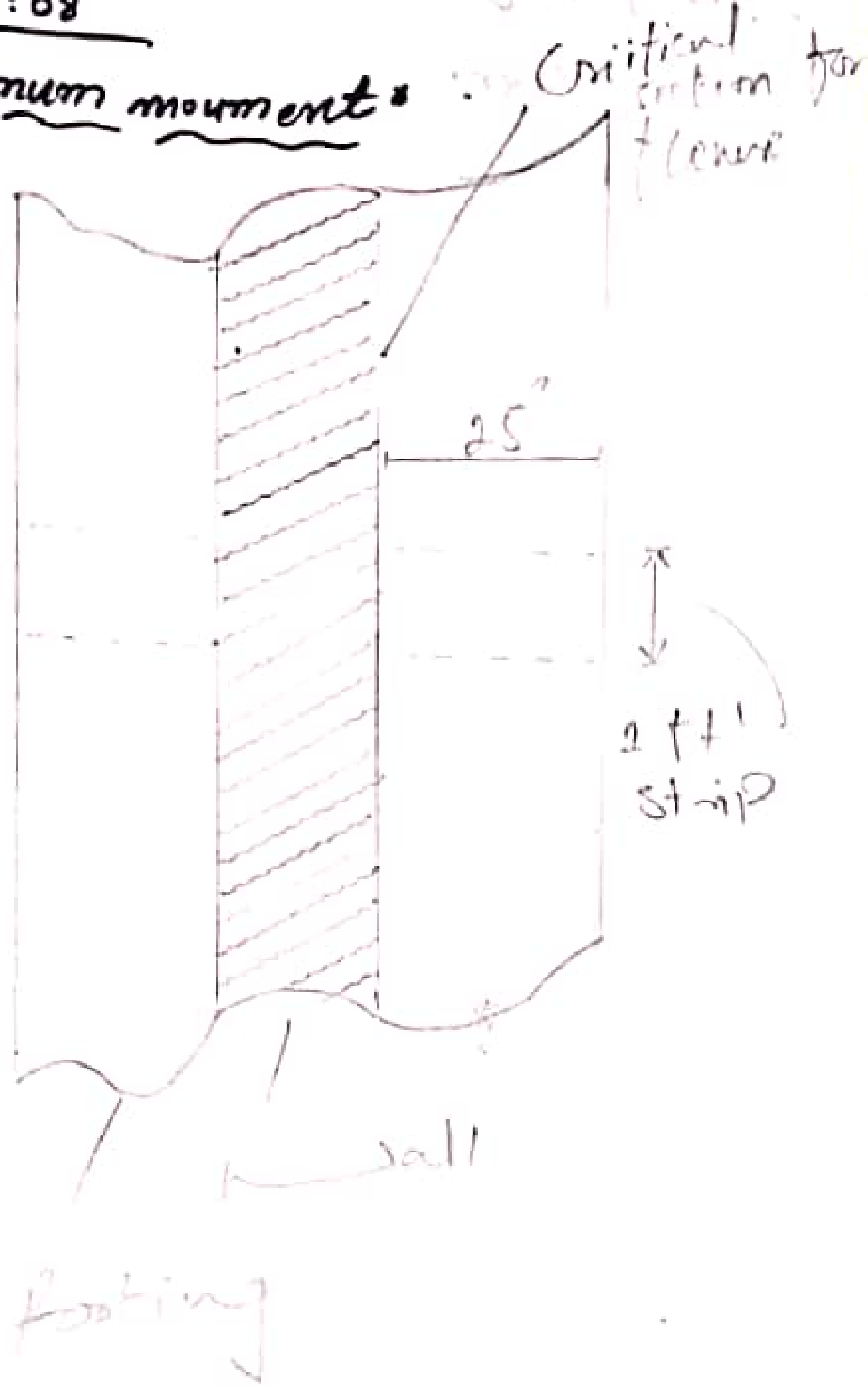
$0.75 \times 2 \times \sqrt{3000} \times 12 \times 15.5/1000$

15.28 kips

As $\phi V_c < V_u$ shear is rquird.

Ans#2 #Step: 08

maximum moument:



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Q 3 :-

Answer:-

Solution:-

* Normal Strength ($\alpha \phi P_n$) of axially loaded column is:

* $\alpha \phi P_n = 0.80 \phi \{0.85 f_c'(A_g - A_{st}) + A_{st} f_y\}$

* $A_g = 18 \times 18 = 324 \ in^2$

* Let $A_{st} = 1\%$ of $A_g = 0.01 \times 324 = 3.24$

* $\alpha \phi P_n = 0.80 \times 0.65 \times \{0.85 \times 3 \times (324 - 3.24) + 324 \times 40\}$

$= 492$ Kips > ($P_u = 300$ Kips), o.k

Therefore, $A_{st} = 0.01 \times 324 = 3.24 \ in^2$

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step 4: calculate bearing area. Areq

Areq = service load / q_e

service load = 10 + 12.5 = 22.5 K/ft

Areq 22.5 / 4.37 = 5.15 ft^2

steps 5: calculate design pressure on base to factored loads q_u.

q_u = Factored load / bearing area.

1.2 (10) + 1.6 (12.5) = 32 Kips

q_u = 32 / 5.17 = 6.19 ksf

step#06 calculate the critical shear V_u.

d = 12 - 3 in cover - 1/2 (bar diameter) = 8.5 in

$V_u = q_u\, b(k - d)$

$V_u = 6.19 \times 1 \cdot [25 - 8.5)(12) = 8.51$ Kips/ft

Step # 09 calculate steel area As

Now using trial and success method for determining As.

$As = Mu / \phi f_y (d - a/2)$ $a = 0.2h$

$As = 0.390\ in^2$ per foot.

Step # 10: Minm reinforcement check

Min reinforcement

$As,min = 0.0018bh = 0.0018 \times 12 = 0.26\ in^2/ft$

$As (0.390 in^2) \geq As min (0.26\ in^2)$ O.K

Step # 11: Main Bars spacing and maximum spacing check

Main bars spacing = $Ao \times 12 / As$

using #5 bars spacing = $0.31 \times 12 / 0.390 = 9.53 = 9$ inch

Max spacing = 3h or 18" = 3(12) = 36" or 18" ok

Step 4:

Assuming # 3, 2 legged ($0.22 in^2$)

Spacing at mid (S_1) = $\phi A_v f_y d / (V_u - \phi V_c)$

$= 0.75 \times 0.22 \times 40 \times 15.5 / (20.63 - 15.28)$

$= 19.12''$

Step - 4:

$\phi V_s < \phi 8 \sqrt{f'_c}\, b_w d$

$\phi 8 \sqrt{f'_c}\, b_w d = 0.75 \times 8 \times \sqrt{3000} \times 12 \times 15.5 / 1000$

$= 61.12K$

$\phi V_s = V_u - \phi V_c = 20.63 - 15.28 = 5.25K <$

61.12K, o.k

Solution:

Main Bars:-

* Using # 6 bar with bar area $A_b = 0.44 \, in^2$
* No of bars = $A_s/A_b = 3.24 / 0.44 = 7.36 \approx 8$ bars
* Use 8 # 6 bars

Q 2:-

Answer Step 01:- Estimate the thickness of footing h

Assuming a total thickness h = 12in

effective depth d = 12 - 3in cover - 1/2 bar diameter

8.5 in

Step 2: calculate weight of fill and weight of concrete, w

w = Wcon = 1×0.15 + 4×0.12 = 0.63 ksf

Step 3: calculate effective bearing capacity qe.

qe = qa - w

qe = 5 - 0.63 = 4.37 ksf

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→ <u>Solution:</u>

• Tie Bars:

* Using # 3 bars, with bar area $A_b = 0.11\ in^2$

Center – Center spacing shall not exceed the least of;

(i) 16 d_b of longitudinal bar = $16 \times 0.75 = 12''$

(ii) 48 d_b of Tie bar = $48 \times 3/8 = 18''$

(iii) Smallest dimensions of member = 18''

Therefore use # 3 ties @ 12'' c/c.

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Step: 4

other checks

check if $\phi V_s \leq \phi 4 \sqrt{f'_c} b_w d$

5.35 kips < 30.56 kips o.k

$\phi V_s \leq \phi 4 \sqrt{f'_c} b_w d$ the maximum spacing (S_{max}) is o.k otherwise reduce spacing by one half

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using similarity of triangle.

$V_u / (10-1.29) = 23.7/10$

$V_u = 23.7 \times (10-1.29) = 20.65\,K$

Step 4: Design for flexure.

$\phi M_n > M_u$ ϕM_n is (M_{design} or M_{cap})

For $\phi M_n = M_u$

$\phi A_s f_y (d - a/2) = M_u$

A_s $M_u / \{\phi f_y (d - a/2)\}$

calculate A_s by trial and sucess method.

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Step No 01

Depth of beam, h = 18"

h = d + Y, Y

For Y = 2.5 in, d = 18 - 2.5 = 15.5"

width of beam cross section b_w = 12"

Step 2:

self weight of beam = $\gamma_c b_w h$ = 0.15 x [12 x (18/144)]

= 0.225 K/ft

w_u = 1.2 w_D + 1.6 w_L

(1.2 x 0.225 + 0.76) + 1.6 x 0.75 = 2.37 K/ft

Step 3

$M_u = w_u l^2 / 8$ = 2.37 x $(20)^2$ x 12/8

1422 in-K

Analysis shear beam:

V = 23.7 kips

support - d = 15.5" = 1.29'

Step No 04

Design for flexure

First Trial

Assume $a = 4''$

$As = 1422 / [0.9 \times 40 \times (15.5 - 4/2)] = 2.92 in^2$

$a = As\ f_y / (0.85 f'_c b_w)$

$= 2.92 \times 40 / (0.85 \times 3 \times 12) = 3.81 in$

Step 4:

Second Trial

$As = (1422 / 0.9 \times 40\ 15.5 - 3.82/2) = 2.90 in^2$

$a = 2.90 \times 40 / 0.85 \times 3 \times 12) = 3.79 in$

Third Trial

$As = 1422 / 0.9 \times 40 \times [15.5 - 3.79/2)$

$2.90 in^2$

$a = 4.49 \times 40 / 0.85 \times 3 \times 12) = 3.79 in$

Ans#2# Step # 6

Critical shear: