$\tau_c =$ ———
bd

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

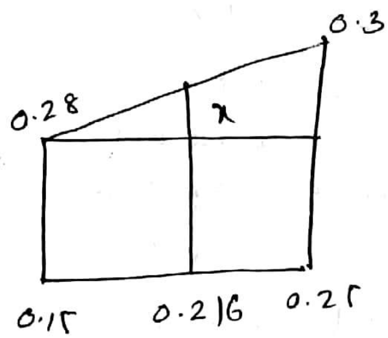
s/o Shorter direcⁿ

$$= \frac{1000 \times \pi/4 \times 10^2}{250}$$

$= 314.159 \text{ mm}^2$

$$\frac{100 A_s}{bd} = \frac{1\cancel{0}0 \times 314.159}{10\cancel{0}\cancel{0} \times 145}$$

$= 0.216$



$$~~\text{ans}~~ \quad \frac{0.25-0.15}{\cancel{0.36-0.28}\ \ 0.216-0.15} = \frac{0.36-0.28}{x}$$

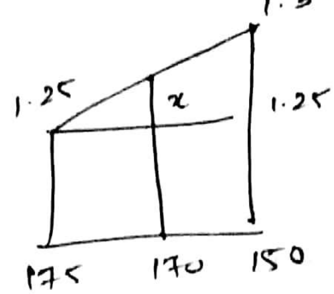
$x = 0.0528$

$\tau_c = 0.28 + 0.0528$

$\tau_c = 0.3328$

From cl. 40.2.1.1 of

D = 170



$$\frac{175-150}{175-170} = \frac{1.3-1.25}{x}$$

$x = 0.01$

$k = 1.26$

$k\tau_c = 0.4193$

$\tau_v < k\tau_c$

Slab is safe in shear.

Step 7 : Check for development length.
[cl. 26.2]

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

$$= \frac{10 \times 0.87 \times 415}{4 \times 1.2}$$

$= 752.187 \text{ mm}$

Q: Design a RCC roofing slab over a room 4m×5m the slab is simply supported on all 4 edges with corners held down. The super imposed load is 2 kN/m² and floor finish is

Use M15 concrete
Fe 415 steel

Given :-

$L = 5m$

$l = 4m$

$f_{ck} = 15 N/mm^2$

$f_y = 415 N/mm^2$

$L.L = 2 kN/m^2$?doubt
↳ for an area

$= 2 \times 1 \ kN/m$ [× breadth if unit is kN/m²]

STEP 1: CHECK FOR ONE WAY OR TWO WAY SLAB.

$\frac{L}{l} = \frac{5}{4} = 1.25 < 2$

∴ It is a 2 way slab.

STEP 2: COMPUTATION OF SLAB DIMENSION.

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

% tensile reinforcement
Assume $p_t = 0.35\%$

~~MF = 1.4~~

∴ from fig 4. of IS 456:2000

$MF = 1.4$

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

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

$d = 142.857$

Assume a clear cover of 20 mm and diameter of 10 mm

$D = d + c + \phi/2$
$= 142.85 + 20 + 10/2$
$= 167.85 \approx 170$

$d = D - c - \phi/2$
$= 170 - 20 - 10/2$
$= 145$

Assume width $b = 1m$

Effective span in one direction

~~l+d~~

$l + d = 4000 + 145$
$= 4145 mm$

Effective span in other direction

$l + d = 5000 + 145$
$= 5145 mm$

STEP 3: COMPUTATIONS OF LOADS AND BENDING MOMENT

$L.L = 2 kN/m$

$D.L = 0.17 \times 1 \times 25$
$= 4.25 kN/m$

$F.L = 0.5 \times 1 \ kN/m^2$
$= 0.5 kN/m$

Total load
$= 6.75 kN/m$

$\frac{l_y}{l_x} = \frac{5.145}{4.145} = 1.24 \approx 1.25$

From table 26

$\alpha_x = \frac{0.072 + 0.079}{2}$

$= 0.0755$

(From table for all edges discontinuous)

$\alpha_y = 0.056$

Annex D

D-1-1.

$M_x = \alpha_x w l_x^2$

$= 0.0755 \times 6.75 \times 4.145^2$

$= 8.755$ kNm

$M_{ux} = 8.755 \times 1.5 = 13.1325$ kNm

$M_y = \alpha_y w l_{gx}^2$

$= 0.056 \times 6.75 \times 4.145^2$

$= 6.494$ kNm

$M_{uy} = 9.741$ kNm

Effective depth required =

$M_u = 0.36 \frac{x_{umax}}{d}\left(1 - 0.42 \frac{x_{umax}}{d}\right) bd^2 f_{ck}$

↓

Highest

$13.134 \times 10^6 = 0.36 \times 0.48 \left[1 - 0.42 \times 0.48\right] \times 1000 \times d^2 \times 15$

$d_{required} = 79.66$ mm

$d_{require} < d_{provided}$

Hence safe

STEP 4: COMPUTATION OF REINFORCEMENT

Shorter direction

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

$13.134 = 0.87 \times 415 \times A_{st} \times 145 \left(1 - \frac{A_{st} \times 415}{1000 \times 145 \times 15}\right)$

$2.508 \times 10^{-4} = A_{st} - A_{st}^2 \, 1.908 \times 10^{-4}$

$A_{st} = 264.124$

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

$= \frac{1000 \times \frac{\pi}{4} \times 10^2}{264.124}$

$= 297.35 \approx 290$ mm

Longer direction: $d_{eff} = 145 - 10 = 135$

$9.741 \times \cancel{10^6}\, 0.87 \times 415 \times A_{st} \times 135 \left[1 - A_{st} \times \frac{415}{1000 \times 15 \times 135}\right]$

$\cancel{= A_{st} - A_{st}^2 \, 1.908 \times 10^{-4}}$

$\overset{199.8}{\cancel{1.998 \times 10^{-4}}} = A_{st} - A_{st}^2 \, 2.049 \times 10^{-4}$

$\cancel{1.99 \times 10^{-4}}$ 208.7

$\cancel{4880}$ 4671.7

$A_{st} = 208.7$

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

$= \frac{1000 \, \frac{\pi}{4} \times 10^2}{208.7}$

$= 376.3 \approx \underset{max}{300}$

STEP 5: TORTIONAL REINFORCEMENT

As the corners are held down all the 4 corners are provided with torsion reinforcement

Size of torsion mesh

Size $= \frac{l_x}{5} \times \frac{l_{gx}}{5}$

$\frac{4.145}{5} = 0.83$

size = 0.829m × 0.829m

At each corner 2 meshes one @ the top and one @ the bottom are provided.

Area of torsion steel =

$= 3/4 \; Ast_x$

$= 3/4 \times 264.124$

$= 198.09 \, mm^2$

provide 10mm ϕ bars at spacing

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

$$= \frac{1000 \times \pi/4 \times 10^2}{198.09}$$

$= 396 \approx 300$

STEP 6: CHECK FOR SHEAR