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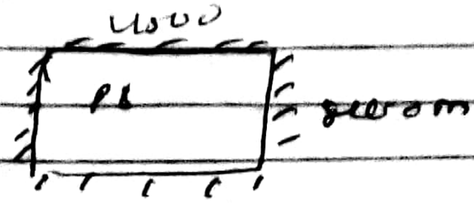
Civil engineering

Designing P5



Capital / dropping = 1.2m
25 = 40N/mm² concrete grade
Slab thickness = 250mm
Finishes = 1.2 kN/m²
Partition = 1.0 kN/m²
Slab = 0.25 × 25 = 6 kN/m²
Total = 8.2 kN/m²

Designing by Reach = 50
Area = 4.5 × 4 = 18 m²
DC per area = 1.4 Gk + 1.6 Qk
= (1.4 × 8.2 × 18) + 1.6 × 5 × 18)
206.64 + 135
341.64

Short span → middle span → span
Span = Lx = 2/3 h = 4 − 2/3 × 1.2 = 3200mm

Moment = 45 90 × 0.071 × l = 45/100 × 0.0071 × 341.6

x 4 = 43.68 kN/m

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

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

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

$l_a = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.018}{0.9}} = 0.974 > 0.95$

$= 0.95$

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

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

Provide y12 @ 200 c/c ($A_s = 566\,mm$)

Spot

$M_2 = 25\% \times 0.071 fL = \frac{25}{100} \times 0.071 \times 364.66 \times A = 26.25$

$W = 2000mm = b$

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

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

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

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

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

Column strip (span)

Span = 3200mm

b = 2000mm

$M = 55\% \ 0.071 fL = \frac{55}{100} \times 0.071 \times 364.66 \times 4 = 53.36 kNm$

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

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

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

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

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

Middle strip (Support)

$M = \frac{75}{100} \times 0.071 \times 341.64 \times 4$ = ~~72.07~~ 72.77

$k = \frac{72.77 \times 10^6}{2020 \times 219^2 \times 25}$ = 0.030

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

z = 208.05

0.95

$As = \frac{72.77 \times 10^6}{208.05 \times 460 \times 0.95}$ = ~~950.~~ 898

Provide Y12 @ 125 c/c ~~125~~ ~~95~~ (A_s = 905 mm)

Long span → middle strip → (span)

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

Moment = $0.45 \times 0.071 \times 341.64 \times 4.5$ = ~~81.99~~ 49.12

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

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

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

z = 208.05

$A_s = \frac{49.12 \times 10^6}{0.95 \times 208.05 \times 460}$ = 606.15

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

Support

M = 0.25 − 0.021 × 38.64² × 4.5 = 28.89

b = 2500

d = 219

$k = \frac{28.89 \times 10^6}{2500 \times 219^2 \times 35}$ = 9.18×10^{-3}

$la = 0.5 + \sqrt{0.25 - \frac{9.18 \times 10^{-3}}{0.9}}$ = 0.989 > 0.95 = 0.95

z = la·d = 208.05

$As = \frac{28.89 \times 10^6}{0.95 \times 208.05 \times 410}$ = 356.56

Provide Y12 @ 300c/c As = 377mm²

Column strip

span = 3700mm

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

Moment = 0.55 × 0.071 × 38.64² × 4.5 = 60.09

$k = \frac{60.09 \times 10^6}{2000 \times 219^2 \times 25}$ = 0.025

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

z = 208.05

$As = \frac{60.09 \times 10^6}{0.95 \times 410 \times 208.05}$ = 740.41

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

Support

Moment = 0.29 × 0.0?? × 31.6? × 4.5 = 81.87

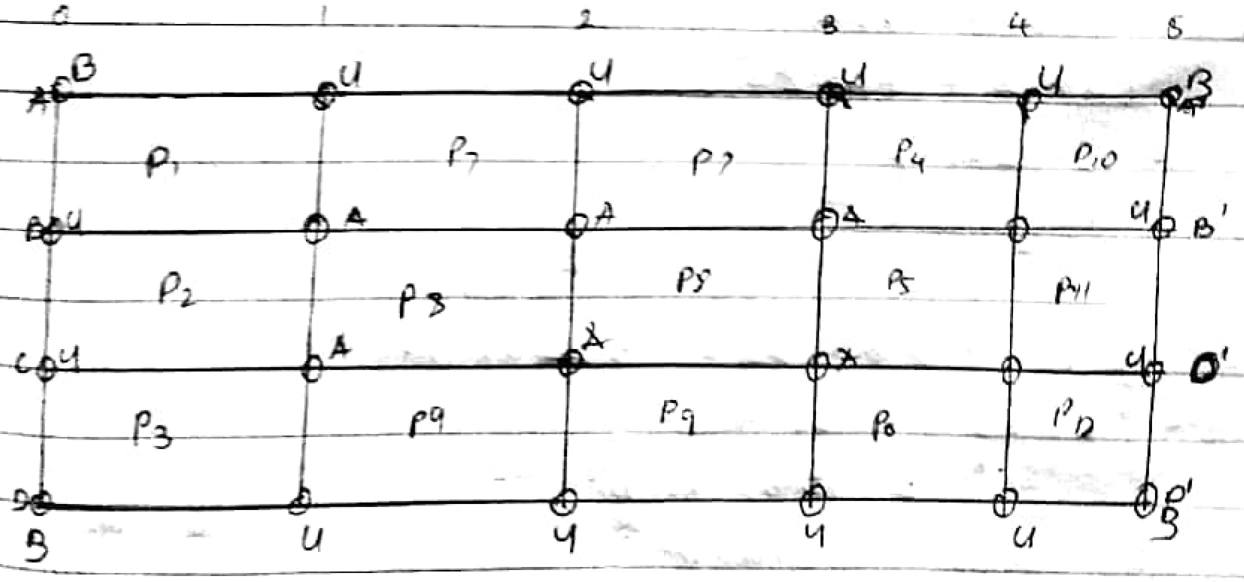
$k = \frac{81.87 \times 10^6}{1000 \times 240^2 \times 25} = 0.034$

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

z = 205.05

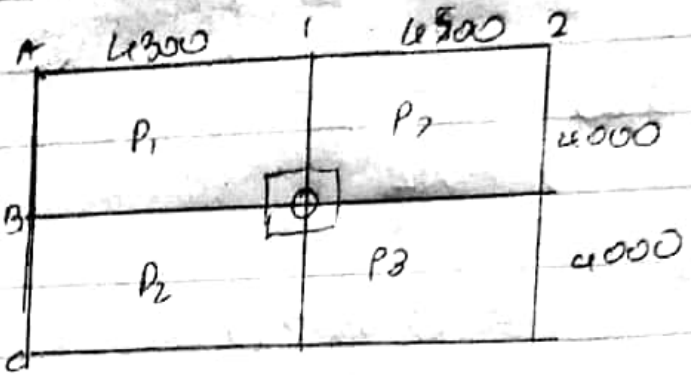
$A_s = \frac{81.87 \times 10^6}{0.95 \times 400 \times 205.05} = 1010.298$

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



key = A = Axial
B = Biaxially
U = Uniaxially

Designing for column B1



A = 4 x 4.4 = 17.6m²

Slab load

Weight of slab = 0.15 x 24 = 3.6kN/m²

Finishes = 1.2kN/m²

Partition = 1.0kN/m²

5.8kN/m²

Design load = 1.4Gk + 1.6Qk

1.4 x 5.8 + 1.6 x 2.5

= 12.12kN/m²

Beam Load

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

wall load = 3.47 x 3 = 10.41 kN/m²

= 13.65 kN/m²

DL = 1.4 x 13.65 = 19.11kN/m²

Design

Roof - 3rd Floor

Roof load = Area x 1.5 x 1.5

= 17.6 x 1.5² = 39.6kN

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

Finishes = 1.0kN/m²

= 3.43 kN/m²

Wall beam = 3·43 (44) × 1·4

Column load = 10kN
Total load = 89·94 kN

3rd floor → 2nd floor
Load from above = 89·94 kN
Column load = 10kN
Slab load = 17·6 × 12 · 12 = 213·312 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 = 10kN
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 = 10kN
slab = 213·312 kN
wall & beam = 160·524
= 1249·45 ≃ 1300 kN

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

N = 1300 kN
f_{cu} = 25
f_y = 410
b = [illegible]

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

$$= 3080.07 mm^2$$

Provide 8 y 25 ($A_s = 3430 mm^2$)

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