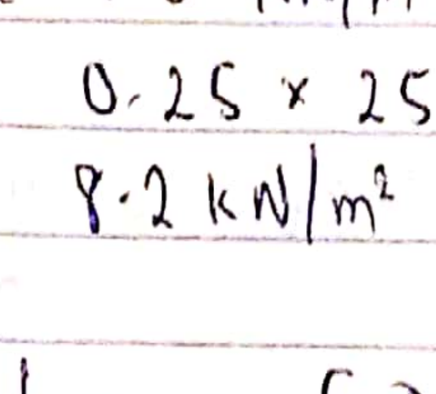
Designing P8



Capital / dropping = 1.2m

25 - 40 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 Gk + 1.6 Qk

= (1.4 × 8.2 × 18) + (1.6 × 5 × 18)

= 206.64 + 135

= 341.64

Short span → Middle strip → Span

Span = l_x - 2/3 h = 4 - 2/3 × 1.2 = 3200mm

Moment = 45% × 0.071 FL =

= 0.45 × 0.071 × 541.68 × 4

= 43.66 kN/m²

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

d = h - cover - ½ ϕ = 20 - 25 - 6 = 219 mm

$K = m/bd^2 f_{cu} = \frac{43.66 \times 10^6}{2000 \times 219^2 \times 2F}$

= 0.018

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

$0.974 > 0.95 = 0.95$

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

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

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

~~Span~~ Support

$M_2 = 25\% \times 0.071 FL = 025 \times 0071 \times 341.6 K = 4$

$= 24.25$

$W = 2000m = b$

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

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

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

$A_s = \frac{24.25 \times 10^6}{0.95 \times 208.05 \times 418} = 299.25$

Provide 410 @ 300 c/c ($A_s = 377 mm^2$)

Column Strip (Span)

Span = 3200mm

b = 2000mm

M = 55% of 0.071 FL = $0.55 \times 0.071 \times 541.64 \times 4$

= 53.36 kN/m²

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

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.022}{0.9}} = 0.97 > 0.95 = 0.95$$

$$z = I_a d = 0.95 \times \frac{219}{448} = 208.05$$

$$A_s = \frac{53.36 \times 10^6}{0.95 \times 410 \times 208.05} = 688.47$$

Provide Y12 @ 180 mm (A_s : 754mm)

Column Strip (support)

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

$$k = \frac{72.72 \times 10^6}{2000 \times 219^2 \times 25} = 0.050$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.050}{0.9}} = 0.96 > 0.95 = 0.95$$

$$z = 208.05$$

$$A_s = \frac{72.77 \times 10^6}{208.05 \times 410 \times 0.95} = 898$$

Provide Y16 @ 125 mm (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

$M = 0.45 \times 0.071 \times 54.64 \times 4.5 = 49.12$

$W = b = l_y - l_x/2 = 4.5 - 2 = 2.5 = 2500$mm

$$K = \frac{59.12 \times 10^6}{2500 \cdot 219^2 \cdot 25} = 0.016$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.018}{0.9}} = 0.98 > 0.95 = 0.95$$

$$z = 205.05$$

$$A_s = \frac{59.12 \times 10^6}{0.95 \times 201.05 \times 410} = 606.15$$

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

Support

$$M = 0.25 \times 0.071 \times 34.64 \times 4.5 = 21.29$$

$$b = 2500$$

$$d = 219$$

$$K = \frac{21.29 \times 10^6}{2500 \times 219^2 \times 25} = 9.10 \times 10^{-3}$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{9.10 \times 10^{-3}}{0.9}} = 0.989 > 0.95 = 0.95$$

$$z = I_a d = 208.05$$

$$A_s = \frac{28.29 \times 10^6}{0.95 \times 208.05 \times 410} = 336.76$$

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

Column Strip

- Span : 3700mm

Width : $L_x/2$ = 2000mm

$$M = 0.55 \times 0.071 \times 32.16 \times 4.5 = 60.04$$

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

$I_1 : 0.5 \cdot \sqrt{0.25 - \frac{0.025}{0.9}} = 0.97 > 0.95 = 0.95$

$z : 206.05$

$A_s = \frac{60.04 \times 10^6}{0.95 \times 410 \times 206.05} = 740.91$

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

Support

Moment $= 0.75 \times 0.071 \times 34.67 \times 4.5 = 81.87$

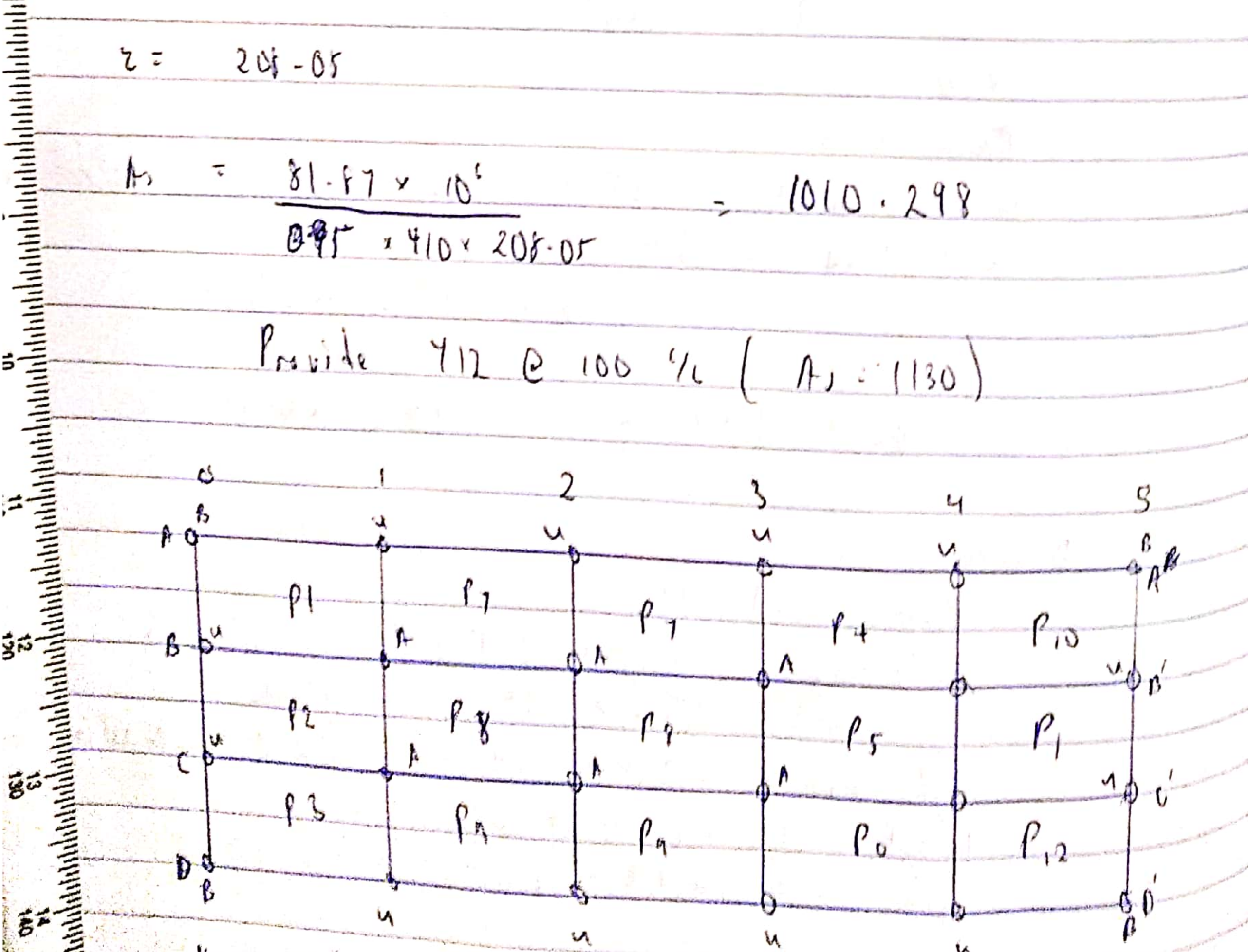
$k = \frac{81.87 \times 10^6}{2000 \times 219^2 \times 27} = 0.034$

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

$z = 204.05$

$A_s = \frac{81.87 \times 10^6}{0.95 \times 410 \times 204.05} = 1010.298$

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

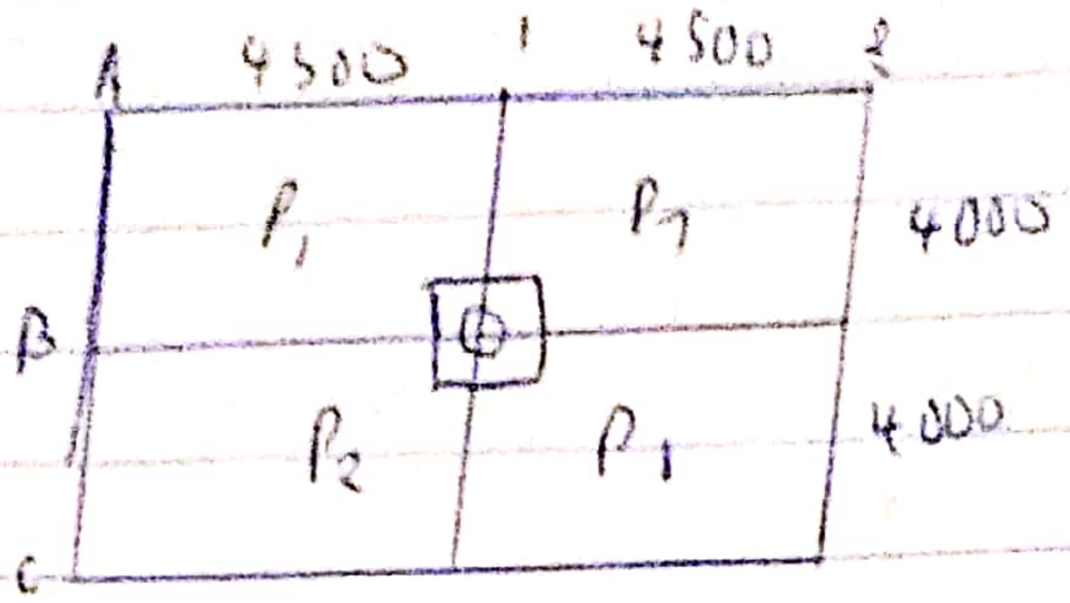


Key A = Axial

B = Biaxial

U = Uniaxial

Designing for Column B_1



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 = $1.0 kN/m^2$

$= 5.8 kN/m^2$

D.L = $1.4 Gk + 1.6 Qk$

$= 4.4 \times 5.8 + 1.6 \times 2.5$

$= 12.12 kN/m^2$

Beam Load

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

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

$\Sigma = 13.65 kN/m^2$

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 = $0.225 \times 0.45 \times 24 = 2.43 kN/m^2$

Finishes = $1.0 kN/m^2$

$= 3.43 kN/m^2$

Column load = 10kN

Total load = 89.94 kN

3rd floor to 2nd floor = 89.99 kN

Column load = 10 kN

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 1,1 Floor

Load = 463.776 kN

Column load = 10 kN

Slab = 213.312 kN

Wall and beam = 160.52 kN

Total = 856.61 kN

1st floor to Ground floor

Load = 856.61 kN

Column load = 10 kN

Slab = 213.312 kN

Walls and beam = 160.524

= 1249.45 ≈ 1300 kN

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

$N = 1300\ kN$

$f_{cu} = 25$

$f_y = 410$

$b = 125$

$$A_s = \frac{1300 \times 10^3 - 0.35 (125 \times 225^2)}{0.7 \times 410 - 0.35 \times 25}$$

$= 3080.07\ mm^2$

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

$A_s\ min = 0.4\ l_e\ h = 0.004 \times 225^2 = 202.5 mm^2$