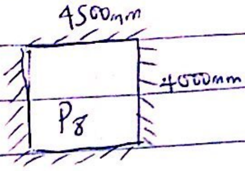
OHWO JAMES EJAOGHENE CVE 308
CIVIL ENGINEERING 17/ENG03/039

Designing for P_8



Capital/dropping = 1.2m
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 = 18m²

D.L per area = $1.4 G_k + 1.6 Q_k$
= (1.4 × 8.2 × 18) + (1.6 × 5 × 18)
= 206.64 + 144
= 350.64

Short span → Middle strip → span

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

Moment = 45% × 0.071 FL
= 45/100 × 0.071 × 350.64 × 4
= 44.81 kN/m

Width = b = $l_x/2 = 4/2 = 2 = 2000mm$

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

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

$Ia = 0.5 + \sqrt{0.25 - k/0.9} = 0.5 + \sqrt{0.25 - \frac{0.0186}{0.9}} = 0.97 > 0.95$
$= 0.95$

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

$As = \frac{M}{0.95 fy_z} = \frac{44.81 \times 10^6}{0.95 \times 410 \times 208.05} = 552.9$

provide Y12 @ 200 c/c ($As = 566mm$)

Support

$M_2 = 25\%$ of $0.071 \beta l = \frac{25}{100} \times 0.071 \times 350.64 \times 4$
$= 24.89$

$W = 2000m = b$

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

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

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

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

Column Strip (span)

Span = 3200mm

b = 2000mm

$M = 55\% \; 0.071 \beta l = \frac{55}{100} \times 0.071 \times 350.64 \times 4$
$= 54.76 \, kN/m^3$

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

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

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

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

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

Column strip support

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

$= 74.69$

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

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

$z = 208.05$

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

provide Y_{12} @ 125 c/c ($A_s = 905mm$)

Long span - Middle strip - span

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

$= 4.5 - 2/3 \times 1.2 = 3700mm$

Moment $= 0.45 \times 0.071 \times 350.64 \times 4.5 = 50.41$

Width $= b = l_y - l_x/2 = 4.5 - 2 = 2.5 = 2500$

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

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

$Z = 208.05$

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

provide Y_{12} @ 175 c/c ($A_s = 646mm^2$)

Support

$M = 0.25 \times 0.071 \times 350.64 \times 4.5 = 28.01$

$b = 2500$

$d = 219$

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

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

$= 0.95$

$Z = I_a d = 208.05$

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

provide Y_{12} @ 300 c/c A_s (377 mm^2)

Column Strip

Span = 3700 mm

Width = $l_y/2$ = 2000 mm

Moment = $0.55 \times 0.071 \times 350.64 \times 45 = 61.62$

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

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

$Z = 208.05$

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

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

Support

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

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

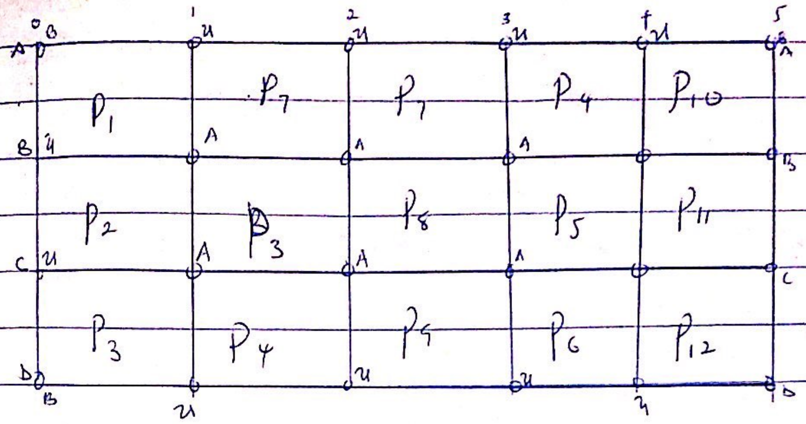
$I_a = 0.5 + \sqrt{0.25 - \frac{0.035}{0.9}} = 0.96 > 0.95 = 0.95$

$Z = 208.05$

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

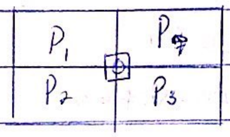
provide Y_{12} @ 100 c/c (A_s = 1130)

2a



Key A = Axial
B = Biaxially
U = Uniaxially

Design for Column B1



A = 4×4.4 = 17.6 m²

Slab load

Weight of slab = 0.15 × 24 = 3.6 kN/m²
finishes = 1.2 kN/m²
partitions = 1.0 kN/m²
5.8 kN/m²

Design load = 1.4 Gk + 1.6 Qk
= 1.4×5.8 + 1.6×2.5
= 12.12 kN/m²

Beam load

Beam wt = 0.225 × 0.6 × 24 = 3.24 kN/m²
Wall load = 3.47 × 3 = 10.41 kN/m²
= 13.65 kN/m²

DL = 1.4 × 13.65 = 19.11 kN/m²

Design

Roof - 3rd floor

Roof load = Area x 1.5 x 1.5

= 17.6 x 1.5^2 = 39.6kN

Roof beam = 0.225 x 0.45 x 24 = 2.43kN/m^2

finishes = 1.0 kN/m^2

= 3.43kN/m^2

Column load = 10kN

Total load = 89.94 kN

3rd floor - 2nd floor

Load from above = 89.94kN

Column load = 10kN

Slab load = 17.6 x 12.12 = 213.312 kN

Beam load = 19.11 x (8.4) = 160.524 kN

Total = 463.776kN

2nd floor to 1st floor

Load from above = 463.78kN

Column load = 10kN

Slab = 213.312kN

Wall & Beam = 160.52kN

Total = 856.61kN

1st floor to ground floor

Load from above = 865.61kN

Column load = 10kN

Slab = 213.312 kN

Wall & Beam = 160.524

= 1249.45 ⇒ 1300kN

$$As = \frac{N - 0.35 f_{cu} bh}{0.7 f_y - 0.35 f_{cu}}$$

$N = 1300\,kN$

$f_{cu} = 25$

$f_y = 410$

$b = 25$

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

provide 8y25 ($A_s = 3930\,mm^2$)

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