roof beam = 0.225 x 0.45 x 24
= 2.437 kN/m²
finishes = 1.0 kN/m²
= 3.43 kN/m²
roof beam = 3.43(4.4) x 1.4

column load = 10kN
Total load = 89.94kN
3rd floor → 2nd floor
load from above = 89.94kN
Column load = 10kN
slab load = 17.6 x 12.12 = 213.112kN
Beam load = 19.11 x (8.4) = 160.524 kN
Total = 463.776 kN

2nd floor → 1st floor
load from above = 463.776kN
Column load = 10kN
slab = 213.312 kN
wall & beam = 160.32 kN
Total = 856.61 kN

1st floor to ground floor
load from above = 856.61kN
column load = 10kN
slab = 213.312 kN
wall & beam = 160.524
= 1249.45 ≃ 1300kN

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

N = 1300kN
$f_{cu} = 25$
$f_y = 410$
b = 25

$$A_s = \frac{1300\times10^3 - 0.35(25\times225^2)}{0.7\times410 - 0.35\times25}$$

= 3080.07 mm²
Provide 8Y25 (A_s = 3930 mm²)
Assuming 0.4% bh = 0.004 x 225²
= 202.5 mm²

provide Y12 @ 175 c/c (As = 646 mm²)

support

M = 0.25 x 0.071 x 464 x 45 = 28.29

b = 2500

d = 429

k = 28.29 x 10^6 / (2500 x 429^2 x 25) = 9.1 x 10^-3

la = 0.5 + √(0.25 - 9.1 x 10^-3 / 0.9) =

= 0.989 > 0.95 = 0.95

z = la.d = 208.05

As = 28.29 x 10^6 / (0.95 x 208.05 x 410) = 336.86

provide Y12 @ 300 c/c (As = 377 mm²)

column strip

span = 3700 mm

width = l_y / 2 = 2000 mm

moment = 0.35 x 0.071 x 324.07 x 44.9 =

= 60.04 kNm

k = 60.04 x 10^6 / (2000 x 219^2 x 25) = 0.025

la = 0.5 + √(0.25 - 0.025 / 0.9) = 0.97 > 0.95

= 0.95

z = la.d = 208.05

As = 60.04 x 10^6 / (0.95 x 410 x 208.05) = 740.91

provide Y12 @ 150 c/c (As = 754 mm²)

support

M = 0.75 x 0.071 x 324.07 x 43.8 = 81.87

k = 81.87 x 10^6 / (2000 x 219^2 x 25) = 0.034

la = 0.5 + √(0.25 - 0.034 / 0.9) = 0.96 > 0.95

= 0.95

z = la.d = 208.05

As = 81.87 x 10^6 / (0.95 x 410 x 208.05) = 1010.298

provide Y12 @ 100 c/c (As = 1130 mm²)

Design of column B1

A = 0.4 x 0.4 = 17.6 m²

slab load

weight of slab = 0.15 x 24 = 3.6 kN/m²

finishes = 1.2 kN/m²

partitions = 10 kN/m²

5.8 kN/m²

DL = 1.4 Gk + 1.6 Qk

= 1.4 x 5.8 + 1.6 x 2.5

= 12.12 kN/m²

Beam load

beam weight = 0.225 x 0.6 x 24.3.24 kN/m²

wall load = 3.47 x 3 = 10.41 kN/m²

= 13.65 kN/m²

UDL = 1.4 x 13.65 = 19.11 kN/m²

design

roof - 3rd floor

roof load = A x 1.5 x 1.5

= 17.6 x 1.5² = 39.6 kN

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

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

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

provide Y12 @ 300 c/c ($A_s = 377$)

column strip

span = 3200mm
b = 2000mm
M = 55% of 0.071 P L =
$\frac{55}{100} \times 0.071 \times 341.64 \times 4 = 53.36$ kNm

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

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

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

$A_s = \frac{53.36 \times 10^6}{0.95 \times 410 \times 208.05} = 658.47$

provide Y12 @ 150 c/c
($A_s = 754mm^2$)

support

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

$K = \frac{72.77 \times 10^6}{2000 \times 219^2 \times 25} = 0.030$

$l_a = 0.5 + \sqrt{0.25 - \frac{0.030}{0.9}} = 0.96 > 0.95$
0.95

$z = l_a d = 208.05$

$A_s = \frac{72.77 \times 10^6}{208.05 \times 410 \times 0.95} = 898.94$

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

long span

middle strip

span.

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

moment $= 0.45 \times 0.071 \times 364.64 \times 4.5 = 49.12$

$b = l_y - \frac{l_x}{2} = 4.5 - 2 = 2.5 = 2500$

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

$l_a = 0.5 + \sqrt{0.25 - \frac{0.016}{0.9}}$
$= 0.98 > 0.95 \therefore 0.95$

$z = l_a d = 208.05$

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

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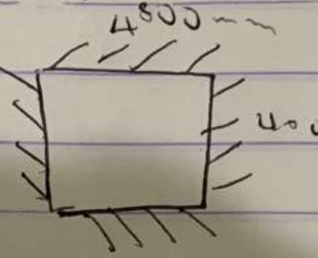
Design for P8



Z-offing = 12m
25-410 N/mm²
Slab thickness = 250mm
finishes = 1 kN/m²
partitions = 1.0 kN/m²
slab = 0.25 × 25 = 6 kN/m²
8.2 kN/m²

Designing by factor 5.0
Area = 4.5 × 4 = 18 m²

U.L = 1.4Gk + 1.6Qk
= (1.4 × 8.2 × 18) + (1.6 × 5 × 18)
= 206.64 + 135
= 341.64

Short span.
middle strip.
span = l_x ⅔ L = 4 − ⅔ × k
= 3200mm

Moment = 45% × 0.071 pL = $\frac{45}{100}$ × 0.071 × 341.6 × 4
= 43.60 kNm

width = b = $\frac{l_x}{2}$ = $\frac{4}{2}$ = 2 = 2000mm
d = h − cover − ½φ = 250 − 25 − 6
= 219mm

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

$l_a = 0.5 + \sqrt{0.25 - k/0.9}$
$= 0.5 + \sqrt{0.25 - 0.018/0.9} = 0.979$
> 0.95
= 0.95

Z = $l_a d$ = 0.95 × 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 @ 200c/c (A_s = 566mm²)

Support

M_2 = 25% × 0.071 pL = $\frac{25}{100}$ × 0.071 × 341.64 × 4
= 24.25
W = b = 2000m

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