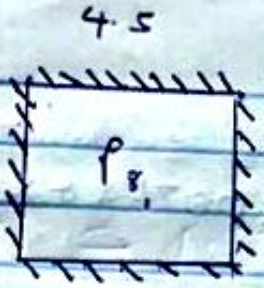
Assignment III

1 Solving for Panel S_1



capital droppings = 1.2m
Steel grade = 25-410 N/mm²
Slab thickness = 250mm
(Gk) loading : Slab

Soln

Gk, (loading) : Slab = 0.025 × 24 = 6 kN/m²
Partition = 1.0 kN/m²
Finishes = 1.2 kN/m²
= 8.2 kN/m²

4.0 × 4.5 = 18m²

per area of effect, DL = 1.4Gk + 1.6Qk
= (1.4 × 8.2 × 18) + (1.6 × 3.5 × 18)
= 307.44 kN

Short span:

Middle strip (Span)

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

Moment = $45\% \times 0.071FL = \frac{45}{100} \times 0.071 \times 307.44 \times 4 = 39.29$kNm

$w = \frac{l_x}{2} = \frac{4.0}{2} = 2.0$m = 2000mm

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

$k = \frac{M}{bd^2 f_{cu}} = \frac{39.29 \times 10^6}{2000 \times 219^2 \times 25} = 0.016$

$I_{ea} = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.016}{0.9}} = 0.98 \approx 0.95$

$z = I_{ad} = 0.95 \times 219 = 208.05$mm

$A_s = \frac{M}{0.95 f_y z} = \frac{39.29 \times 10^6}{0.95 \times 410 \times 208.05} = 494.85$mm²

Provide Y12 @ 225 c/c ($A_s = 2502$mm²)

Support

$M = \frac{85}{100} \times 0.071 \times 4 \times 307.44 = 21.83\ kNm$

$w = \frac{l_{ex}}{2} = 2000mm$

$k = \frac{21.83 \times 10^6}{2000 \times 219^2 \times 25} = 0.0091$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.0091}{0.9}} = 0.99 \geq 0.95$

$z = 208.05 \times 0.95 \times 2 = 208.05mm$

$A_s = \frac{21.83 \times 10^6}{209.05 \times 0.95 \times 410} = 269.39mm^2$

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

Column Strip: (Span)

$Span = l_{ex} - 2h = 3200$

$Width = \frac{l_{ex}}{3} = 2000$

$M = \frac{55}{100} \times 0.071 \times 307.44 \times 4 = 48.02\ kNm$

$k = \frac{48.02 \times 10^6}{2000 \times 219^2 \times 25} = 0.02$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.02}{0.9}} = 0.98 \geq 0.95$

$z = 0.95 \times 219 = 208.05mm$

$A_s = \frac{48.02 \times 10^6}{0.95 \times 410 \times 208.05} = 592.58mm^2$

Provide Y12 @ 175 c/c ($A_s = 646mm^2$)

Support

$\frac{75}{100} \times 0.071 \times 307.44 \times 4 = 65.48\ kNm$

$k = \frac{65.48 \times 10^6}{2000 \times 219^2 \times 25} = 0.029$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.029}{0.9}} = 0.97 \geq 0.95$

$z = 208.05mm$

$A_s = \frac{65.49 \times 10^6}{0.95 \times 410 \times 209.05} = 808.04 mm^2$

Provide Y12 @ 125 c/c ($A_s = 905 mm^2$)

Long span:

Middle strip: (Span)

effective span $= l_y - \frac{2}{3}h = 4.5 - \frac{2}{3} \times 1.2 = 3600 mm$

Moment $= 0.45 \times 0.071 \times 307.44 \times 4.5 = 44.2 kNm$

width $= l_y - \frac{l_x}{2} = 4.5 - \frac{4.0}{2} = 2.5 = 2500 mm$

$d = 219$

$k = \frac{M}{bd^2 f_{cu}} = \frac{44.2 \times 10^6}{2500 \times 219^2 \times 24} = 0.015$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.015}{0.9}} = 0.99 \simeq 0.95$

$Z = 208.05$

$A_s = \frac{44.2 \times 10^6}{0.95 \times 410 \times 208.05} = 545.44 mm^2$

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

Support

$M = 0.25 \times 0.071 \times 307.44 \times 4.5 = 24.56 kNm$

$w = l_y - \frac{l_x}{2} = 4.5 - \frac{4}{2} = 2500 mm$

$k = \frac{24.56 \times 10^6}{2500 \times 219^2 \times 25} = 0.0012$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.0012}{0.9}} = 0.99 \simeq 0.95$

$Z = 208.05$

$A_s = \frac{24.56 \times 10^6}{0.95 \times 208.05 \times 410} = 303.08 mm^2$

provide Y12 @ 200 c/c ($A_s = 377 mm^2$)

Column Strip: (Span)

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

Moment $= 0.55 \times 0.071 \times 307.44 \times 4.5 = 54.03$ kNm

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

$$k = \frac{54.03 \times 10^6}{2000 \times 219^2 \times 25} = 0.023$$

$$I_a = 0.95 + \sqrt{0.25 - \frac{0.023}{0.9}} = 0.97 \geq 0.95$$

$z = 208.05$

$$A = \frac{54.03 \times 10^6}{0.95 \times 208.05 \times 410} = 666.75 mm^2$$

Provide Y12 @ 150 C/C ($A_s = 754 mm^2$)

Support

Moment $M = 0.75 \times 0.071 \times 307.44 \times 4.5$

$= 73.67$ kNm

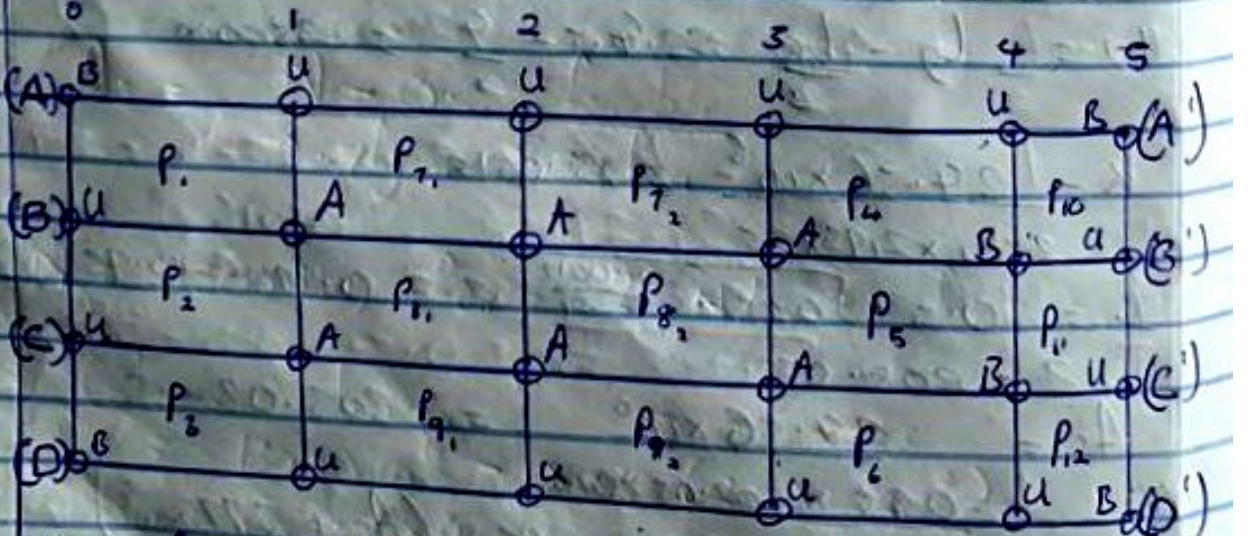
$$k = \frac{73.67 \times 10^6}{2000 \times 219^2 \times 25} = 0.031$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.031}{0.9}} = 0.97 \geq 0.95$$

$z = 208.05$

$A_s = 909.11 mm^2$

Provide Y12 @ 100 C/C ($A_s = 1130 mm^2$)

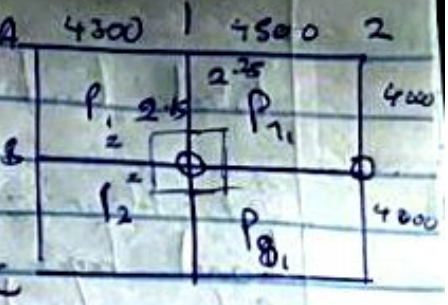


A - Axially loaded

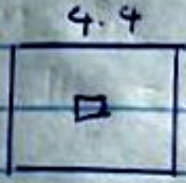
U - Uniaxially loaded

B - Biaxially loaded

b Designing for column B1.
For 3 floor.



i Column Load Calculation
Assuming column dimensions as 225×225
Volume of concrete = $0.225^2 \times 3$ =



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

Slab load
wt 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 wt = $0.225 \times 0.600 \times 24 = 3.24\ kN/m^2$
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
$= 17.6 \times 1.5^2 = 39.6\ kN$
Roof beam = $0.225 \times 0.450 \times 24 = 2.43\ kN/m^2$
finishes = $1.0\ kN/m^2$
$= 3.43\ kN/m^2$
Roof beam = $3.43 (4 + 4.4) \times 1.4 = 40.34\ kN$
Column load = $10\ kN$

Total load = 89.94 kN

3rd floor - 2nd floor

Load from above = 89.941 kN
Colum load = 10 kN
Slab load = 17.6 × 12.12 = 213.312 kN
Beam load = 19.11 × (8.4) = 160.524 kN
= 463.776 kN

2nd floor - 1st floor

Load from above = 463.78 kN
Column load = 10 kN
Slab = ~~249~~ 213.312 kN
Wall & Beam = 160.524 kN
= 865.61 kN

1st floor - Ground floor

Load from above = 865.61 kN
Columb load = 10 kN
Slab = 213.312 kN
Wall & Beam = 160.524
= 1249.45 ≈ 1300 kN

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

N = 1300 kN, f_{cu} = 25 N/mm², f_y = 410 N/mm²

Column dimensions = 225 × 225

$$= \frac{1300 \times 10^3 - 0.35 (25 \times 225^2)}{0.7 \times 410 - 0.35 \times 25}$$

= 3080.08 mm²

Provide 8Y25 (A_{st} = 3930 mm²)

$A_{s min}$ = 0.4% b_c = 0.004 × 225² = 202.5 mm²