**Department of Civil Engineering**
**Katihar Engineering College, Katihar**

**Subject:** Design of Concrete Structure-I
**Topic:** Design of Slab
**Lecture:** 07
**Course Instructor:** Prof. Rashid Mustafa

⇒ D.1.3 → Moment calculated as per D.1.2 as applicable for middle strip only.

D.1.7 → In edge strip minimum reinforcement required for slab may be provided.

D.1.4 / D.1.5 / D1.6 — Detailing of Reinforcement.

D.1.4 . About +ve Moment Reinforcement 100% to be provided upto
0.15 L from simply supported edge
0.25 L from continuous edge

At least 25 % . Continue upto support. ②

D.1.5 : Negative Reinforcement over Continuous edge (in Middle strip)

100% - to be Continued upto 0.15L
50% to be extended upto 0.30L
} For Edge support

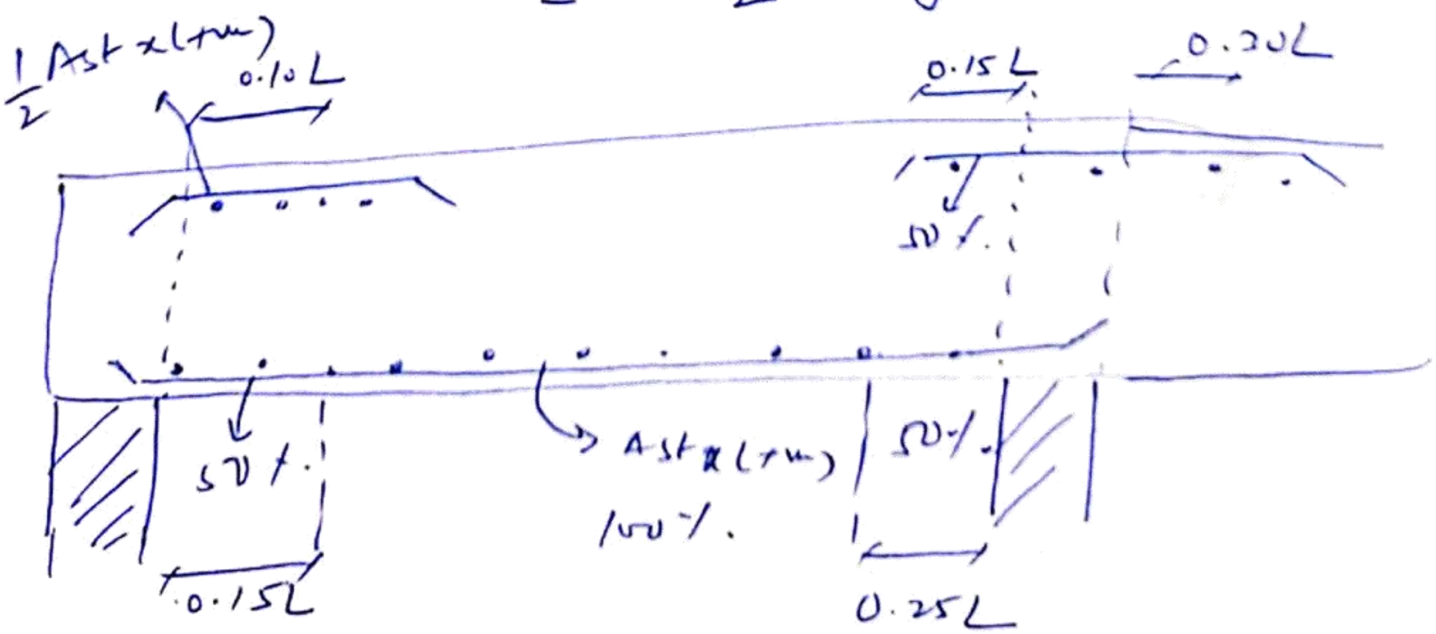
D.1.6 At discontinuous edge. (at simply supported edge)

→ Some -ve moment may arise

→ Reinforcement half of +ve reinforcement Provided at mid span

→ In x-dirctn
$= \frac{1}{2} \times Ast_x (+ve)$

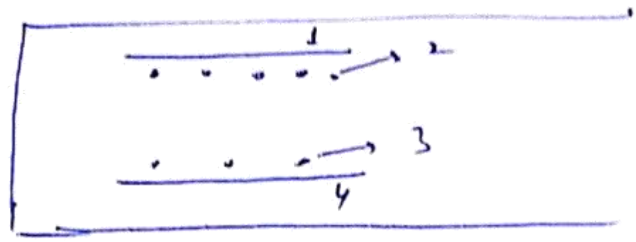
→ In y-dirctn
$= \frac{1}{2} Ast_y (+ve$



## ⇒ Torsion Reinforcement:

D.1.8 Torsion Reinforcement shall be provided at corner where both edges are simply supported.

→ Provided in 4 layers.

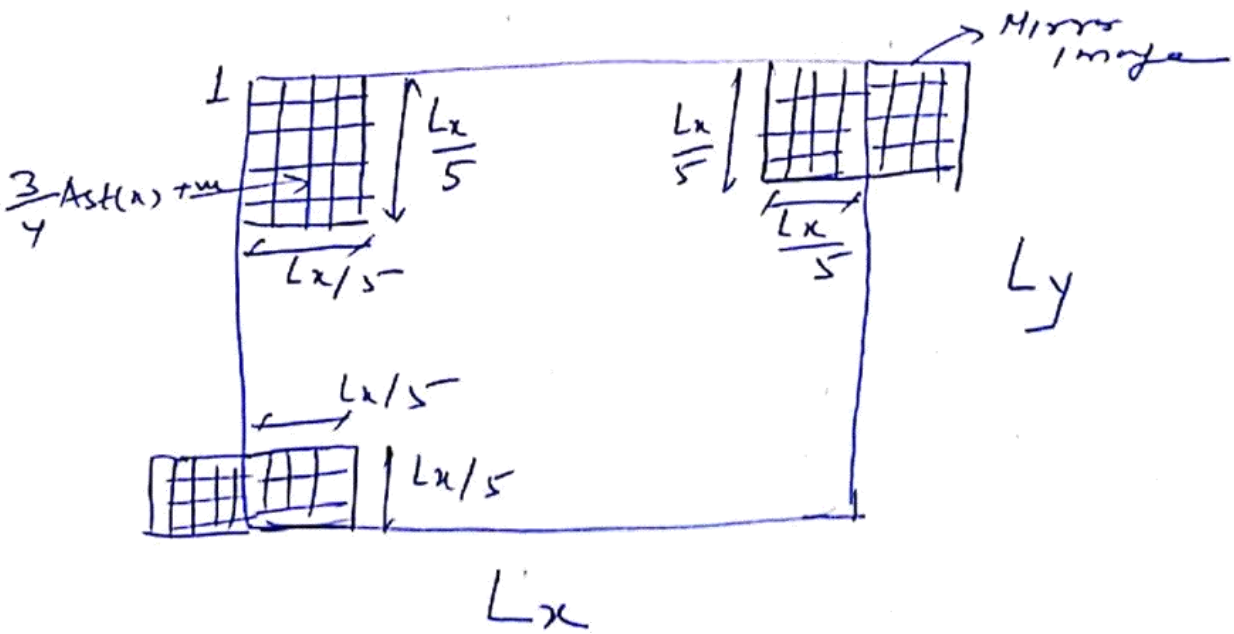



→ Length of Reinforcement (size of Mesh)

$$= \frac{L_x}{5}$$

→ Area of steel in each layer

$$= \frac{3}{4} \times A_{st(x)} \; (+ve)$$



D.1.9 Torsion Reinforcement equal to half of that at Corner (1) shall be provided at those Corner also where the slab is simply supported at one edge.

→ Provided in 4 layers

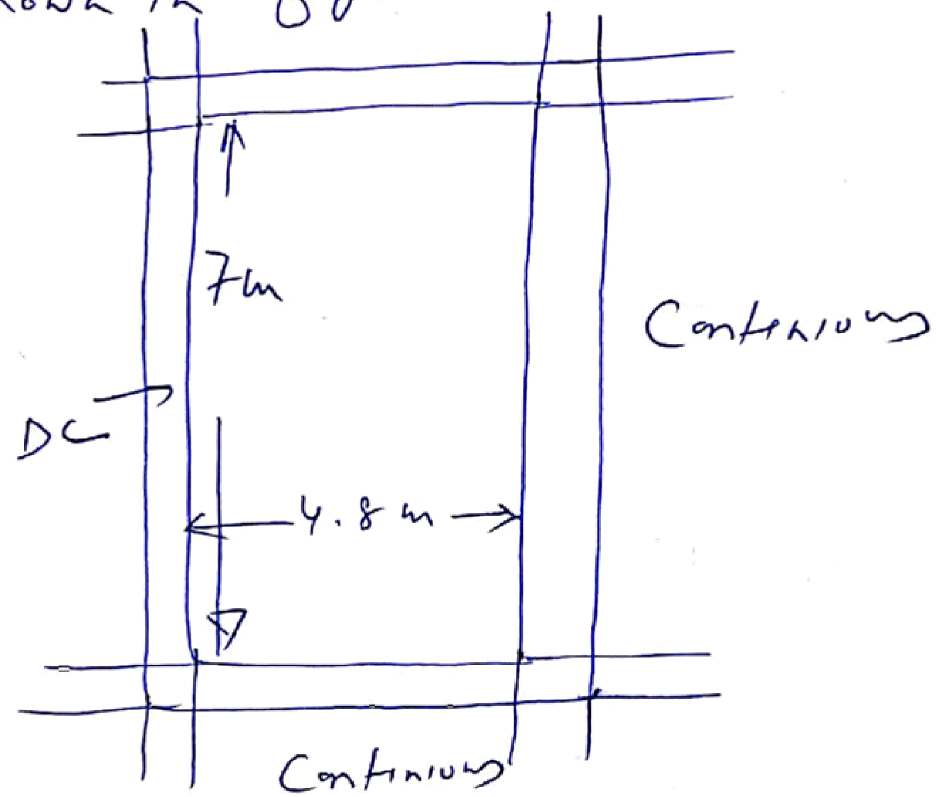
→ Size of Mesh = $L_x/5$

→ Area of steel = $\frac{3}{4} \times A_{st}(x)$ + ...

D.1.10 . When both edges are Continuous

→ No torsion reinforcement Provided.

Q. Design a slab having Continuous support over 3 edges and one long edge as shown in figure.



Design of slab using IS codes method. M25 Concrete / Fe415 Steel. Use LSM.

Live load on slab = 10 kN/m²

Superimposed load of water proofing = 100 mm thick brick work = 250 mm (unit wt = 24 kN/m³)

width of support = 250 mm

Sol<sup></sup>.

Width of support = 250 mm

$\frac{L_y}{L_x} = ?$

(1) Load calculation:

Overall Depth = $\frac{span}{32} = \frac{4800}{32}$

= 150 mm

d = 150 − 30 = 120 mm

DL = 0.15 × 1 × 1 × 25 = 3.75 kN/m²

LL = 10 × 1 × 1 = 10 kN/m²

Water Proofing = 0.10 × 1 × 1 × 24 = 2.4 kN/m²

Total load = 16.15 kN/m²

factored load = 1.5 × 16.15 = 24.23 kN/m²

(2) Effective span (Leff)

W = 250 mm

$L_0/12 = \frac{4800}{12} = 400$

$W < \frac{L_0}{12}$

$L_{effx} = L_x + d = 4.8 + 0.12 = 4.92 m$

$L_x + W = 4.8 + 0.25 = 5.05$

$L_{effx} = 4.92 m$

$L_{effy} = L_{y0} + d = 7 + 0.12$ } less

$L_{y0} + W = 7 + 0.25$

$L_{effy} = 7.12 m$

$\frac{L_{effy}}{L_{effx}} = \frac{7.12}{4.92} = 1.45 < 2$

(3) Panel No (3) (From IS code)

$\alpha_x (-ve) = 0.065$

$\alpha_x (+ve) = 0.049$

$\alpha_y (-ve) = 0.037$

$\alpha_y = (+ve) = 0.028$

(4) Moment

$M = \alpha \cdot w L_x^2$

$= \alpha \times 24.23 \times 4.92^2$

$= 586.52 \alpha$

| Moment | $\alpha$ | Moment (kN-m) | d (mm) | Ast (mm²) | dia | spacing |
|---|---|---|---|---|---|---|
| $M_x(-)$ | 0.065 | 38.12 | 120 mm | 1026 | 12 mm | 110.2 |
| $M_x(+)$ | 0.049 | 28.74 | 120 | 739 | 10 | 106.3 |
| $M_y(-)$ | 0.037 | 21.70 | 120 | 542 | 10 | 144.9 |
| $M_y(+)$ | 0.028 | 16.42 | 120 | 402 | 10 | 190 |

⑤ $d = \sqrt{\dfrac{Mu_{max}}{Q \cdot B}} = \sqrt{\dfrac{38.12 \times 10^6}{1000 \times 0.138 \times 25}}$

$= 105\ mm < 120\ mm$ ok

⑥ Ast reqd

$Mu = 0.87 f_y Ast(d - 0.42 x_u)$

$= 0.87 f_y Ast\left(d - 0.42 \times \dfrac{0.87 f_y Ast}{0.36 f_{ck} B}\right)$

⑦ $\text{spacing} = \dfrac{1000}{n} = \dfrac{1000}{\dfrac{Ast}{\frac{\pi}{4} \times \phi^2}}$

⑧ Distribution of bar

$= \dfrac{0.12}{100} \times 1000 \times 150 = 180\ mm^2$

(9) Check for shear

$SF_x = w_u \times l_x / 3$

$SF_y = w_u \times l_x \left(\frac{r}{r+2}\right)$

$V_{yu} = 24.23 \times 4.92 \times \left(\frac{1.45}{1.45+2}\right)$

$= 50.10\ kN$

Nominal shear stress $(\tau_{vu}) = \frac{50.13 \times 10^3}{1000 \times 120}$

$= 0.42\ N/mm^2$

% of steel (50% curtailment) $= \frac{\left(\frac{1000}{200}\right) \times \frac{\pi}{4} \times 10^2 \times 100}{1000 \times 120}$

$= 0.33\%$

M 25 $p_t = 0.33\%$

$\tau_c = 0.401$

~~$\tau_v < \tau$~~ $\tau_v > \tau_c$ failed

No curtailment allowed

(10) Check for development length

$L_d \le \frac{1.3 M_1}{V} + L_0$

$L_d = \frac{0.87 f_y \phi}{4 \tau_{bd}}$

(11) Torsion Reinforcement