DESIGN OF ONE WAY SLAB

1. Design a simply supported R.C.C slab for an office floor having clear dimensions of 4m by 10m with 230mm walls around. Adopt M-20 grade concrete and Fe 415 grade HYSD bars.

GIVEN:

Clear span = 4M, wall thickness = 230mm

Live load = $4 kN/m^2$, Floor finish = 1.5 kN/m^2

f_{ck} = 20 N/mm^2, f_y = 415 N/mm^2

THICKNESS OF SLAB:

Assuming effective depth,

$$d = \frac{\text{span}}{25} = \frac{4000}{25} = 160mm.$$

Adopt clear cover of 20mm and using 10MM dia bar,

Total Depth, D = 185 mm

EFFECTIVE SPAN:

Least value of

i) clear span + Effective depth = 4 + 0.16 = 4.16m

ii) Centre to centre of supports = 4 + 0.23 = 4.23m..

$\therefore L = 4.16m$

LOADS:

Self weight of slab = $0.185 \times 25 = 4.625 kN/m^2$

Finishes = 1.5 kN/m^2,

Live load = 4.00 kN/m^2

Total load = 10.125 kN/m²

∴ Ultimate load = 1.5 × 10.125 = 15.19 kN/m²

ULTIMATE MOMENTS & SHEAR FORCES:

$$M_u = \frac{wl^2}{8} = \frac{15.19 \times 4.16^2}{8} = 32.86 \text{ kNm}$$

$$V_u = \frac{wl}{2} = \frac{15.19 \times 4.16}{2} = 31.60 \text{ kN}$$

LIMITING MOMENT OF RESISTANCE:

$$M_{ulim} = 0.138 f_{ck} bd^2$$

$$= [0.138 \times 20 \times 10^3 \times 160^2] \times 10^{-4}$$

$$= 70.65 \text{ kNm}.$$

$M_u < M_{ulim}$ ⇒ Section is under reinforced

TENSION REINFORCEMENTS:

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$$M_u = 0.87 f_y A_{st} d \left[1 - \frac{A_{st} f_y}{bd f_{ck}}\right]$$

$$32.86 \times 10^6 = 0.87 \times 415 A_s \times 160 \left[1 - \frac{415 A_{st}}{10^3 \times 160 \times 20}\right]$$

$$\therefore A_{st} = 531 \text{ mm}^2$$

Using 10mm diameter bars, Spacing is

$$S = \frac{1000 a_{st}}{A_{st}} = \frac{1000 \times \pi/4 \times 10^2}{531}$$

$$= 147 \text{ mm}.$$

Adopt a spacing of 140mm.

DISTRIBUTION BARS :

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$$A_{st} = 0.12\% bd = \frac{0.12}{100} \times 1000 \times 185$$

$$= 220 \text{ mm}^2$$

Provide 8mm diameter bars at 230mm centre to centre

CHECK FOR SHEAR STRESS :

$$\tau_v = \frac{V_u}{bd}$$

$$= \frac{31.6 \times 10^3}{1000 \times 160} = 0.198 \text{ N/mm}^2$$

$$P_t = \frac{100 A_{st}}{bd}$$

$$= \frac{100 \times 531 \times 0.5}{1000 \times 160} = 0.166$$

Pg.no -73 $\Rightarrow$ $k \tau_c = 1.23 \times 0.293 = 0.36 \text{ N/mm}^2 > \tau_v$

$\therefore$ The slab is safe in shear.

CHECK FOR DEFLECTION CONTROL :

$$(l/d)_{max} = (l/d)_{basic} \times k_t \, k_c \, k_f$$

Pg.no -38 $\Rightarrow$ $k_t = 1.4$, $k_c = 1.0$, $k_f = 1.0$.

$$(l/d)_{max} = 20 \times 1.4 \times 1.0 \times 1.0 = 29.$$

$$(l/d)_{provided} = \frac{4160}{160} = 26 < 29.$$

$\therefore$ Hence, the deflection criteria is satisfied