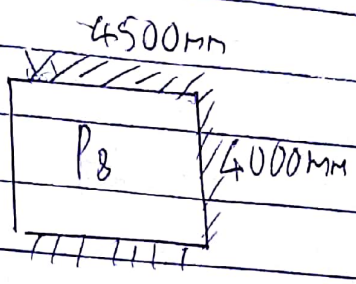
NWAGBE ANTHONY OSAGIE
F17/ENG03/053
Structural Design.

Designing for P8



Capital I dropping = 1.2m
25 - 410 N/mm² concrete
Slab thickness = 250mm

finishes = 1.2kN/m
Partitions = 1.0kN/m²
Slab = 0.25 × 25 = 6kN/m²
Total = 8.2kN/m²

Designing for factory = 5.0
Area = 4.5 × 4 = 18m²
0.L per area = 1.4Gk + 1.6Qk.
= (1.4 × 8.2 × 18) + (1.6 × 5 × 18)
206.64 + 135
341.64

Shorter span ⟶ Middle strip ⟶ Span.
Span = $L_x - \frac{2}{3}h = 4 - \frac{2}{3} \times 1.2 = 3200mm$

moment = 45% × 0.071 fl = $\frac{45}{100} \times 0.071 \times 341.6 \times 4$

= 43.68 kN/m²

width = $b = \frac{L_x}{2} = \frac{L}{2} = \frac{2}{2} = 2000mm$

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

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

$l_a = 0.5 + \sqrt{0.25 - \frac{K}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.018}{0.9}} =$

$0.974 > 0.95$

$= 0.95$

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

$A_s = \frac{M}{0.95 f_{y2}} = \frac{43.66 \times 10^6}{0.95 \times 410 \times 208.05} = 538.8$

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

Sport

$M_2 = 25\% \times 0.071 fl = \frac{25}{100} \times 0.071 \times 341.64 \times 4 = 24.25$

$W = 2000\,m = b$

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

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

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

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

Provide Y16 @ 300 c/c ($A_s = 377\ mm^2$)

Column strip (span)

Span = 3200 mm

b = 2000 mm

m = 55% 0.0714 = $\frac{55}{100} \times 0.071 \times 341.64 \times 4 = 53.36\ kN/m^2$

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

$Z_o = 0.5 + \sqrt{0.25 - \frac{0.22}{0.9}} = 0.97 > 0.95 = 0.95$

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

$A_s = \frac{53.36 \times 10^6}{0.95 \times 410 \times 208.05} = 658.4$

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

Column strip (support)

$m = \frac{75}{100} \times 0.071 \times 341.64 \times 4 = 72.77$

$= \frac{77.77 \times 10^6}{2000 \times 219^2 \times 25} = 0.030$

$Z_o = 0.5 + \sqrt{0.25 - \frac{0.232}{0.9}} = 0.96 > 0.95 = 0.95$

$Z = 208.05$

$A_s = \frac{77.07 \times 10^6}{208.05 \times 410 \times 0.95} = 898$

Provide Y12 @ 125 ($A_s = 905 mm$)

Long. span → middle span → (span)

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

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

width $= 6 = L_y - \frac{L_x}{2} = 4.5 - 2 \cdot 2.5 = 2500$

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

$$\phi a = 0.5 + \sqrt{0.25 - \frac{0.016}{9}} = 0.983 > 0.95 = 0.95$$

$= 208.05$

$$A_s = \frac{49.12 \times 10^6}{0.95 \times 208.05 \times 410} = 606.15$$

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

Support

$M = 0.25 \times 0.071 \times 34.64 \times 4.5 = 24.21$

$b = 2500$

$d = 219$

$$k = \frac{28.29 \times 10^6}{2500 \times 219^2 \times 25} \quad 9.10 \times 10^{-3}$$

$$\phi a = 0.5 \times \sqrt{0.25 - \frac{9.10 \times 10^{-3}}{09}} = 0.984 > 0.95 = 0.95$$

$z = \pm a \cdot d = 208.05$

$A_s = \frac{27.29 \times 10^6}{0.95 \times 208.05 \times 410} = 336.76$

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

Column slab

Span = 3700mm

width = $\frac{1}{2}x$ = 2000mm

moment = $0.55 \times 0.071 \times 341.67 \times 4.5 = 60.04$

$k = \frac{60.04 \times 10^6}{2000 \times 219^2 \times 25} = 0.025$

$\pm a = 0.5 + \sqrt{0.25 - \frac{0.027}{0.9}}$ $0.479 > 0.95 = 0.95$

$z = 208.05$

$A_s = \frac{60.04 \times 10^6}{0.95 \times 410 \times 208.05} = 740.91$

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

Support

Moment = $0.75 \times 0.071 \times 341.67 \times 4.5 = 81.87$

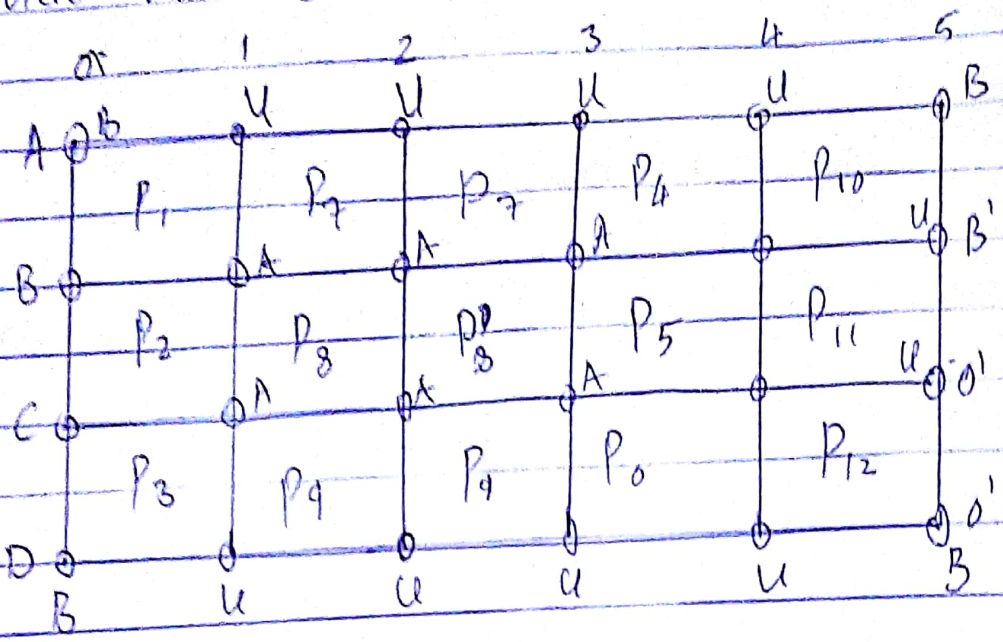
$k = \frac{81.87 \times 10^6}{2000 \times 219^2 \times 25} = 0.034$

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

$Z = 208.05$

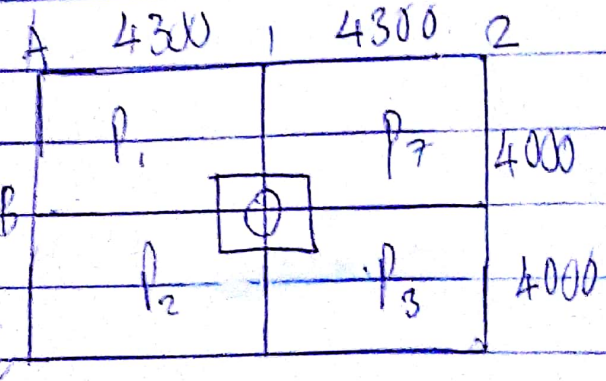
$A_s = \frac{81.87 \times 10^6}{0.95 \times 410 \times 208.05} = 1010.298$

Provide Y12 @ 100 c/c ($A_s = 1130$)



Key = A = Axial
B = Biaxially
U = Uniaxially.

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 = $1.22\ kN/m^2$

Partition = $1.0\ kN/m^2$

$5.8\ kN/m^2$

Design Load = $4.4G_k + 1.6Q_k$

$1.4 \times 5.8 + 1.6 \times 2.5$

$= 12.12\ kN/m^2$

Beam load.

beam at = $0.225 \times 0.6 \times 24 = 3.024\ kN/m^2$

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 $\times 1.5 \times 1.5$

$= 17.6 \times 1.5^2 = 39.6\ kN$

Roof Beam = $0.225 \times 0.45 \times 24 = 2.45\ kN/m^2$

Finishes = $1.0\ kN/m^2$

$= 3.43 \text{ kN/m}^2$

Roof Beam $= 3.43(44) \times 14$

Column load $= 10 \text{ kN}$.
total load $= 89.94 \text{ kN}$

3rd floor $\longrightarrow$ 2nd floor
Load above $= 89.947 \text{ kN}$
column Load $= 10 \text{ kN}$.
Slab load $= 17.6 \times 12.12 = 213.312 \text{ kN}$

Beam load $= 19.11 \times (8.4) = 160.524 \text{ kN}$
Total $\Rightarrow 463.776 \text{ kN}$

2nd floor to 1st floor.
Load ~~beam~~ from above $= 463.78 \text{ kN}$.

Column load $= 10 \text{ kN}$
Slab $= 213.312 \text{ kN}$
Total $\Rightarrow 856.61 \text{ kN}$.

1st floor to ground floor.
load from above $= 865.61 \text{ kN}$.
Column load $= 10 \text{ kN}$.
Slab $= 213.312 \text{ kN}$.
wall & beam $= 160.524$
$= 1249.45 \approx 1300 \text{ kN}$

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

$N = 1300\ kN$

$f_{cu} = 25$

$f_y = 410$

$F = 25$

$$A_s = \frac{1300 \times 10^6 - 0.35 (125 \times 225^2)}{0.7 \times 410 - 0.35 \times 25}$$

$$= 3080.07\ mm^2$$

Provide 8 ϕ 25 ($A = 3930\ mm^2$)

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