wednesday SLAB MODULE 3

ONE WAY SLAB

- $\frac{L}{l}$ (larger span by shorter span) always greater than 2

2. Slab is supported only on 2 opposite sides

- Since the ratio of longer span to shorter span is greater than 2 the load distribution takes place in the shorter direction
- The main reinforcement is provided only in one direction.

- The ratio of longer span to shorter span is less than 2 and the load distribution takes place in both direction
- The main reinforcement is provided in both direction
- Slab is supported on all the 4 sides

Q: Design a reinforced concrete slab for a room having inside dimension 3×7 m thickness of the supporting wall is 300mm Slab carries 75mm thick lime mortar at its top The unit rate is given by 20 KN/m³ live load on the slab is 2 kN/m Assume the slab to be simply supported at the ends. Use M20 concrete & Fe 415 steel.

modification factor

$L = 7m$

$l = 3m$

thickness of support
$= 300mm$

~~Finishing load: Eck = 20kN/m³~~

$L.L = 2 kN/m$

[75mm thick lime mortar unit wt = 20kN/m³]

$= \cancel{1 \times 75 \times 20}$

$= \cancel{1500}$

length is always 1m

$f_{ck} = 20 N/mm^2$

$f_y = 415 N/mm^2$

STEP 1 : CHECK FOR ONE WAY SLAB

$\frac{L}{l} = \frac{7}{3} = 2.33$

> 2

∴ It is one way slab

STEP 2 : SLAB DIMENSIONS

pg:38

$\frac{l}{d} = 20 \times M.F$ modification factor

{ Assume Percentage tension reinforcement $= 0.35$

∴ Modification factor $= 1.4$ }

⇓

from Fig 4 of IS 456:2000

$\frac{l}{d} = 20 \times 1.4$

$\frac{3000}{d} = 20 \times 1.4$

$d = \frac{3000}{20 \times 1.4} = 107.14 mm$

Assume clear cover = 30

$D = d + c + \phi/2$ $c = 30$, $\phi = 12$ → max upto 16

$= 107.14 + 30 + 12/2$

$= 143.14$

$\approx 150mm$

$d = 150 - 30 - 6 = 114mm$, $b = 1m$

Effective span [cl 21.2.1

(i) c/c = 3300 (3000+300)

(ii) $l + d$ = 3000 + 114 = 3114

∴ effective span = 3114 mm

STEP 3 : COMPUTATION OF BENDING MOMENT & LOAD

L.L = 2 kN/m

D.L = c/s Area x unit wt

= 0.15 x 1 x 25

= 3.75 kN/m

FL = 0.075 x 1 x 20

= 1.5 kN/m

Total DL = 3.75 + 1.5

= 5.25 kN/m

Total Load = L.L + D.L

= 2 + 5.25

= 7.25 kN/m

$$M = \frac{wl^2}{8} = \frac{7.25 \times 3.114^2}{8}$$

$$M_u = \frac{7.25 \times 3.114^2}{8} \times 1.5$$

= 13.18 kNm

STEP 4 :

DEPTH OF NEUTRAL AXIS

$$M_u = 0.36 \frac{x_u}{d}\left[1 - 0.42 \frac{x_u}{d}\right] bd^2 f_{ck}$$

$$13.18 \times 10^6 = 0.36 \frac{x_u}{d}\left[1 - 0.42 \frac{x_u}{d}\right] 1000 \times 114^2 \times 20$$

$$\frac{x_u}{d} = 0.15$$

0.0149
2.237

$$\frac{x_{umax}}{d} = 0.48$$

[cl. 38.1 of IS 456:2000]

$$\frac{x_u}{d} < \frac{x_{umax}}{d}$$

∴ under reinforced

STEP 5: COMPUTATION of A_{st}

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

$$13.18 \times 10^6 = 0.87 \times 415 \times A_{st} \times 114 \left[1 - \frac{A_{st}\, 415}{1000 \times 114 \times 20}\right]$$

$$320.21 = A_{st} - A_{st}^2\, 1.82 \times 10^{-4}$$

x = 341.3, 5153.20

A_{st} = 341.3 mm² → main bar

from Cl. 26.5.2.1

$A_{st\,min}$ = 0.12% c/s area

$$= \frac{0.12\, bD}{100}$$ HYSD

$$= \frac{0.12 \times 1000 \times 150}{100}$$

= 180 mm² → for distribution bar.

SPACING OF MAIN BAR

$$= \frac{\text{breadth} \times \text{Area of 1 bar}}{A_{st}}$$

$$= \frac{1000 \times \frac{\pi}{4} \times 12^2}{341.431}$$

$= 331.24\ mm^2$

check for spacing

cl. 26.3.3 b of IS 456:2000 pg: 46

(i) 331.24

(ii) $3 \times d = 3 \times 114 = 342$

(iii) 300

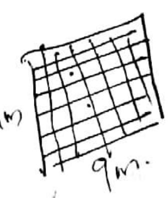
So provide 12mm ϕ bar @ 300mm c/c as main reinforcement

DISTRIBUTION REINFORCM

$$\text{Spacing} = \frac{1000 \times \text{Area of 1 bar}}{A_{st\,min}}$$

Assume ϕ of bars as 8mm =

$$\frac{1000 \times \frac{\pi}{4} \times 8^2}{180}$$



$= 279\ mm^2$

Check for spacing of distribution bars

(i) ~~279~~ $\approx$ 270mm

(ii) $5d = 5 \times 114 \times 570$

(iii) 450

provide 8mm ϕ bars @ 270mm c/c as distribution bars

CHECK FOR SHEAR

cl. 40.1

$\tau_v < k \tau_c$

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

$$V_u = \frac{wl}{2} \times 1.5$$

$$= \frac{7.25 \times 3.114}{2} \times 1.5$$

$= 16.93\ kN$

$$\tau_v = \frac{16.93 \times 10^3}{1000 \times 114}$$

$= 0.148\ N/mm^2$

$$\tau_c \Rightarrow \frac{100 A_s}{bd}$$

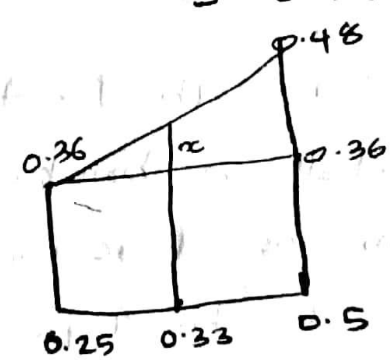
$$A_s = \frac{1000 \times \text{Area of 1 bar}}{\text{Spacing}}$$

$$= \frac{1000 \times \pi/4 \times 12^2}{300}$$

$= 376.99\ mm^2$

$$\frac{100 A_s}{bd} = \frac{100 \times 376.99}{1000 \times 114}$$

$= 0.33$



$$\frac{0.5-0.25}{0.33-0.25} = \frac{0.48-0.36}{x}$$

$x = 0.0384$

$\tau_c = 0.36 + 0.0384$

$= 0.3984$

From cl. 40.2.1.1 of IS 456: 2000

$k = 1.30$

$k\tau_c = 1.3 \times 0.3984$

$= 0.507$

$\therefore$ τ_v 0.148 < 0.507

$\tau_v < k\tau_c$

$\therefore$ the slab is safe in shear

STEP 7 : CHECK FOR DEVELOPMENT LENGTH [Cl. 26.2.1]

$$L_d = \frac{\phi \sigma_s}{4\tau_{bd}}$$

$$= \frac{12 \times 0.87 \times 415}{4 \times 1.2}$$

$= 902.62$ mm

Q: Design a slab 9 x 4 m supported on brick wall 300 mm which is independent to be a floor of a library and is supposed to have a live load ... M20 concrete Fe 415 HYSD bar(i)

$L = 9$ m

$l = 4$ m

Support 300mm

L.L = 5 kN/m

FL = 1 kN/m

$f_{ck} = 20 \, N/mm^2$

$f_y = 415 \, N/mm^2$

STEP 1 : CHECK FOR ONE WAY SLAB

$$\frac{L}{l} = \frac{9}{4} = 2.25 > 2$$

It is one way slab

STEP 2: SLAB DIMENSIONS

$$\frac{l}{d} = 20 \times MF$$

$$\frac{4000}{d} = 20 \times 1.4$$

$d = 142.85$

$D = d + c + \phi/2$

$= 142.85 + 30 + 12/2$

$= 178.85$

≈ 200 mm

$d = 200 - 30 - 6$

$= 164$ mm

$b = 1$m

Effective span