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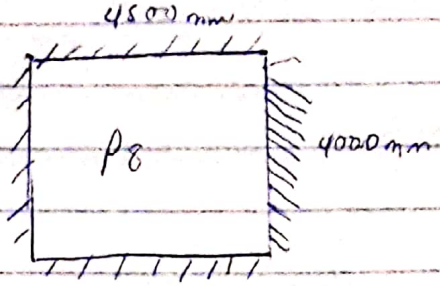
16/Eng03/052
Civil Engineering

Designing for P8



Capital / diagonal = 12m
25 – 410 N/mm² (Concrete grade)
slab thickness = 250mm

Finishes = 1.2 KN/m²
partitions = 1.0 KN/m²
slab = 0.25 × 25 = 6 KN/m²
Total = 8.2 KN/m²

Designing for factory = 5.0

Area = 4.5 × 4 = 18 m²

D.L per area = 1.4 (Gk) + 1.6 (Qk)
= 1.4 (1.4 × 8.2 × 18) + (1.6 × 5 × 18)
= 206.64 + 144
= 350.64

Short span ⟶ middle strip → span

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

Moment = 45° × 0.071 RL
= $\frac{45}{100}$ × 0.071 × 350.64 × 4
= 44.81 KN/m.

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

$d = h - cover - 0.5\phi = 250 - 25 - 6 = 219mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{44.81 \times 10^6}{2000 \times 219^2 \times 25} = 0.0186$

$I_a = 0.5 + \sqrt{0.25 - \frac{K}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.0186}{0.9}} = 0.97 > 0.95$

0.95

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

$A_s = \frac{M}{0.95 f_y Z} = \frac{44.81 \times 10^6}{0.95 \times 410 \times 208.5} = 552.9$

provide Y_{12} @ 200 c/c (A_s = 566m

Support

$M_x = 25 \times 0.071 f_L = \frac{25}{100} \times 0.071 \times 350.64 \times 4$

$= 24.89$

$w = 2000m = b$

$K = \frac{24.89 \times 10^6}{2000 \times 219^2 \times 25} \} 0.01$

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

$A_s = \frac{24.89 \times 10^6}{0.95 \times 208.05 \times 410} = 307.15$

provide y12@300 c/c ($A_s = 377 mm^2$)

Column strip (span)

Span = 3200mm

$b = 2000mm$

$M = 55\% \ 0.071 f_L$

$= \frac{55}{100} \times 0.071 \times 350.64 \times 4$

$= 54.76 kN/m^2$

$K = \frac{M}{bd^2 f_{cu}} = \frac{54.76 \times 10^6}{2000 \times 219^2 \times 25} = 0.023$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.023}{0.9}} = 0.97 > 0.95$

$= 0.95$

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

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

provide y12@150c/c (A_s = 754mm)

Column strip (Support)

$M = \frac{75}{100} \times 0.071 \times 350.64 \times 4$

$= 74.69$

$K = \frac{74.69 \times 10^6}{2000 \times 219^2 \times 25} = 0.031$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.031}{0.9}} = 0.96 > 0.95 = 0.95$

$Z = I_a d = 208.05$

$A_s = \frac{74.69 \times 10^6}{208.05 \times 410 \times 0.95} = 921$

Provide y12@125c/c (A_s = 905mm)

Long span - middle strip - span

Effective span = $l_y - \frac{2}{3} h$

$= 4.5 - \frac{2}{3} \times 1.2 = 3700$ mm.

Moment $= 0.45 \times 0.071 \times 350.64 \times 4.5$

$= 50.41$

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

$K = \frac{50.41 \times 10^6}{2500 \times 219^2 \times 25} = 0.0168$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.0168}{0.9}} = 0.98 > 0.95 = 0.95$

$Z = 208.05$

$A_s = \frac{50.41 \times 10^6}{0.95 \times 208.05 \times 410} = 622.07$

provide y12 @175c/c (A_s = 646 mm^2)

Support

$M = 0.25 \times 0.071 \times 350.64 \times 4.5 = 28.07$

$b = 2500$

$d = 219$

$K = \frac{28.01 \times 10^6}{2500 \times 219^2 \times 25} = 9.34 \times 10^{-3}$

$I_a = 0.5 + \sqrt{0.25 - \frac{9.34 \times 10^{-3}}{0.9}} = 0.989 > 0.95$

$Z = I_a d = 208.05$

$A_s = \frac{28.01 \times 10^6}{0.95 \times 208.05 \times 410} = 345.65$

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

Column strip

Span = 3700 mm

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

Moment = $0.55 \times 0.071 \times 350.64 \times 4.5 = 61.62$

$K = \frac{61.62 \times 10^6}{2000 \times 219^2 \times 25} = 0.025$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.025}{0.9}} = 0.97 > 0.95 = 095$

$Z = 208.05$

$A_s = \frac{61.62 \times 10^6}{0.95 \times 410 \times 208.05} = 760.40$

Provide y12 @ 150 c/c ($A_s = 756 mm^2$)

Support

Moment = $0.75 \times 0.071 \times 350.64 \times 4.5 = 84.02$

$K = \frac{84.02 \times 10^6}{2000 \times 219^2 \times 25} = 0.035$

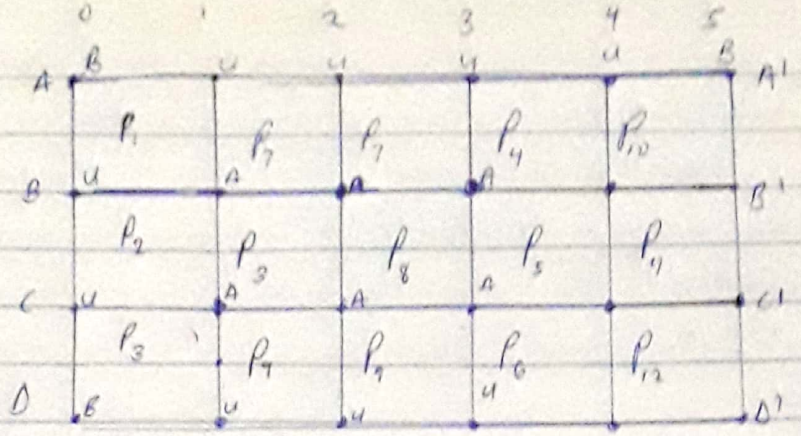
$I_a = 0.5 + \sqrt{0.25 - \frac{0.025}{0.9}} = 0.96 > 0.95$

$Z = 208.05$

$A_s = \frac{84.02 \times 10^6}{0.95 \times 410 \times 208.05} = 1036.83$

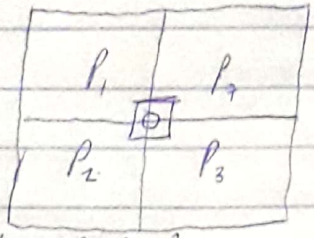
provide y12 @ 100 c/c ($A_s = 1130 mm^2$)

Q2



Key = A = Axial
B = Biaxially
U = Uni-axially

Designing for Column B1



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

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 = $1.4(Gk) + 1.6(Qk)$

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

$= 12.12 kN/m^2$

Beam load

Beam weight = $0.225 \times 0.6 \times 24 = 3.24 kN/m^2$

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 × 1.5²

= 17.6 × 1.5² = 39.6kN

Roof beam = 0.225 × 0.45 × 24 = 2.43 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

Column load = 10 kN

Slab load = 17.6 × 12 × 1.2 = 213.312 kN

Beam load = 19.11 × (8.4) = 160.524 kN

Total = 463.776 kN

2nd floor - 1st floor

Load from above = 463.78 kN

Column load = 10 kN

Slab load = ~~160.52 kN~~ 213.312 kN

Wall & beam load = 160.52 kN

Total = 856.61 kN

1st floor - ground floor

Load from above = 856.61 kN

Column load = 10 kN

Slab load = 213.312 kN

wall & beam load = 160.524

Total = 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

$b = 25$

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

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

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

$= 202.5\ mm^2$.