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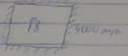
- 17/ENG03/035
- Civil Eng
- Structural design
- Assignment III

Designing to P8



Capital lifting = 1.2m
25 kN/m³ Concrete grade
Slab thickness = 250mm

Finishes = 1.2 kN/m²
Partitions = 1.0 kN/m²
Slab = 0.25 x 25 = 6 kN/m²
Total = 8.2 kN/m²

Design to Ability = 5.0
Area = 4.5x4 = 18m²

D.L Per DG = 1.4Gk + 1.6Qk
= (1.4 x 8.2 x 18) + (1.6 x 5 x 18)
204.4 + 135
341.64

Slab span => middle strip => 9P
Span = lx - $\frac{2}{3}$ h = 4 - $\frac{2}{3}$ x 1.2 = 3200mm

Moment = 45% x 0.071 L = $\frac{45}{100}$ x 0.07 x 341.64 x 4 = 43.1 kNm/m

Width = $b = \frac{l_x}{2} = \frac{4}{2} = 2 = 2000mm$

$d = h - cover - \frac{1}{2}\phi = 250 - 25 - 6 = 219mm$

$= \frac{63.66 \times 10^6}{2000 \times 219^2 \times 25} = 0.018$

$0.5 + \sqrt{0.25 - \frac{}{}} = 0.5 + \sqrt{0.25 - \frac{0.018}{0.9}} =$

$= 0.95 \times 219 = 208.05$

$\frac{M}{0.95 f_y z} = \frac{63.66 \times 10^6}{0.95 \times 410 \times 208.05} = 538.8$

H12 @ at 200 c/c ($A_s = 566mm$)

Span

$M_2 = 25\% \times 0.071 fcu = \frac{25}{100} \times 0.071 \times 24.67 \times A = 26.2$

$W = 2000mm = b$

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

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

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

$As = \frac{24.25 \times 10^6}{2000 \times 219^2 \times 25}$ $\frac{24.25 \times 10^6}{0.95 \times 208.05 \times 410} = 299.25$

Provide Y10 @ 300c/c ($As = 377mm^2$)

Column strip (span)

Span = 3200mm

b = 2000mm

$M = 55\% \ 0.071 fcu = \frac{55}{100} \times 0.071 \times 36.1.66 \times A = 53.36$

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

$z = 0.5 + \sqrt{0.25 - \frac{0.022}{0.9}} = 0.977 > 0.95 = 0.95$

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

$As = \frac{53.36 \times 10^6}{0.95 \times 410 \times 208.05} = 658.47$

Provide Y12 @ 150 c/c ($As = 754mm$)

Column strip (support)

$M = \frac{75}{100} \times 0.071 \times 381.64 \times 4 = 72.77$

$k = \frac{72.77 \times 10^6}{2500 \times 219^2 \times 25} = 0.030$

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

$z = 208.05$

$As = \frac{72.77 \times 10^6}{208.05 \times 460 \times 0.95} = 848$

Provide Y12 @ 125 c/c (As = 905 mm)

Long span → middle strip → (span)

Effective span = $l_y - \frac{2}{3}h = 4.5 - \frac{2}{3} \times 1.2 = 3700mm$

Moment = $0.45 \times 0.071 \times 381.64 \times 4.5 = 49.12$

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

$k = \frac{49.12 \times 10^6}{2500 \times 219^2 \times 25} = 0.018$

$la = 0.5 + \sqrt{0.25 - \frac{0.018}{0.9}} = 0.98 > 0.95 = 0.95$

$z = 208.05$

$A_s = \frac{49.12 \times 10^6}{0.95 \times 208.05 \times 460} = 606.45$

Provide Y12 @ 175 c/c (A_s = 646 mm²)

Support

$M = 0.25 \times 0.071 \times 34.64 \times 4.5 = 28.89$

$b = 2500$

$d = 219$

$k = \frac{28.89 \times 10^6}{2500 \times 219^2 \times 25} = 9.64 \times 10^{-3}$

$l_a = 0.5 + \sqrt{0.25 - \frac{9.64 \times 10^{-3}}{0.9}} = 0.989 > 0.95 = 0.95$

$z = l_a \cdot d = 208.05$

$A_s = \frac{28.89 \times 10^6}{0.95 \times 208.05 \times 410} = 356.96$

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

Column strip

span = 3700mm

width $= \frac{l_x}{2} = 2000mm$

Moment $= 0.55 \times 0.071 \times 34.64 \times 3.7 \times 4.5 = 60.04$

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

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

$z = 208.05$

$A_s = \frac{60.04 \times 10^6}{0.95 \times 410 \times 208.05} = 740.91$

Provide Y12 @ 150c/c ($A_s = 754$)

$= 0.75 \times 0.021 \times 381.67 \times 4.5 = 81.87$

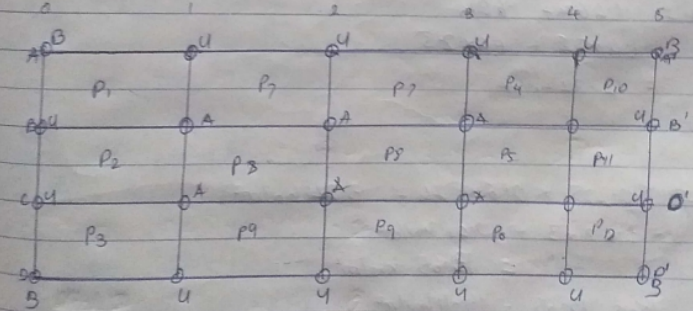
$$\frac{81.87 \times 10^6}{2000 \times 249^2 \times 25} = 0.034$$

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

$$208.05$$

$$= \frac{81.87 \times 10^6}{0.95 \times 400 \times 208.05} = 1010.298$$

Provide Y12 @ 100 c/c (A_s = 1130)



key = A = Axial
B = Biaxially
U = Uniaxially

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

Column load = 10 kN

Slab load = 17.6 x 12.12 = 213.312 kN

Beam load = 19.11 x (8.4) = 160.524 kN

Total ⇒ 463.776 kN

2nd floor to 1st floor

Load from above = 463.78 kN

Column load = 10 kN

Slab = 213.312 kN

Wall & beam = 160.524 kN

Total ⇒ 856.61 kN

1st floor to ground floor

Load from above = 865.61 kN

Column load = 10 kN

slab = 213.312 kN

wall & beam = 160.524

= 1249.45 ≃ 1300 kN

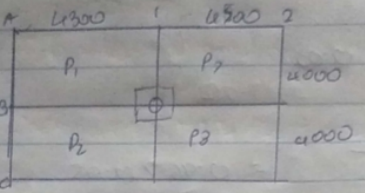
$$A_s = \frac{N - 0.35 f_{cu} bh}{0.7 f_y - 0.35 f_{cu}}$$

N = 1300 kN

f_{cu} = 25

f_y = 410

Designing for column B1



A = 4 × 4.3 = 17.6m²

Slab load

Weight of slab = 0.15 × 24 = 3.6kN/m²

Finished = 1.2kN/m²

Partition = 1.0kN/m²

5.8kN/m²

Design Load = 1.4G1 + 1.6Q1

1.4 × 5.8 + 1.6 × 2.5

= 12.12kN/m²

Beam Load

beam cut = 0.225 × 0.6 × 24 = 3.24kN/m²

wall load = 3.47 × 3 = 10.41 kN/m²

= 13.65 kN/m²

DL = 1.4 × 13.65 = 19.11kN/m²

Design

Roof - 3rd Floor

Roof load = Area × 1.5 × 1.5

= 17.6 × 1.5² = 39.6kN

Roof beam = 0.225 × 0.45 × 24 = 2.43kN/m²

Finished = 1.0kN/m²

= 3.43 kN/m²

$$A_s = \frac{1300 \times 10^6 - 0.35 (25 \times 225^2)}{0.7 \times 410 - 0.35 \times 25}$$

$$= 3080.07 mm^2$$

Provide 8 y 25 ($A_s = 3930 mm^2$)

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