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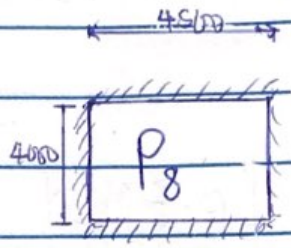
17/ENG03/024
Civil Engineering
CVE 308 (Structural Design) Assignment 3.

Question 1.)



Slab loading:

Slab = $0.25 \times 24 = 6 kN/m^2$

Finishes = $1.2 kN/m^2$

Partition = $1.0 kN/m^2$

$8.2 kN/m^2$

gradesbress = $25.40 N/mm^2$

Design load = $1.4G_k + 1.6Q_k$

$= (1.4 \times 8.2) \times 4.5 \times 4 + (16 \times 5) \times 4.5 \times 4$

$= 206.64 + 144$

$= 350.64 kN$

$d = 250 - 25 - \frac{1}{2} \times 12 = 219 mm$

Short span

(Middle strip)

(Span)

Effective span = $l_x - 2/3h$

$= 4 - 2/3 \times 1.2$

$= 3.2 = 3200mm$

Moment = $\frac{45}{100} \times 0.071 \times fl = \frac{45}{100} \times 0.071 \times 350.64 \times 4 = 44.81 kNm$

width (b) = $\frac{l_x}{2} = \frac{4}{2} = 2000mm$

$k = \frac{M}{bd^2 f_{cu}}$

$= \frac{44.81 \times 10^6}{2000 \times 219^2 \times 25} = 0.01869$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.01869}{0.9}}$

$= 0.5 + \sqrt{}$

$I_a = 0.997 = 0.95$

$z = I_{ad} = 0.95 \times 219$

$z = 208.05$

$A_s = \frac{M}{0.95 f_y z} = \frac{44.88 \times 10^2}{0.95 \times 410 \times 208.05} = 552.98 mm^2$

$\therefore$ Provide Y12 @ 200 c/c ($565 mm^2$)

Shortspan

(Middle Strip)

(Supports)

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

$= 24.9 kNm$

$k = \frac{24.9 \times 10^6}{2000 \times 219^2 \times 25} = 0.0103$

$Ja = 0.95$

$z = 208.05$

$As = \frac{24.9 \times 10^6}{0.95 \times 410 \times 280.05} = 307.27 mm^2$

∴ Provide Y12 @ 300c/c ($377 mm^2$)

Shortspan (Column strip)

(Span)

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

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

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

$= 54.77 kNm$

width $= 2000 mm$

$k = \frac{54.77 \times 10^6}{2000 \times 219^2 \times 25} = 0.023$

$I_a = 0.95$

$Z = 208.05$

$A_s = \frac{54.77 \times 10^6}{0.95 \times 410 \times 208.05} = 675.88\ mm^2$

∴ Provide Y12 @ 150 c/c ($754\ mm^2$)

Short span
(Column strip)
(Support)

$M = \frac{75}{100} \times 0.071 \times 350.64 \times 4 = 74.69$

$k = \frac{74.69 \times 10^6}{2000 \times 219^2 \times 25} = 0.0311$

$I_a = 0.95$

$Z = 208.05$

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

∴ Provide Y12 @ 100 c/c ($1130\ mm^2$)

Longspan
(Middle Strip)
(Span)

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

$= 4.5 - \frac{2}{3} \times 1.35$

$= 3.88 m$

Moment = $\frac{45}{100} \times 0.71 \times 350.64 \times 45$

$= 50.41 kNm$

width = $l_y - \frac{l_x}{2}$

$= 4.5 - \frac{4}{2}$

$= 4.5 - 2$

$= 2.5 m$

$k = \frac{M}{bd^2 f_{cu}} = \frac{50.41 \times 10^6}{2500 \times 219^2 \times 25} = 0.07$

$I_a = 0.95$

$Z = 208.05$

$A_s = \frac{50.41 \times 10^6}{0.95 \times 470 \times 208.05} = 621.95 mm^2$

∴ Provide Y12 @ 175 c/c ($646 mm^2$)

Long span
(Middle Strip)
(Support)

$M = \frac{25}{100} \times 0.071 \times 350.64 \times 4.5$

$= 28.0$

$K = \frac{28 \times 10^6}{2500 \times 219^2 \times 25} = 0.009$

$I_a = 0.95$

$Z = 208.05$

$A_s = \frac{28 \times 10^6}{0.95 \times 410 \times 208.05} = 345.53 mm^2$

∴ Provide Y12 @ 300c/c ($377 mm^2$)

Long span
(Column Strip)
(Span)

Effective span = 3600mm

$M = \frac{55}{100} \times 0.071 \times 350.64 \times 4.5 = 61.62 kNm$

width = 2000mm

$K = \frac{61.62 \times 10^6}{2000 \times 219^2 \times 25} = 0.026$

$I_a = 0.9$

$Z = 208.05$

$A_s = \frac{61.62 \times 10^6}{0.95 \times 410 \times 208.05} = 760.41 mm^2$

∴ Provide Y10 @ 185% 100% (785 mm^2)

Long span
(Column Strip)
(Support)

$M = \frac{75}{100} \times 0.071 \times 350.64 \times 4.5 = 84.022 kNm$

$K = \frac{84.022 \times 10^6}{2000 \times 219^2 \times 25} = 0.04$

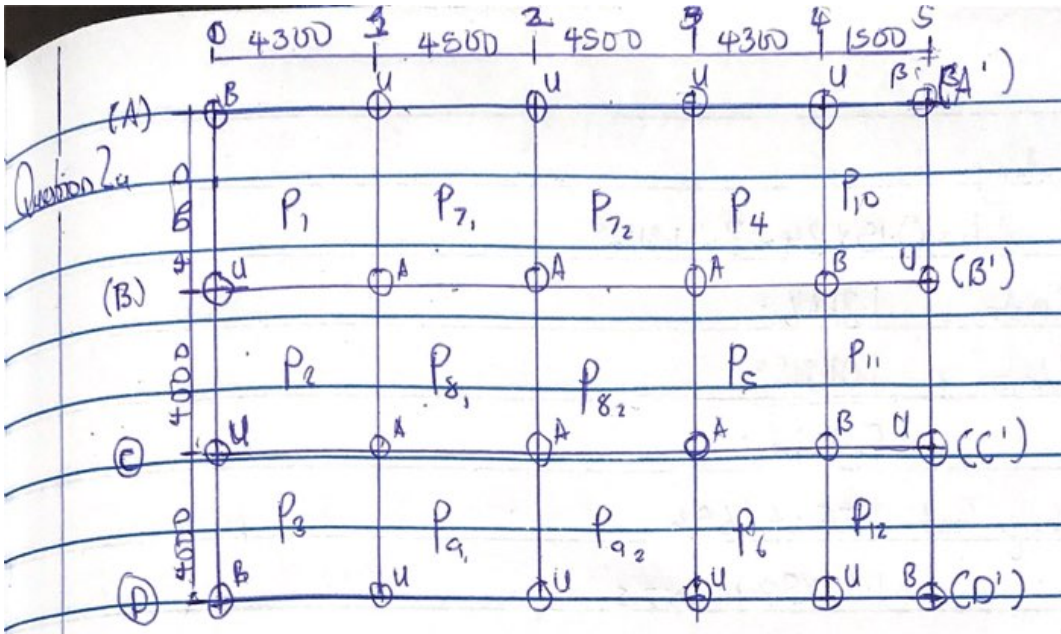
$I_a = 0.95$

$Z = 208.05$

$A_s = \frac{84.022 \times 10^6}{0.95 \times 410 \times 208.05} = 1036.85 mm^2$

∴ Provide Y12 @ 100% (1130 mm^2)

Question 2a



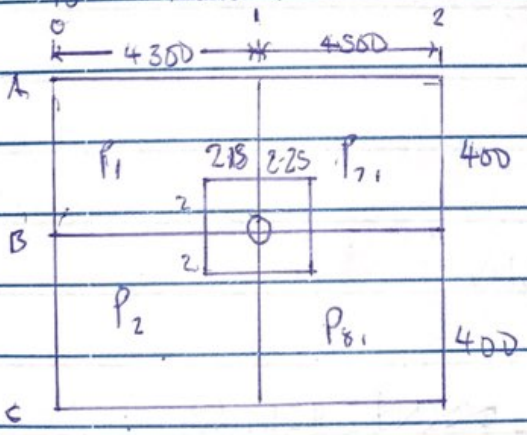
A = Axially loaded

U = Uniaxially loaded

B = Biaxialy loaded

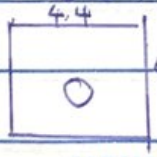
2b.) Designing for Colomn B1:

for 3 floors:



2.15+2.25=4.4

2+2 = 4



A = 4×4.4 = 17.6m²

Slab loading

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

finishes = $1.2\ kN/m^2$

Partition = $1.0\ kN/m^2$

$5.8\ kN/m^2$

Design load = $1.4G_k + 1.6Q_k$

$= 1.4 \times 5.8 + 1.6 \times 2.5$

$= 12.12\ kN/m^2$

Beam load

beam wt = $0.225 \times 0.650 \times 24 = 3.24\ kN/m^2$

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

$= 13.65\ kN/m^2$

D.L = $1.4 \times 13.65 = 19.11\ kN/m^2$

Design

Roof - 3rd Floor

Roof load = Area $\times 1.5 \times 1.5$

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

Roof beam = $0.225 \times 0.450 \times 24 = 2.431\ kN/m^2$

finishes = $1.0\ kN/m^2$

$= 3.43\ kN/m^2$

Roof beam = $3.43(44.4) \times 1.4 = 40.34\ kN$

Total Load = 89.94kN

3rd floor - 2nd floor

load from above = 89.94kN

Column load = 10kN

Slab load = 17.8 X 12.12 = 213.312 kN

Beam load = 19.11 X (8.4) = 160.524 kN

= 463.776 kN

2nd floor - 1st floor

load from above = 463.78 kN

Column load = 10kN

Slab = 213.312 kN

wall $ beam = 160.524 kN

= 865.61 kN

1st floor - Ground floor

load from above = 865.61 kN

Column load = 10kN

Slab = 213.312 kN

Wall $ beam = 160.524

= 1249.45 ≈ 1300 kN

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

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

$$= 3080.08 \text{ mm}^2$$

∴ Provide 8Y25 ($A_s = 3430 \text{ mm}^2$)

$$A_{sm} = 0.4\% bh = \frac{0.4}{100} \times 225^2 = 202.5 \text{ mm}^2$$