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

$x = 0.0384$

$\tau_c = 0.36 + 0.0384$

$= 0.3984$

From cl. 40.2.1.1 of IS 456: 2000

$k = 1.30$

$k\tau_c = 1.3 \times 0.3984$

$= 0.507$

$\therefore \tau_v$ 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.]

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

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

$= 902.62$ 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 ...

M20 concrete Fe 415 HYSD bar.

$L = 9$ 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

(i) c/c = 4000 + 300 = 4300

$l + d = 4000 + 164 = 4164$

effective span = 4164 mm

STEP 3: COMPUTATION OF BENDING MOMENT & LOAD.

L.L = 5 kN/m

D.L = 0.2 × 1 × 25

= 5

F.L = 1 kN/m

TL = L.L + D.L + F.L

= 11 kN/m

$$m = \frac{wl^2}{8} = \frac{11 \times 4.164^2}{8}$$

= 23.84.

$M_u = m \times 1.5$

= 35.761 kNm

STEP 4: DEPTH OF NEUTRAL AXIS

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

$$\frac{35.761 \times 10^6}{1000 \times 164^2 \times 20} = 0.36 \frac{x_u}{d}\left[1 - 0.42\frac{x_u}{d}\right]$$

$$\frac{x_u}{d} - 0.42 \frac{x_u^2}{d} = 0.1846$$

$x = 0.201, 2.179$

$$\frac{x_u}{d} = 0.201$$

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

20

12

8

STEP 5: COMPUTATION OF Ast

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

$$35.761 \times 10^6 = 0.87 \times 415 \times A_{st} \times 164 \left[1 - \frac{A_{st} \times 415}{1000 \times 164 \times 20}\right]$$

$603.94 = A_{st} - A_{st}^2 \; 1.2 \times 10^{-4}$

$A_{st} = 655.5$ 7697

From cl. 26.5.2.1

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

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

$$= \frac{0.12 \times 1000 \times 200}{100}$$

$= 240 \text{ mm}^2$

SPACING OF MAIN BAR

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

$$= \frac{1000 \times \pi/4 \times 12^2}{655.5}$$

$= 172.53 \text{ mm}^2$

check for spacing

Cl. 26.3.3.b of IS 456:2000

(i) $172.53 \approx 170$

(ii) 3d = 3 × 164 = 492

(iii) 300

So provide 12mm ϕ bar @ ~~172.53~~ 170 mm c/c as main reinforcement

DISTRIBUTION REINFORCEMENT

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

Assume $\phi = 8mm$

$$\frac{1000 \times \pi/4 \times 8^2}{240}$$

$= 209.43 \, mm^2$

Check for spacing

(i) $209.43 \approx 200$

(ii) $5d = 5 \times 164 = 820$

(iii) 450

provide 8mm ϕ bar at 200 mm c/c as distribution bars.

STEP 6: CHECK FOR SHEAR

Cl- 40.1

$\tau_v < k\tau_c$

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

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

$$= \frac{11 \times 4.164 \times 1.5}{2}$$

$= 34.353$

$$\tau_v = \frac{34.353 \times 10^3}{1000 \times 164}$$

$= 0.209$

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

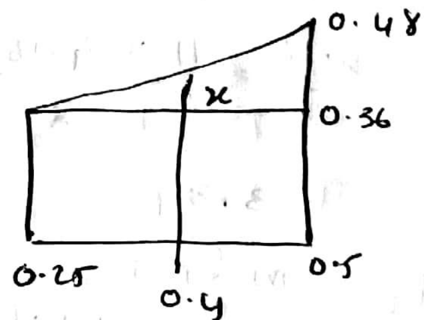
$$A_s = \frac{1000 \text{ Area of 1 bar}}{\text{Spacing}}$$

$$= \frac{1000 \times \pi/4 \times 12^2}{170}$$

$= 665.278$

$$100 A_s/bd = \frac{100 \times 665.278}{1000 \times 164}$$

$= 0.405$



$$\frac{0.5 - 0.25}{0.5 - 0.4} = \frac{0.5 - 0.36}{x}$$

$x = 0.056$.

$\tau_c = x + 0.36$

$= 0.416$.

From cl- 40.2.1.1

$k = 1.3$

$k\tau_c = 1.3 \times 0.416$

$= 0.499$

$\tau_v < k\tau_c$

slab is safe in shear.

STEP 7: CHECK FOR DEVELOPMENT LENGTH

cl. 26.2.1

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

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

$$= 902.62 \text{ mm}$$