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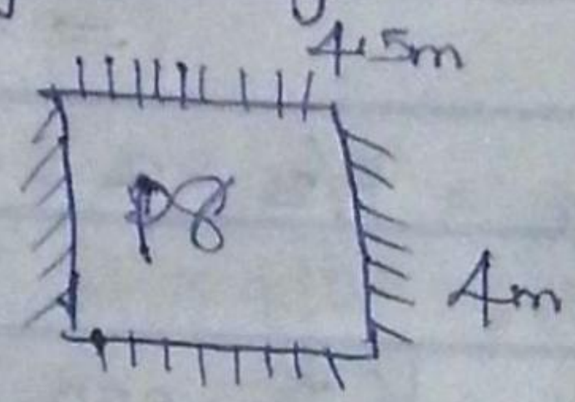
17/ENG03/055
Structural Analysis (CVE 308)
Civil Engineering



Capital dropping = 1.2m
Concrete grade = 25 - 410 N/mm²
Slab thickness = 250mm

Finishes = 1.2 kN/m²
Partitions = 1.0 kN/m²
Slab = 0.25 × 25 = 6.25 = 6kN/m²
Total = 8.2 kN/m²

Factor of design = 5.0
Area = 4 × 4.5 = 18m²
Design load = 1.4Gk + 1.6Qk
= (1.4 × 8² × 18) + (1.6 × 5 × 18)
= 206.64 + 144
= 350.64

Short Span

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

$$\text{Moment} = 45\% \times 0.071\,fl = \frac{45}{100} \times 0.071 \times 350.64 \times 4$$

$$= 44.811\,kN/m^2$$

$$\text{width, } b = \frac{l_x}{2} = 4/2 = 2 = 2000mm$$

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

$$k = \frac{M}{bd^2 f_{cu}} = \frac{44.81 \times 10^6}{2000 \times 219^2 \times 25} = 0.018$$

$$I_a = 0.5 + \sqrt{\frac{0.25 - k}{0.9}} = 0.5 + \sqrt{\frac{0.25 - 0.018}{0.9}} = 0.987 0.95$$

$$= 0.95$$

$$Z = \frac{I_{aq} f}{} = 0.95 \times 219 = 208.05mm$$

$$A_s = \frac{M}{0.95 f_y z} = \frac{44.81 \times 10^6}{0.95 \times 410 \times 208.05} = 552.11\,mm^2$$

Provide f12 @ ?

Support

$$M_2 = 25\% \times 0.071\,fL = \frac{25}{100} \times 0.071 \times 350.64 \times 4$$

$$= 24.9\,kN/m^2$$

$$d = 260mm$$

$$k = \frac{24.9 \times 10^6}{2000 \times 217^2 \times 25} = 0.01$$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.01}{0.9}} = 0.99 > 0.95$
$= 0.95$

$Z = 0.95 \times 219 = 208.05mm$

$A_s = \frac{24.9 \times 10^6}{0.95 \times 410 \times 208.05} = 307.27mm^2$

Provide Y12 @ 377mm

Column strip (span)

Span = 3200mm b = 2000mm

$M = 55\%$ of $0.071 f L = \frac{55}{100} \times 0.071 \times 350.64 \times 4$

$= 54.78 kN/m^2$

$K = \frac{54.78 \times 10^6}{2000 \times 219^2 \times 25} = 0.023$

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

$Z = 0.95 \times 219 = 208.05mm$

$A_s = \frac{54.78 \times 10^6}{410 \times 0.95 \times 208.05} = 676 mm^2$

Provide Y12 @

Support

$M = \frac{75}{100} \times 0.071 \times 350.64 \times 4 = 74.67 kN/m^2$

$$K = \frac{74.69 \times 10^6}{2000 \times 219^2 \times 25} = 0.08$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.08}{0.9}} = 0.97 > 0.95$$

$$= 0.95$$

$$Z = 0.95 \times 219 = 208.05mm$$

$$A_s = \frac{74.69 \times 10^6}{410 \times 208.05 \times 0.95} = 921.7mm^2$$

Provide Y12 @ 1130mm

long Span. ($l_b = 2500$)

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

$Moment = 0.45 \times 0.071 \times 350.64 \times 4.5 = 50.41 KN/m^2$

$$K = \frac{50.41 \times 10^6}{2500 \times 219^2 \times 25} = 0.01$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.01}{0.9}} = 0.97 > 0.95$$

$$= 0.95$$

$$Z = 0.95 \times 219 = 205.05mm$$

$$A_s = \frac{50.41 \times 10^6}{410 \times 208.05 \times 0.95} = 602.07mm^2$$

Provide Y12 @, 616mm

Supports

$M = 0.25 \times 0.071 \times 350.61 \times 4.5 = 28\ kNm/m$

$K = \frac{28 \times 10^6}{2500 \times 219^2 \times 25} = 9.31 \times 10^{-3}$

$I_a = 0.5 + \sqrt{0.25 - \frac{9.31 \times 10^{-3}}{0.9}} = 0.99 > 0.95$
$= 0.95$

$Z = 0.95 \times 219 = 208.05mm.$

$As = \frac{28 \times 10^6}{416 \times 0.95 \times 208.05} = 345.53\ mm^2$

Provide 4/12 @ 377mm

Column strip

Span = 3700m

$b = b/2 = 2000mm$

Moment $= 0.55 \times 0.071 \times 350.61 \times 4.5 = 61.61\ kNm$

$K = \frac{61.61 \times 10^6}{2000 \times 219^2 \times 25} = 0.026$

$I_a = 0.5 + \sqrt{\frac{0.25 - 0.026}{0.9}} = 0.99 > 0.95$
$= 0.95$

$Z = 0.95 \times 219 = 208.05mm$

$As = \frac{61.61 \times 10}{416 \times 0.95 \times 208.05} = 760.28\ mm^2$

Provide ϕ12 @ 905mm

Support

Moment = 0.75 × 0.071 × 350.64 × 4.5 = 84.02 kN/m²

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

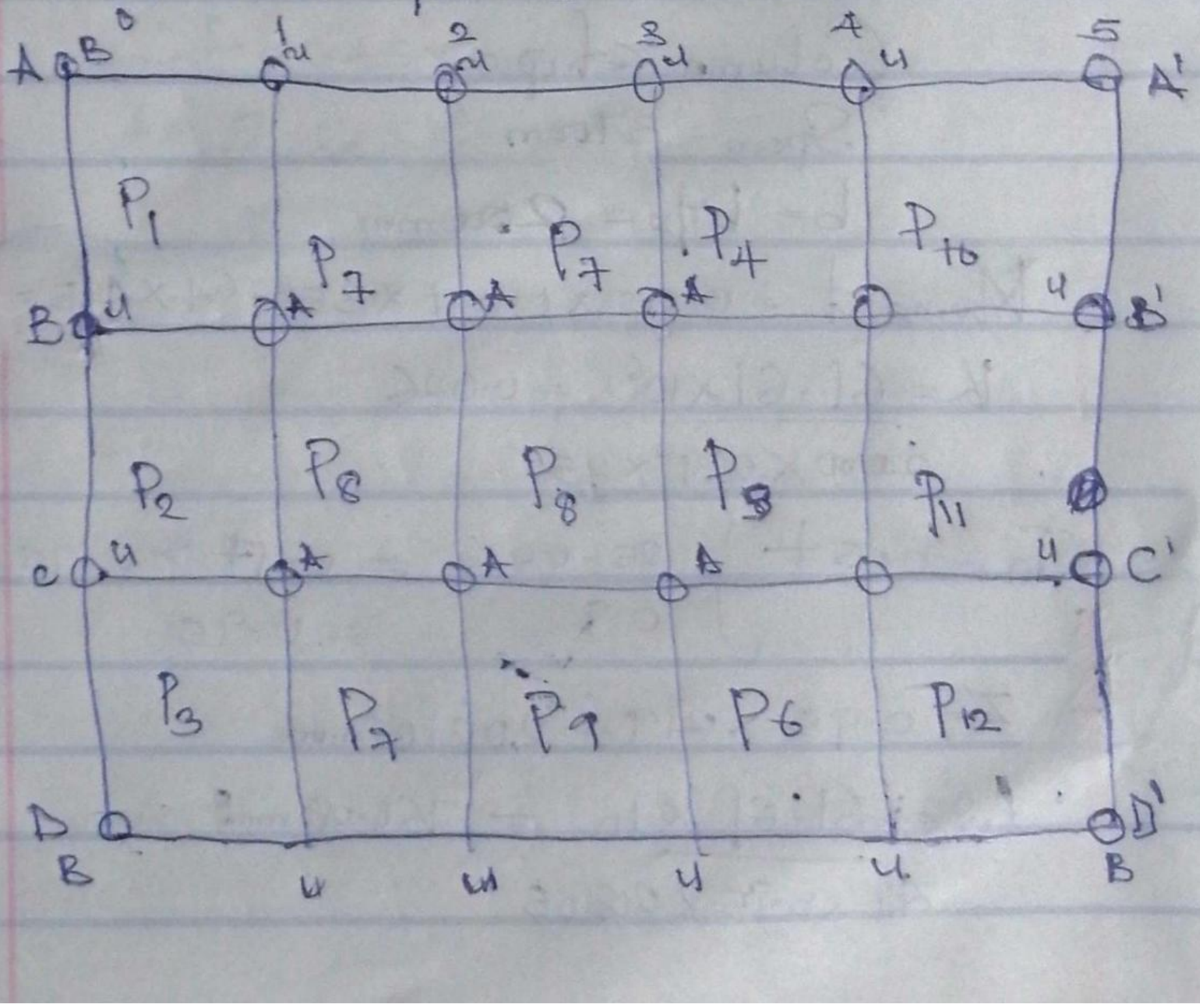
$$I_a = 0.5 + \sqrt{0.25 + \frac{0.035}{0.9}} = 0.96 > 0.95$$

$$= 0.95$$

$$Z = 0.95 \times 219 = 208.05 \text{ mm}$$

$$AS = \frac{84.02 \times 10^6}{0.95 \times 208.05 \times 410} = 1087.2 \text{ mm}^2$$

Provide ϕ12 @ 130 mm

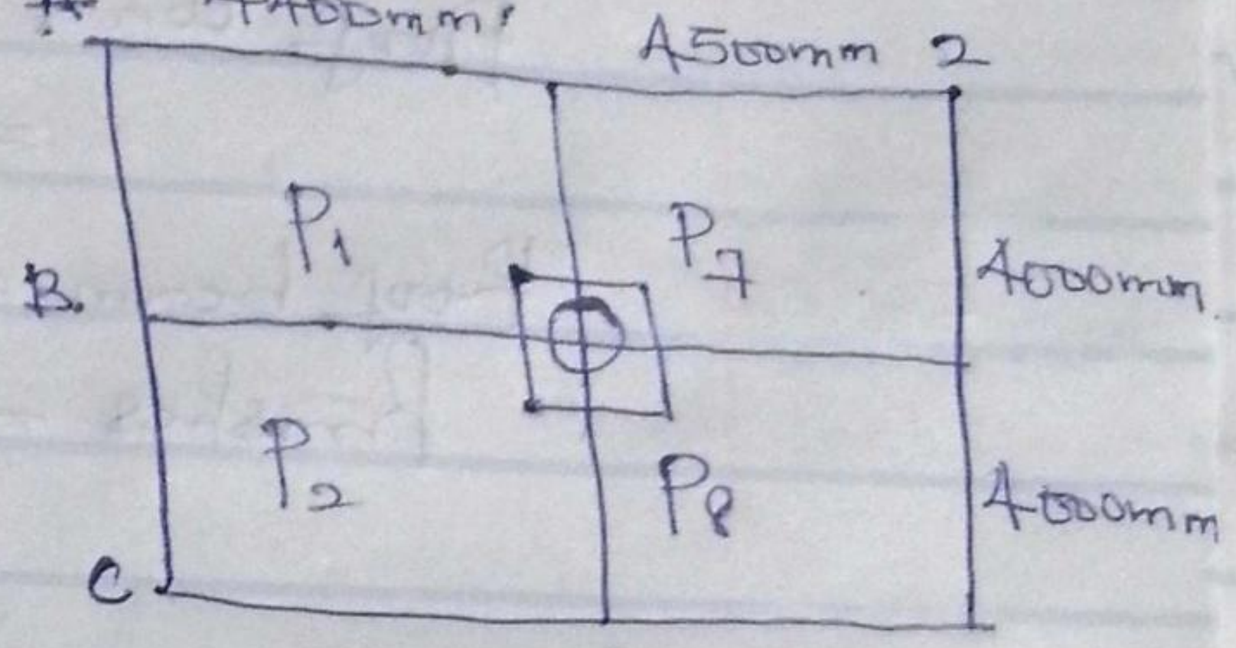


Key = 1 = 1x1=1

B = Biaxially

U = Unsymmetry

Design of Column B1



A = 4X4.4 = 17.6m²

Slab load

Wt of Slab = 0.15 x 24 = 8.6 kN/m²

finishes = 1.2 kN/m²

Partitions = 1.0 kN/m²

= 5.8 kN/m²

Design load = 1.4Gk + 1.6Qk

= (1.4X5.8) + (1.6X2.5)

= 12.12 kN/m²

Beam load :

Wt of beam = 0.225 + 0.6X24 = 3.24 kN/m²

Wall load = 3.47X3 = 10.41 kN/m²

13.65 kN/m²

Design load = 1.4 X 8.65 = 19.11 KN/m²

Design

Roof of 3rd floor

Roof load = Area X 1.5 X 1.5

= 17.6 X 1.5 X 1.5 = 39.6 KN

Roof beam = 0.225 X 0.45 X 24 = 2.43 KN/m²

Finishes → 1.0 KN/m²

3.43 KN/m²

Roof beam = 3.43 (AL)n 1.4

Colum load = 10 KN

Total load = 89.94 KN

3rd floor → 2nd floor

load above = 89.94 KN

Column load = 10 KN

Slab load = 17.6 X 12.12 = 213.312 KN

Beam load = 19.11 X (84) = 160.524 KN

Total = 473.776 KN

2nd - 1st floor

Load above = 473.776 KN

Column load = 10 KN

Slab load = 213.312kN

beam & wall load = 160.524 kN

Total = 857.61kN

1st - ground floor

Load above. = 857.61 kN

Colum. load = 10kN

Slab load = 213.312 kN

beam & wall Load = 160.524

1241.446 kN

$$As = \frac{N - 0.35 \cdot Fcu \, bh}{0.7 fy - 0.35 fcu}$$

$$N = \frac{1241.446 \times 10^3 - 0.35 \times (25 \times 225)}{0.7 \times 410 - 0.35 \times 25}$$

$$= 2869.64 mm^2$$

Provide 4y25 @ 2950mm