FAQs

1. Design a reinforced concrete slab for a room of size 4m x 5m supported on 230mm thick walls, which do not have any adequate provision to resist torsion at corners, and subjected to a live load of 2.5 kN/m^2. The load due to floor finish is 1 kN/m^2 and partition is 2 kN/m^2. Use M20 and Fe415 as materials.

   Size of slab = 4.23m x 5.23m effective

   The ratio l_y/l_x = 5.23/4.23 = 1.24 < 2; it is two way slab.

   a. Load calculations:

   i. Dead loads

   Assume thickness of slab from cl. 23.2.1 of IS 456:2000

   l/d = 20;

   d = 211.50mm

   D = 231.5mm

   Assume D = 200mm

Self-weight of slab	=	0.200 x 25 =	5.0 kN/m^2
Weight of floor finish	=	=	1.0 kN/m^2
Partitions	=	=	2.0 kN/m^2
Total dead loads		$\mathbf{w_d}$ =	**8.0 kN/m^2**
ii. Live load on sla		$\mathbf{w_l}$ =	**2.5 kN/m^2**
iii. Total load on slab		$\mathbf{w}$ =	**10.5 kN/m^2**

   b. Bending moment calculations

   $M_x = \alpha_x w l_x^2$

   $M_x = \alpha_y w l_x^2$

   From Table 27 of IS 456: 2000; bending moment coefficients are

   l_y/l_x = 5.23/4.23 = 1.24; $\alpha_x = 0.088$; $\alpha_y = 0.0585$

   $M_X = 0.088 \times 10.5 \times 4.23^2$ = 16.53 kNm

   $M_Y = 0.0585 \times 10.5 \times 4.23^2$ = 10.99 kNm

   M_{ux} = 1.5 x 16.53 = 24.80 kNm

   M_{uy} = 1.5 x 10.99 = 16.485 kNm

   c. Effective depth of slab

   Consider 1m width of the slab and by equating M_{umax} to M_{ulim}

   $M_{ulim} = 0.138 f_{ck} b d^2 = M_{umax}$

   d = 94.79mm < 180mm

   Hence safe against flexure

   Keep D = 200mm; d = 180mm

d. Area of reinforcement (along Shorter direction)

Main Steel:

$\mathbf{M_{ux}}$ = $\mathbf{0.87f_yA_{st}(d\text{-}o.416x_u)}$

$A_{st,\ reg}$ = 400 mm^2

Check for Minimum steel as per IS 456:2000

A_{st} = 0.12% cross sectional area

= 216 mm^2 < 400 mm^2

Hence $A_{st\ reg}$ = 400 mm^2

Provide 10mm diameter bar

Spacing = 196.35mm

Provide 8mm diameter bar at 175mm c/c

$A_{st\ pro}$ = 448.80mm^2

e. Area of reinforcement (along Longer direction)

Main Steel:

$\mathbf{M_{uy}}$ = $\mathbf{0.87f_yA_{st}(d\text{-}o.416x_u)}$

$A_{st,\ reg}$ = 262.17 mm^2

Check for Minimum steel as per IS 456:2000

A_{st} = 0.12% cross sectional area

= 216 mm^2 < 262.17 mm^2

Hence $A_{st\ reg}$ = 262.17 mm^2

Provide 8mm diameter bar

Spacing = 191.73mm

Provide 8mm diameter bar at 175mm c/c

Torsion Steel:

A_{st} = ¾ of Main steel A_{st} = ¾ x 400 = 300 mm^2

Use 8mm dia bars;

Spacing = 166mm

Provide 8mm dia bars at 150mm c/c at each corners both top as well as bottom in two layers at a distance of l/5 from the face of support.

f. Check for deflection

As per cl.23.2.1 of IS 456:2000

l/d = 20 x M.F

p_t = 0.25%

f_s = 214.53 N/mm^2

M.F = 1.9

d = 111.32mm < 180mm

Hence safe against deflection.