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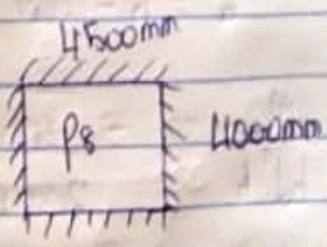
structural design
Assignment III

Designing ps



Capital/dropping = 1.2m

Slab thickness = 250mm

Finishes = $1.2 KN/m^2$
Partitions = $1.0 KN/m^2$
Slab = $0.25 \times 28 = 6 KN/m^2$
Total = $8.2 KN/m^2$

Designs by Parts = 5.0
Area = $4.5 \times 4 = 18 m^2$

D.L per area = $1.4 Gk + 1.6 Qk$
$= (1.4 \times 8.2 \times 18) + (1.6 \times 5 \times 18)$
$206.64 + 135$
$= 341.64$

Short span → Middle strip → span
span = $Lx - \frac{2}{3}h = 4 - \frac{2}{3} \times 1.2 = 3200mm$

Moment = 45% of $0.071 pl = \frac{45}{100} \times 0.071 \times 341.64 \times 4$

$= 43.66$ KN/m

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

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

$k = \frac{M}{bd^2 b} = \frac{43.66 \times 10^6}{2000 \times 219^2 \times 25} = 0.018$

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

$= 0.5 + \sqrt{0.25 - \frac{0.018}{0.9}} = 0.979 > 0.95$

$= 0.95$

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

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

provide T12 at 200 c/c ($A_s = 566$mm)

Support

$M_2 = 25\% \times 0.071 fl = \frac{25}{100} \times 0.071 \times 341.64 \times$

$= 24.25$

$W = 2000$mm $= b$

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

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

$$Z = Z_a \cdot d = 0.95 \times 219 = 208.05$$

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

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

Column strip (span)

span = 3200mm

b = 2000mm

M = 55% 0.071 fl = $\frac{55}{100} \times 0.071 \times 341.64 \times 4$

= 53.36 kN/m²

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

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

$$= 0.95$$

$$Z = Z_a \cdot d = 0.95 \times 219 = 208.05$$

$$A_s = \frac{53.36 \times 10^6}{0.95 \times 410 \times 208.05} = 668.47$$

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

Column Strip (support)

$$M = \frac{75}{100} \times 0.071 \times 341.64 \times 4 = 72.77$$

$$K = \frac{72.77 \times 10^6}{2000 \times 219^2 \times 25} = 0.030$$

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

$$Z = 208.05$$

$$As = \frac{72.77 \times 10^6}{208.05 \times 410 \times 0.95} = 898$$

Provide y_{12} @ 125 c/c ($As = 905mm$)

Long span ⟶ middle strip ⟶ (Span)

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

$$\text{Moment} = 0.45 \times 0.071 \times 341.64 \times 4.8 = 49.12$$

$$\text{Width} = b = l_y - \frac{l_x}{2}$$

$$= 4.5 - 2 = 2.5 \simeq 2500$$

$$K = \frac{49.12 \times 10^6}{2500 \times 219^2 \times 25} = 0.016$$

$$Le = 0.5 + \sqrt{0.25 - \frac{0.016}{0.9}} = 0.98 > 0.95$$
$$= 0.95$$

$z = 208.05$

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

provide Y12 @ 175 c/c ($A_s = 646mm$)

Support

$M = 0.28 \times 0.071 \times 391\ 341.67 \times 4.5 = 27.29$

$b = 2500$

$d = 219$

$K = \frac{27.29 \times 10^6}{2500 \times 219^2 \times 28} = 9.10 \times 10^{-3}$

$Lo = 0.5 + \sqrt{0.25 - \frac{9.10 \times 10^{-3}}{0.9}} = 0.989 > 0.95$

$= 0.95$

$z = Lo \cdot d = 208.05$

$A_s = \frac{27.29 \times 10^6}{0.95 \times 208.05 \times 410} = 336.86$

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

Column Strip

Span = 3700mm

width = $l_x/2$ = 2000mm

Moment = $0.58 \times 0.071 \times 341.67 \times 4.5 = 60.04$

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

$$Z_a = 0.5 + \sqrt{0.25 - \frac{0.034}{0.9}} \quad 0.97 > 0.95 \quad = 0.95$$

$$Z = 208.05$$

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

provide y_{12} @ 150 c/c ($A_s = 756$)

Support Moment $= 0.78 \times 0.071 \times 341.67 \times 4.6 = 81.87$

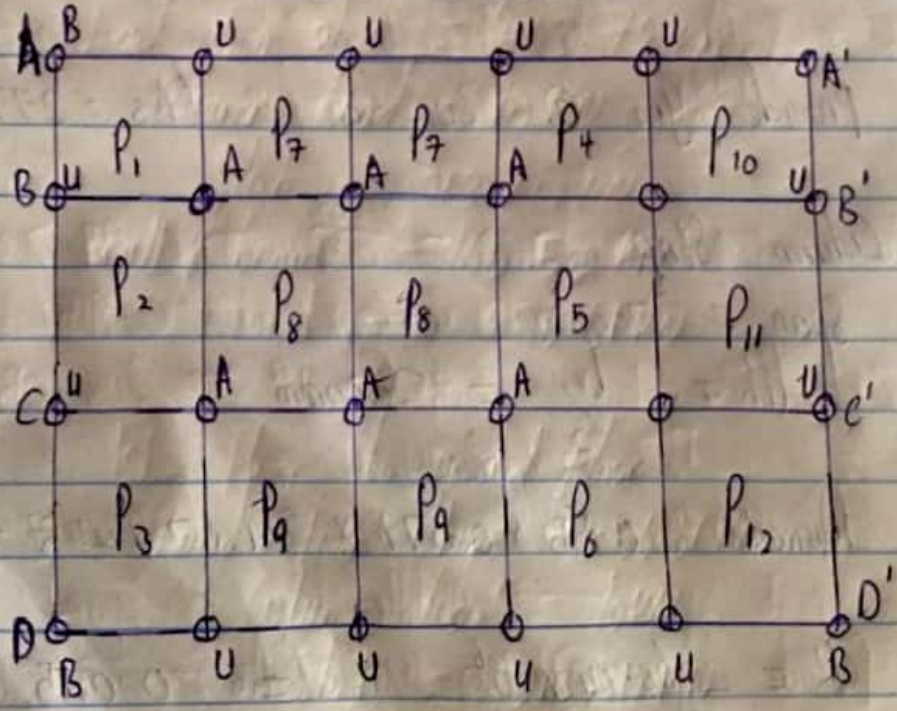
$$K = \frac{81.87 \times 10^6}{2000 \times 219^2 \times 25} = 0.034$$

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

$$Z = 208.05$$

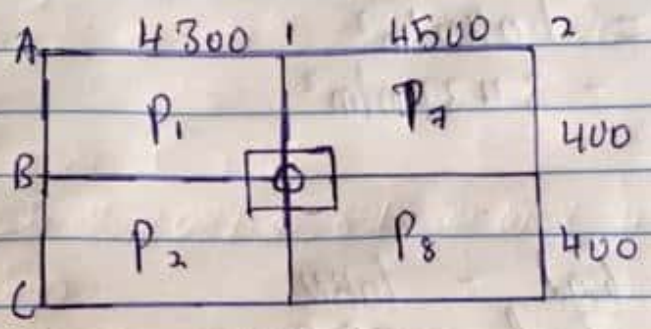
$$A_s = \frac{81.87 \times 10^6}{0.95 \times 410 \times 208.05} = 1010.298$$

provide y12 @ 100 c/c ($A_s = 1130$)



Key = A = Axial
B = Biaxially
U = Uniaxially

Design for Column B.



$A = 4 \times 4.4 = 17.6m^2$

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 = $1.4Gk + 1.6Qk$
$1.4 \times 5.8 + 1.6 \times 2.5$
$= 12.12 KN/m^2$

Beam Load

beam wb = $0.225 \times 0.6 \times 24 = 3.24 KN/m^2$
wall load = $3.47 \times 3 = 10.41 KN/m^2$
$= 13.65 KN/m^2$

DL = $1.4 \times 13.65 = 19.11 KN/m^2$

Design

Roof – 3rd floor

Roof load = Area × 1.5 × 1.5

= 17.6 × 1.5² = 39.6 KN

Roof beam = 0.225 × 0.45 × 24 = 2.437 KN/m²

Finishes = 1.0 KN/m²

= 3.43 KN/m²

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 × 12.12 = 213.112 KN

Beam load = 19.11 × (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 = 213.112 KN

wall & beam = 160.52 KN

Total ⟹ 856.61 KN

1st floor to ground floor

Load from above = 856.61 KN

Column load = 10 KN

Slab = 213.312 KN

wall & beam = 160.52v

= 1249.48 ≈ 1300KN

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

N = 1300 KN

f_{cu} = 25

f_y = 410

b = 225

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

$$= 3080.07 \text{ mm}^2$$

Provide y25 (A_s = 3930mm²)

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

$= 202.5 \text{mm}^2$