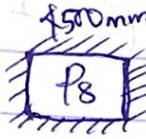
Samuel Adebayo Almartson
Civil Engineering 17/ENG03/038

Designing for P8



$A_{tog} = 4.5 \times 4 = 18m^2$

Capital/dropping = 1.2m
grade stress = 25-410 N/mm²
Thickness = 250 mm

loading
slab weight = $0.25 \times 24 = 6 kN/m^2$
finishes = $1.2 kN/m^2$
partition = $1.0 kN/m^2$
$G_K = 8.2 kN/m^2$

$\Delta L = 1.4 G_K + 1.6 Q_K$ $Q_K = 5.0$ (factory)

~~$1.4(8.2) + 1.6(5.0)$~~

$= [1.4(8.2) \times (4.5 \times 4)] + [1.6(5.0) \times (4.5 \times 4)]$

$\Delta L(F) = 350.64 kN/m^2$

Short span
Middle strip span

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

Moment $= 45\% \times 0.071 FL$

$= \frac{45}{100} \times 0.071 \times 350.64 \times 4 = 44.81 kN/m$

width, $b = l_x/2 = 4/2 = 2m = 2000\ mm$

$d = h - cover - \frac{1}{2}\phi$

$= 250 - 25 - \frac{1}{2}(12)$

$= 219\ mm$

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

$Z_a = 0.5 + \sqrt{0.25 - \frac{0.0186}{0.9}} = 0.97\ (\leq 0.95)$

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

$A_s = \frac{m}{0.95 f_y Z} = \frac{44.81 \times 10^6}{0.95 \times 410 \times 208.05} = 552.97 m$

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

Middle strip support

$M_2 = 25\%$ of $0.07 l_x^2$

$= \frac{25}{100} \times 0.07 \times 350.64 \times 4 = 24.89$

$N = 2000 mm$

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

$Z_a = 0.5 + \sqrt{0.25 - \frac{0.01}{0.9}} = 0.99\ (\leq 0.95)$

$Z = 208.05$

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

Provide Y12 @300c/c (377mm²)

Column strip span

span = 3200mm

b = 2000mm

m = 55% of 0.071FL

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

$= 54.76 \text{ kN/m}^2$

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

$Z = 0.5 + \sqrt{0.25 - \frac{0.023}{0.9}} = 0.97 (\leq 0.95)$

$Z = 0.95 \times 219 = 208.05$

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

Provide Y12 @ 150c/c (754mm)

Column strip support

$m = 75/100 \times 0.071 \times 350.64 \times 4 = 74.69 \text{ kN/m}^2$

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

$Z = 0.5 + \sqrt{0.25 - \frac{0.031}{0.9}} = 0.96 (\leq 0.95)$

$Z = 208.05$

$A_s = \frac{74.69 \times 10^6}{208.05 \times 410 \times 0.95} = 924 \text{ mm}$

Provide Y12 @125c/c (905mm)

Long span

Middle strip span

$\text{span} = l_y - \frac{2}{3}l = 4.5 - \frac{2}{3} \times 1.2 = 3.7m = 3700mm$

$m = .45/100 \times 0.071 \times 350.64 \times 4.5 = 50.41 kN/m^2$

$b = l_y - l_{x/2} = 4.5 - 4/2 = 2.5m = 2500mm$

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

$J_q = 0.5 + \sqrt{0.25 - \frac{0.0168}{0.9}} = 0.98 (\leq 0.95)$

$z = 0.95 \times 219$

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

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

Middle strip support

$m = 0.25 \times 0.071 \times 350.64 \times 4.5 = 28.01 kN/m^2$

$b = 2500mm$

$d = 219mm$

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

$J_q = 0.5 + \sqrt{0.25 - \frac{9.34 \times 10^{-3}}{0.9}} = 0.989 (\leq 0.95)$

$z = J_q \cdot d = 208.05$

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

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

Column strip

span = 3700mm

width = $l_y/2$ = 2000mm

Moment = 0.55 × 0.071 × 350.64 × 4.5 = 61.62

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

$I_a = 0.5 + \sqrt{0.25 - \frac{0.025}{0.9}} = 0.97 (\leq 0.95)$

Z = 208.05

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

Provide Y12 @ 150% (756mm)

Support

$M = 0.75 \times 0.071 \times 350.64 \times 4.5 = 84.02 kN/m^2$

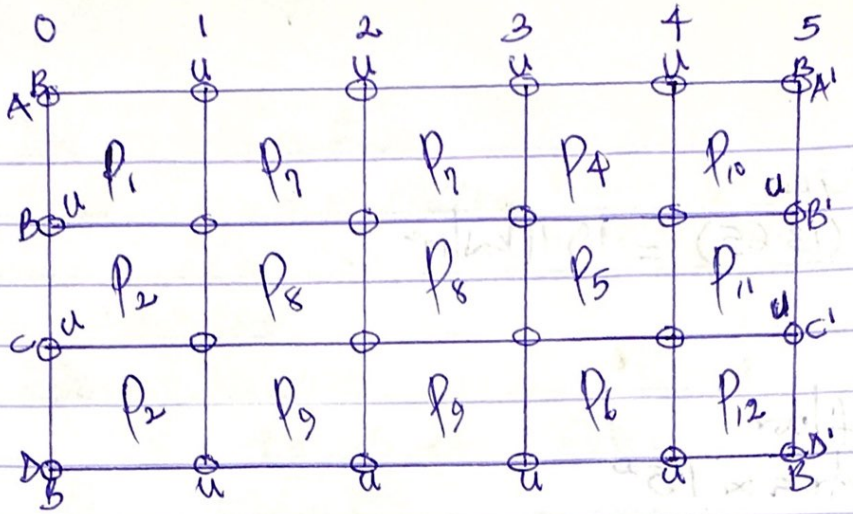
$K = \frac{84.02 \times 10^6}{2000 \times 219^2 \times 25} = 0.035$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.035}{0.9}} = 0.96 (\leq 0.95)$

Z = 208.55

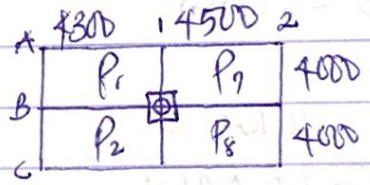
$A_s = \frac{84.02 \times 10^6}{0.95 \times 410 \times 208.05} = 1036.83mm$

Provide Y12 @ 100% (1130mm



Key = A = Axially
B = Biaxially
U = Uniaxially

Designing for column B1



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

Loading

slab weight = $0.15 \times 24 = 3.6 kN/m^2$

finishes = $1.2 kN/m^2$

partition = $1.0 kN/m^2$

$G_k = 5.8 kN/m^2$

$D.L = 1.4G_k + 1.6Q_k$

$= 1.4(5.8) + 1.6(2.5)$

$= 12.12 kN/m^2$

Loading

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

wall load = $3 \times 3.47 = 10.41 kN/m^2$

$G_k = 13.65 kN/m^2$

D.L = 1.4gk
= 1.4 (13.65) = 19.11 kN/m²

Design
Roof - 3rd floor
Roof load = Area x 1.5²
= 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

Column Load = 10 kN
Total Load = 89.94kN

3rd flor - 2nd flor
Load from above = 89.94kN
Column Load = 10kN
Slab load = 17.6 x 12.12 = 213.312 kN
Beam Load = 19.11 (8.4) = 160.524kN
Total = 463.776 kN

2nd flor - 1st flor
Load from above = 463.78 kN
column load = 10kN
slab = 213.312 kN
Wall & Beam = 160.52 kN
Total = 856.6kN

1st flow to ground flow

Load from above = 565.61kN

Column Load = 101kN

slab = 243.312kN

Wall & Beam = 160.524

= 1249.45 ≈ 1300kN

$$A_s = \frac{N - 0.35 f_{cu} bh}{0.70 f_y - 0.35 f_{cu}}$$

N = 1300kN

$f_{cu} = 25$

$f_y = 410$

$b = 25$

$$A_s = \frac{1300 \times 10^6 - 0.35(25 \times 225^2)}{0.70 \times 410 - 0.35 \times 25}$$

Provide 8Y25 ($3930mm^2$)

$A_{s\,min} = 0.4\%\, bh = 0.4/100 \times 225 \times 225$

$= 202.5mm^2$