Assignment 3
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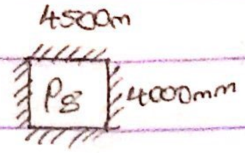
17/ENG03/003
Civil Engineering

Designing For P8



Slab thickness = 250mm = 0.25m

Capital / dropping = 1.2m

25 - 40 N/mm² concrete grade

finishes = 1.2

Partitions = 1.0

Slab = 0.25 x 24 = 6kN/m²

Total = 8.2kN/m²

Designing

$D.L = 1.4 G_k + 1.6 Q_k$

$= (1.4 \times 8.2 \times 4.5 \times 4) + (1.6 \times 5 \times 4.5 \times 4)$

$= 206.64 + 135$

$= 341.64$ kN (FL)

Short span

Middle strip

span = $l_x - \frac{2}{3}h = 4 - \frac{2}{3} \times 1.2 = 3200$mm

~~support~~ $M = 45\% \times 0.071 \times 341.64 \times 4 = 43.66$

$b = 4/2 = 2 = 2000$mm

Support = $M = 25\% \times 0.071 \times 341.64 \times 4 = 24.25$

Span

$d = h - \text{cover} \times \frac{1}{2}Ø = 250 - 25 \times \frac{1}{2} \times 12 = 219$mm

$K = \frac{M}{bd^2 f_{cu}} = \frac{43.66 \times 10^6}{2000 \times 219^2 \times 25} = 0.018$

$I_a = 0.5 + \sqrt{0.25 - k/0.9} = 0.5 + \sqrt{0.25 - 0.05/0.9}$

$= 0.97 > 0.95 \cong 0.95$

$z = I_a d = 0.95 \times 219 = 208.05$

$A_s = \frac{M}{0.95 \times f_y z} = \frac{43.66 \times 10^6}{0.95 \times 410 \times 208.05} = 538.8\ mm^2$

Provide Y12 @ 200 c/c ($A_s = 566mm^2$)

Support

$d = h - cover - \frac{1}{2}\phi = 219mm$

$k = \frac{M}{bd^2 f_{cu}} = \frac{24.25 \times 10^6}{2000 \times 219^2 \times 25} = 0.01$

$I_a = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.01}{0.9}} = 0.989 > 0.95 \cong 0.95$

$z = I_a d = 219 \times 0.95 = 208.05$

$A_s = \frac{M}{0.95 f_y z} = \frac{24.25 \times 10^6}{0.95 \times 410 \times 208.05} = 299.25$

Provided Y12 @ 300 c/c ($A_s = 377mm^2$)

Column Strip

Span = 3200mm

b = 2000mm

$M = 55\% \times 0.071 \times 341.64 \times 4 = 53.36 \times 10^6$

Support = M = $75\% \times 0.071 \times 341.64 \times 4 = 72.77$

Span

d = 219

$k = \frac{M}{bd^2 f_{cu}} = \frac{53.36 \times 10^6}{2000 \times 219^2 \times 25} = 0.022$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.022}{0.9}} = 0.97 > 0.95 \cong 0.95$

$z = I_a d = 0.95 \times 219 = 208.05$

$A_s = M/0.95 f_y z = 53.36 \times 10^6 / 0.95 \times 410 \times 208.05 = 658.49\ mm^3$

Provided Y12 @ 150 c/c (As = 754 mm²)

Support

d = 219

$k = \frac{M}{bd^2 f_{cu}} = \frac{72.77 \times 10^6}{2000 \times 219^2 \times 25} = 0.030$

$l_a = 0.5 + \sqrt{0.25 - \frac{0.030}{0.9}} = 0.96 > 0.95 \doteq 0.95$

$z = l_a d = 208.05$

$A_s = \frac{M}{0.95 \times f_y z} = \frac{72.77 \times 10^6}{0.95 \times 410 \times 208.05} = 898 \text{ mm}^2$

Provide Y12 @ 125 c/c (As = 905 mm²)

Long Span

Middle Strip

Span = $l_y - \frac{2}{3}h = 4.5 - \frac{2}{3} \times 1.2 = 3700$

$M = 45\% \times 0.071 \times 341.64 \times 4.5 = 49.12$

$b = l_y - \frac{l_x}{2} = 4.5 - 2 = 2.5 = 2500 \text{ mm}$

Support $M = 25\% \times 0.071 \times 341.64 \times 4.5 = 28.29$

Span

d = 219

$k = \frac{M}{bd^2 f_{cu}} = \frac{49.12 \times 10^6}{2500 \times 219^2 \times 25} = 0.01$

$l_a = 0.5 + \sqrt{0.25 - \frac{0.01}{0.9}} = 0.98 > 0.95 \doteq 0.95$

$z = l_a d = 0.95 \times 219 = 208.05$

$A_s = \frac{M}{0.95 f_y z} = \frac{49.12 \times 10^6}{0.95 \times 410 \times 208.05}$ 606.15 mm²

Provided Y12 @ 175 c/c (As = 646 mm²)

Support

d: 219

D = 2500

$K = \frac{M}{bd^2 f_{cu}} = \frac{28.29 \times 10^6}{2500 \times 219^2 \times 25} = 9.40 \times 10^{-3}$

$I_a = 0.5 + \sqrt{0.25 - \frac{9.40 \times 10^{-3}}{0.9}} = 0.98 > 0.95 \approx 0.95$

$Z = I_a d = 208.05$

$A_s = \frac{28.29 \times 10^6}{0.95 \times 410 \times 208.05} = 356.86\ mm^2$

Provide Y12 @ 300 c/c $A_s = 377 mm^2$

Column strip

Span = 3700

$b = l_x/2 = 2000$

$M = 55\% \times 0.071 \times 341.64 \times 4.5 = 60.04$

$K = \frac{60.04 \times 10^6}{2000 \times 219^2 \times 25} = 0.025$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.025}{0.9}} = 0.97 > 0.95 \approx 0.95$

$Z = I_a d = 208.05$

$A_s = \frac{60.04 \times 10^6}{0.95 \times 400 \times 208.05} = 740.91\ mm^2$

Provided Y12 @ 150 c/c $(A_s = 754 mm^2)$

Support

$M = 75\% \times 0.071 \times 341.64 \times 4.5 = 81.87$

$K = \frac{81.87}{2000 \times 219^2 \times 25} = 0.034$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.034}{0.9}} = 0.96 > 0.95 \approx 0.95$

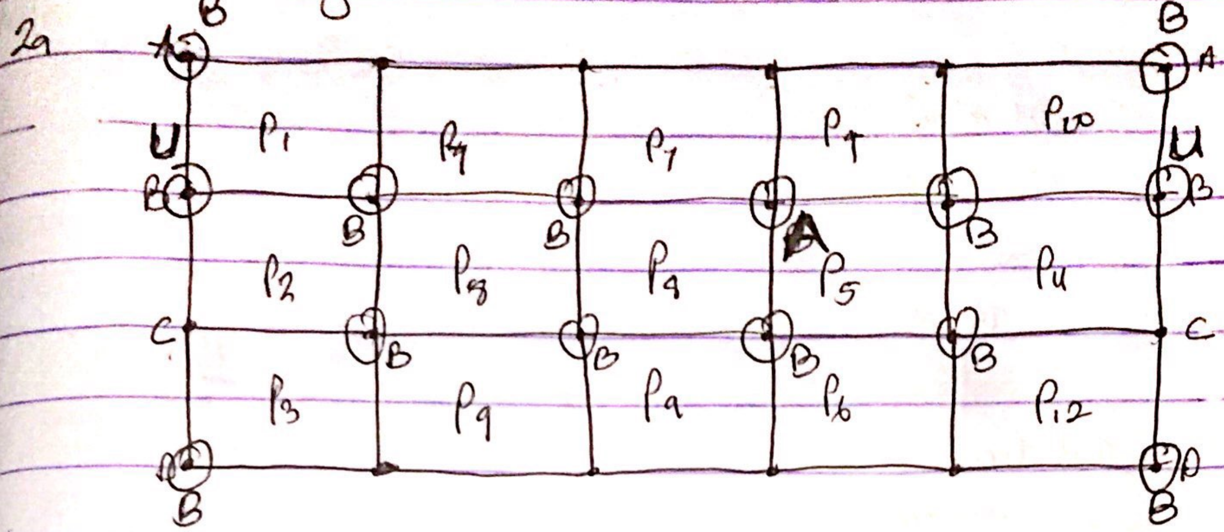
Z = 208.05

$A_s = \frac{81.87 \times 10^6}{0.95 \times 410 \times 208.05} = 1010.298\,mm^2$

Provided Y12 @ 100 c/c (A_s = 1130 mm^2)

Column Design

2a

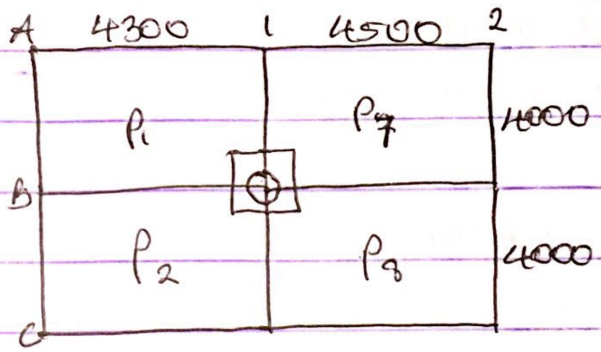


Key - A = Axial

B = Biaxially

U - Uniaxially

Designing for Column B1



$A = 4 \times 4.5 = 17.6\,m^2$

Slab Load

Weight of slab: $0.15 \times 24 = 3.6\,kN/m^2$

finishes = $1.2\,kN/m^2$

Partition = $1.0\,kN/m^2$

$5.8\,kN/m^2$

Design Load = $1.4\,G_k + 1.6\,Q_k$

$= 1.4 \times 5.8 \times 1.6 \times 2.5$

Beam Load =

beam wt = $0.225 \times 0.6 \times 24 = 3.24\,kN/m^2$

Wall load = $3.47 \times 3 = 10.41\,kN/m^2 = 1$

$18.65\,kN/m^2$

Dl = ~~[illegible]~~ * ~~[illegible]~~ 1.4 x 13.65 = 19.11 kN/m²

Design:

Roof - 3rd floor

Roof load = Area x 65 x 1.5

= 17.6 x 1.5² = 39.6 kN

Roof beam = 0.225 x 0.45 x 24 = 2.437 kN/m²

finishes 1.0

= 3.43 kN/m²

Roof beam = 3.43 (4.4) x 1.4

Column load = 10 kN

Total load = 89.94 kN

3rd floor – 2nd floor

Load from above = 89.94 kN

Colum load = 10 kN

Slab load = 17.6 x 12.12 = 213.312 kN

Beam load = 19.11 x (8.4) = 160.524 kN

B- Total = 463.776 kN

2nd floor to 1st floor

Load from above = 463.78 kN

Column load = 10 kN

Slab load = 213.312

Beam load - 160.524

Total = ~~[illegible]~~ ≃ ~~[illegible]~~ 856.61 kN

1st floor to ground floor

Load from above = 856.61

Column load = 10 kN

Slab load = 213.312

Beam load = 160.524

Total = 1249.45 ≃ 1300 kN

$$A_s = \frac{N - 0.35 f_{cu} bb}{0.7 f_y - 0.35 f_{cu}}$$

N = 1300 kN

$f_{cu} = 25$

$f_y = 400$

b = 25

$$A_s = \frac{1300 - 0.35 \times (25 \times 225^2)}{0.7 \times 400 - 0.35 \times 25}$$

= 3080.07 mm^2

Provide 8 y25 (A_s = 3930 mm^2)

$A_{s\,min} = 0.4\% \, bh = 0.004 \times 225^2 = 202.5\,mm^2$