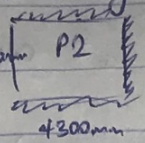
Assignment 3 Question 1

1) Design one of the panels in figure 1 as flat slab. Assume Capital/droppings of 1.2m in diameter, 25-410N/mm² concrete grade, slab thickness = 250mm



A. Loading

Finishes; 1.2KN/m²

Partition; 1.0KN/m²

Slab ; 0.25 × 24 = 6KN/m²

8.2KN/m²

Area = 4.0 × 4.3 = 17.2m²

D.L = 1.4G.K + 1.6Q.K

= 1.4(8.2)(17.8) + 1.6(17.8 × 3.0) ← classrooms

= 289.784 KN

d = h - cover - ½Φ = 250 - 25 - ½(12) = 219mm

B. Short Span ; Middle Strip • Span

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

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

Moment ; $\frac{45}{100} \times 0.071 \times 289.784 \times 4 = 37.034 KNm$

Width ; b ; $\frac{l_x}{2} = \frac{4}{2} = 2000mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{37.034 \times 10^6}{2000 \times 219^2 \times 25} = 0.015$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.015}{0.9}} = 0.98\ (0.95)$

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

$A_s = \frac{M}{0.95 f_{yz}} = \frac{37.034 \times 10^6}{0.95 \times 410 \times 208.05} = 457mm^2$

Provide, Y12 at 225 c/c ($A_{s\,prov} = 502mm^2$)

• Support

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

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

Moment ; $\frac{25}{100} \times 0.071 \times 289.784 \times 4 = 20.57$

Width ; b ; $\frac{l_x}{2} = \frac{4}{2} = 2000mm$

$K = \frac{20.57 \times 10^6}{2000 \times 219^2 \times 25} = 0.0086$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.0086}{0.9}} = 0.99\ (0.95)$

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

$$A_s = \frac{20.59 \times 10^6}{0.95 \times 410 \times 208.05} = 253.84\,mm^2$$

Provide Y12 @ 300 c/c ($A_{s\,prov} = 377\,mm^2$)

Column Strip ; Span

Effective length/Span $= l_x - \frac{2}{3}h$

$= 4 - \frac{2}{3}(1.2) = 3200\,mm$

Moment; $\frac{55}{100} \times 0.071 \times 289.784 \times 4 = 45.26$

Width; b; $\frac{l_x}{2} = \frac{4}{2} = 2000\,mm$

$$K = \frac{M}{bd^2 f_{cu}} = \frac{45.26 \times 10^6}{2000 \times 219^2 \times 25} = 0.019$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.019}{0.9}} = 0.98\ (0.95)$$

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

$$A_s = \frac{45.26 \times 10^6}{0.95 \times 410 \times 208.05} = 558.52\,mm^2$$

Provide Y12 @ 200 c/c ($A_{s\,prov} = 566\,mm^2$)

• Support

Effective length/Span $= l_x - \frac{2}{3}h$

$= 4 - \frac{2}{3}(1.2) = 3200\,mm$

Moment; $\frac{75}{100} \times 0.071 \times 289.784 \times 4 = 61.72$

Width; b; $\frac{l_x}{2} = \frac{4}{2} = 2000\,mm$

$$K = \frac{M}{bd^2 f_{cu}} = \frac{61.72 \times 10^6}{2000 \times 219^2 \times 25} = 0.026$$

$$I_a = 0.5 + \sqrt{0.25 - \frac{0.026}{0.9}} = 0.97\ (0.95)$$

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

$$A_s = \frac{61.72 \times 10^6}{0.95 \times 410 \times 208.05} = 761.64\,mm^2$$

Provide Y12 @ 125 c/c ($A_{s\,prov} = 905\,mm^2$)

c. ~~Short~~ Long Span; Middle Strip; Span

Effective length/Span; $l_y - \frac{2}{3}h$

$4.3 - \frac{2}{3}(1.2) = 3500mm$

Moment; $\frac{45}{100} \times 0.071 \times 289.784 \times 4.3 = 39.81 KNm$

Width, b; $l_y - \frac{l_x}{2} = 4.3 - \frac{4}{2} = 2300mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{39.81 \times 10^6}{2300 \times 219^2 \times 25} = 0.014$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.014}{0.9}} = 0.98\ (0.95)$

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

$A_s = \frac{39.81 \times 10^6}{0.95 \times 410 \times 208.05} = 491.27 mm^2$

Provide Y12 @225 c/c ($A_{s\,prov} = 502mm^2$)

Support;

Effective length/Span; $l_y - \frac{2}{3}h$

$4.3 - \frac{2}{3}(1.2) = 3500mm$

Moment; $\frac{25}{100} \times 0.071 \times 289.784 \times 4.3 = 22.12 KNm$

Width, b; $l_y - \frac{l_x}{2} = 4.3 - \frac{4}{2} = 2300mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{22.12 \times 10^6}{2300 \times 219^2 \times 25} = 0.008$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.008}{0.9}} = 0.99(0.95)$

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

$A_s = \frac{22.12 \times 10^6}{0.95 \times 410 \times 208.05} = 272.97 mm^2$

Provide Y12 @ 300 c/c ($A_{s\,prov} = 377mm^2$)

; Column Strip; Span

Effective length/Span; $l_y - \frac{2}{3}h$

$4.3 - \frac{2}{3}(1.2) = 3500mm$

Moment; $\frac{55}{100} \times 0.071 \times 289.784 \times 4.3 = 48.66 KNm$

Width, b; $\frac{l_x}{2} = 2000mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{48.66 \times 10^6}{2000 \times 219^2 \times 25} = 0.02$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.02}{0.9}} = 0.98\ (0.95)$

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

$A_s = \frac{48.66 \times 10^6}{0.95 \times 410 \times 208.05} = 600.48 mm^2$

Provide Y12 @ 175 c/c ($A_{s\,prov} = 646mm^2$)

Supports

Effective Length / Span = $L_y - \frac{2}{3}h$

$= 4.3 - \frac{2}{3}(1.2) = 3500mm$

Moment: $\frac{\beta_s}{100} \times 0.071 \times 289.984 \times 4.3 = 66.35 kNm$

Width, b; $\frac{L_x}{2} = \frac{4}{2} = 2000mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{66.35 \times 10^6}{2000 \times 219^2 \times 25} = 0.028$

$I_a = 0.5 + \sqrt{0.25 - \frac{0.028}{0.9}} = 0.97 \ (0.95)$

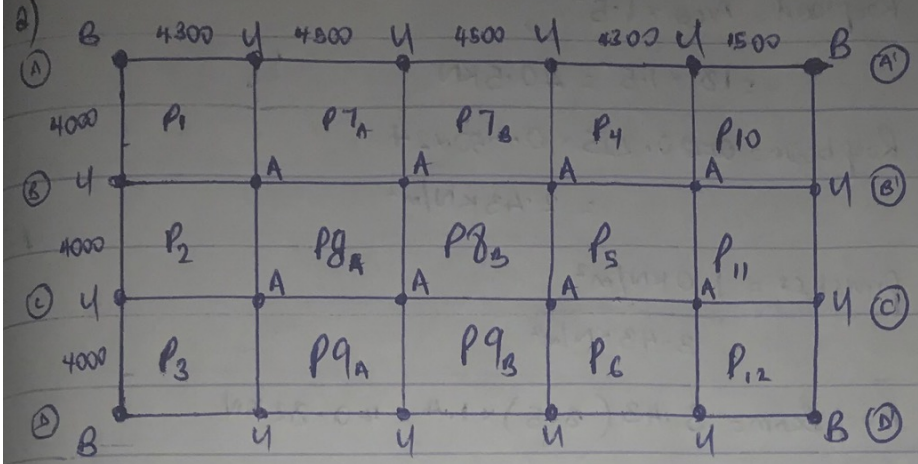
$z = I_a d = 0.95 \times 219 = 208.05$

$A_s = \frac{66.35 \times 10^6}{0.95 \times 410 \times 208.5} = 818.78 mm^2$

Provide Y12 @ 125 c/c ($A_s = 905 mm^2$)

Assignment 3, Question 2

a)

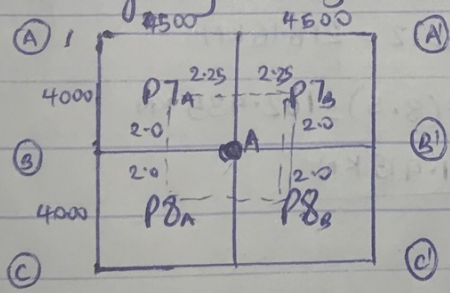


where A = Axially Loaded Columns

B = Biaxially " "

U = Uniaxially " "

b) Locate and Design any Axially loaded column in Figure 2, Assume 3 suspended floors



$A = 4.5 \times 4 = 18 m^2$

Loading ~~Area of slab~~ Beam Perimeter = 4.5 + 4 = 8.5m

Slab load; Weight of slab = $0.15 \times 24 = 3.6\ KN/m^2$

finishes = $1.2\ KN/m^2$

Partition = $1.0\ KN/m^2$

$5.8\ KN/m^2$

Design Load = $1.4G_K + 1.6Q_K$

$= 1.4 \times 5.8 + 1.6 \times 3.0$

$= 12.92\ KN/m^2$

Beam load; Weight of beam = $0.225 \times 0.600 \times 24 = 3.24\ KN/m^2$

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

$13.65\ KN/m^2$

Design load = $1.4(13.65)$

$= 19.11\ KN/m^2$

B. Design; Roof - 3rd floor;

Roof load = Area $\times 1.5^2$

$= 18 \times 1.5^2 = 40.5$ KN

Roof beam = $0.225 \times 0.450 \times 24$

$= 2.43$ KN/m^2

finishes = 1.0 KN/m^2

3.43 KN/m^2

Roof Beam = $3.43(8.5) \times 1.4 = 40.82$ KN

Column Load = 10 KN

Total Load = 91.32 KN

3rd floor - 2nd floor;

Load from above = 91.32 KN

Column load = 10 KN

Slab load = $18 \times 82.12 = 218.16$ KN

Beam load = $19.11 \times (8.5) = 162.435$ KN

Total load = 481.915 KN

2nd floor - 1st floor;

load from above ; 481.915 KN

Column Load ; 10 KN

Slab load ; 218.16 KN

Beam load ; 162.435 KN

Total Load ; 872.51 KN

1st floor - Ground floor;

load from above ; 872.51 KN

Column Load ; 10 KN

Slab load ; 218.16 KN

Beam load ; 162.435 KN

Total load = 1263.105 ≈ 1300 KN

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

25 - 410 N/mm²

N = 1300 KN = 1300 × 10⁶ N

∴ Column b × h = 225 × 225 mm

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

$$= 3080.08 mm^2$$

Provide Y25 @ 125 c/c ($A_{s\,provided} = 3930 mm^2$)