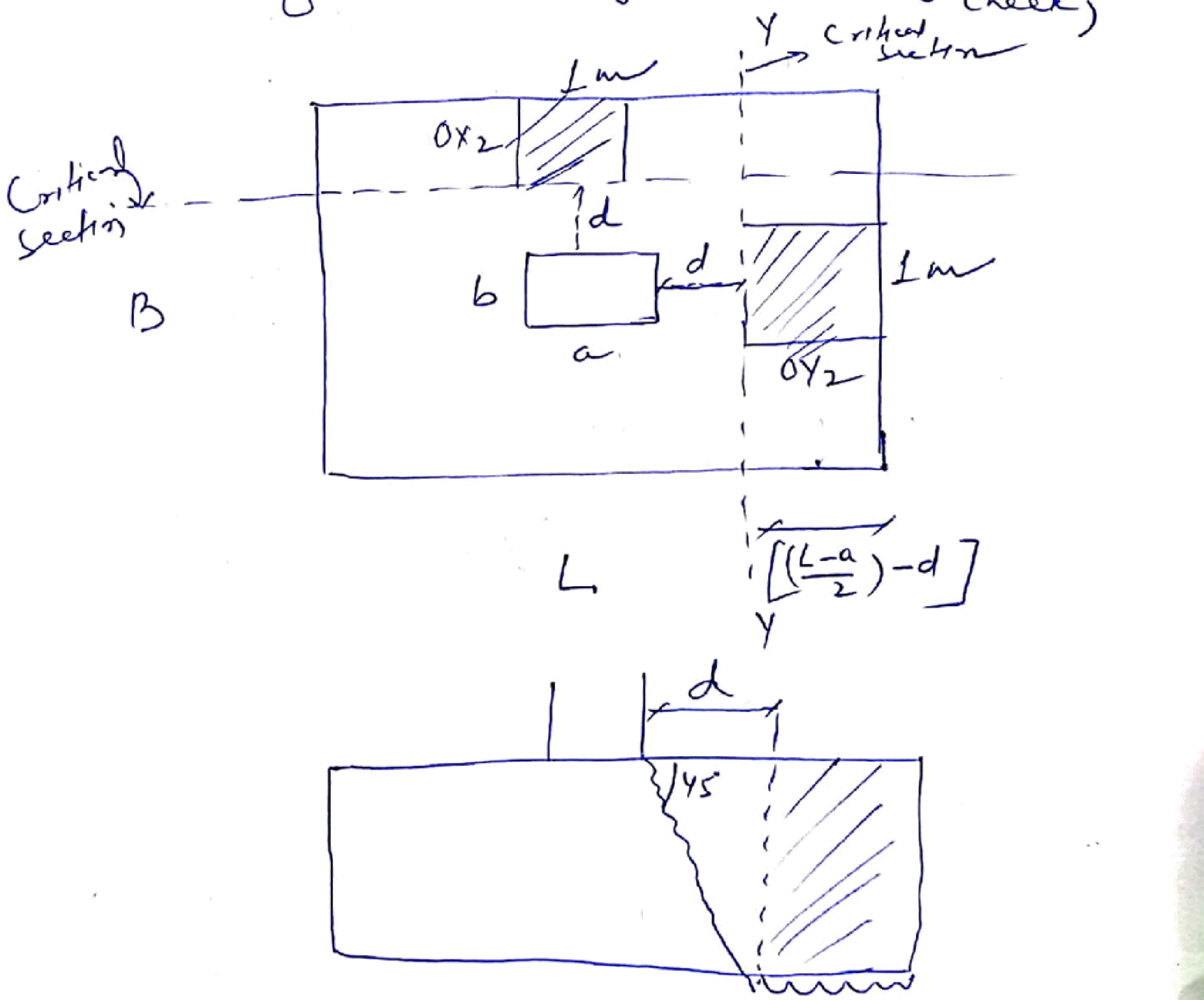
Department of Civil Engineering
Katihar Engineering College, Katihar

Subject: Design of Concrete Structure-I
Topic: Footing
Lecture: 02
Course Instructor: Prof. Rashid Mustafa

(2) Check for One way shear (single shear check)



Critical section for SF (One way shear)

→ At "d" distance from face of Column

→ Most Critical section will be the section where overhang is maxm.

→ If at X–X overhang is maxm

$$OY_2 = \left[\frac{L-a}{2} - d\right]$$

Total shear force for 1 m strip

$$V_y = W_o \times 1 \times OY_2$$

$$\boxed{V_y = W_o \times 1 \times \left[\left(\frac{L-a}{2}\right) - d\right]}$$

↳ WSM

$$\boxed{V_{uy} = W_{uo} \times 1 \times \left[\frac{L-a}{2} - d\right]}$$

↳ LSM.

Nominal shear stress

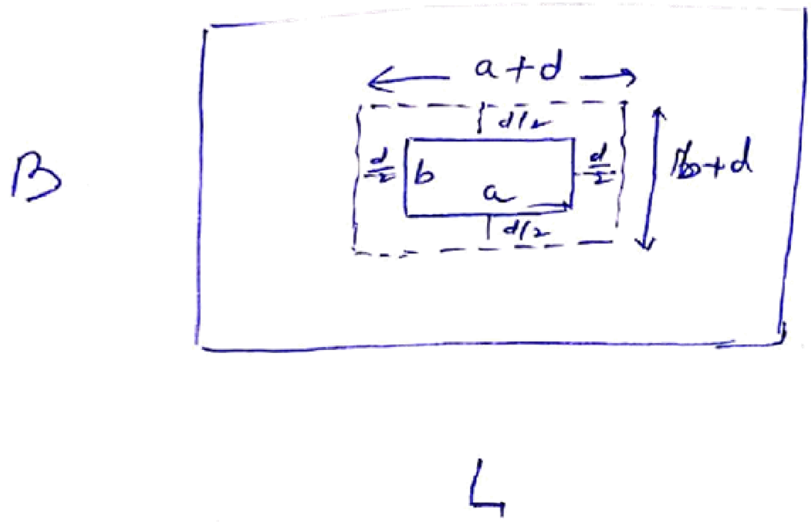
$$\tau_v = \frac{V}{B_1 d} = \frac{V}{1000 \times d} \leq k \cdot \tau_c$$

$$\tau_{vu} = \frac{V_u}{B_1 d} = \frac{V_u}{1000 \times d} \leq k \cdot \tau_c$$

Value of K

Slab thickness (mm)	≤ 150	175	200	225	250	275	≥ 300
K	1.30	1.25	1.20	1.15	1.10	1.05	1.00

(4) Check for Punching Shear (Two way shear)



→ Critical section is at "$\frac{d}{2}$" distance all around the column section.

Net Punching force (Pnet) $= P - W_0(a+d)(b+d)$

→ Punching shear stress (τ_{vp}) $= \dfrac{P_{net}}{\text{Resisting Area}}$

$= \dfrac{P_{net}}{\text{Perimeter} \times \text{width}}$

$$\tau_{vp(developed)} = \frac{P - W_o(a+d)(b+d)}{2[(a+d)+(b+d)] \times d}$$

↳ WSM

In LSM

$$\tau_{vp(dev)} = \frac{P_u - W_{uo} \times (a+d)(b+d)}{2[(a+d)+(b+d)] \times d}$$

→ Permissible Punching shear stress

$$\tau_{vp(Permissible)} = k_\beta \times 0.16\sqrt{f_{ck}}$$

↳ WSM

$$\tau_{vp(Permissible)} = k_\beta \times 0.25\sqrt{f_{ck}}$$

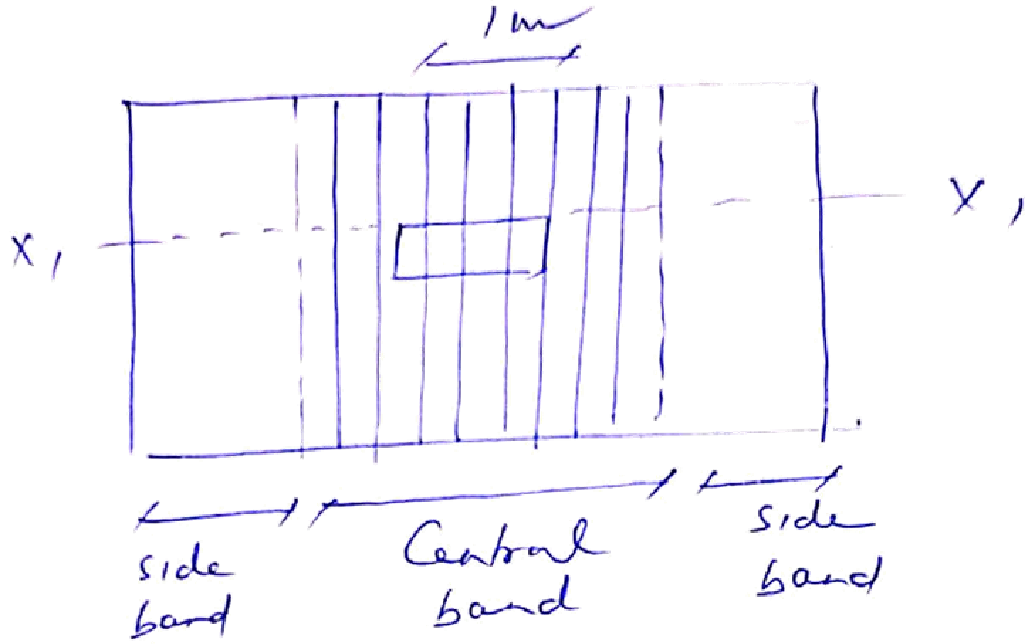
↳ LSM

Where,

$$k_\beta = \left(0.5 + \frac{b}{a}\right) \not> 1.0$$

Step 5. Area of steel.

(a) For Moment about X-X (for Mx)



Design of shorter bars.

Area of steel required for Mx (for 1m width)

$$A_{st} = \frac{BM}{\sigma_{st} \cdot J \cdot d}$$ → WSM

$$A_{st} = \frac{BM_u}{0.87 f_y \cdot J \cdot d}$$ → LSM

$$A_{st} = \frac{0.5 f_{ck}}{f_y}\left[1 - \sqrt{1 - \frac{4.6 M_u}{f_{ck} B_1 d^2}}\right] B_1 d$$

$B_1 = 1000$ mm

→ Area of steel required for full length (L) $= L \times A_{st}$

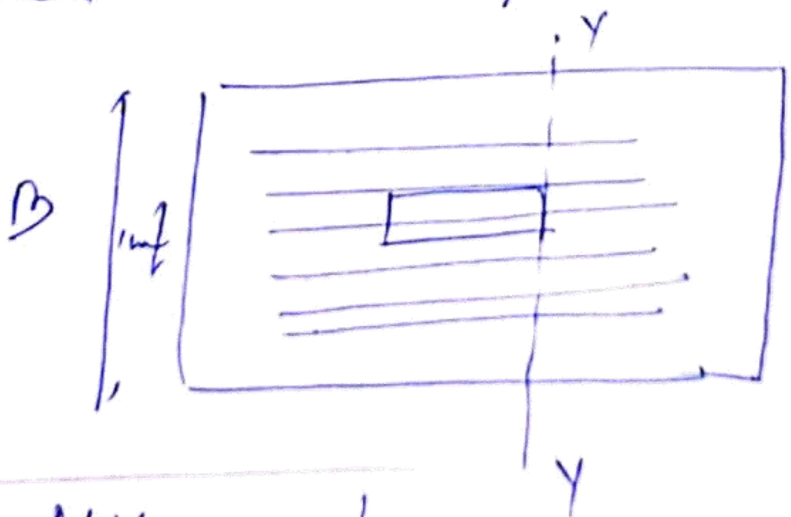
→ Total No of bars for full width $(n_T) = \dfrac{L \times A_{st}}{\frac{\pi}{4} \times \phi^2}$

→ No of reinforcement to be provided in Central band $(n_c) = n_T \times \dfrac{2}{\left(1 + \frac{L}{B}\right)}$

→ No of reinforcement to be provided on two side bands

$$(n_s) = \frac{n_T - n_c}{2}$$

(b) For Moment about Y–Y (For My)



$$A_{st} = \frac{M_Y}{\sigma_{st} \cdot J \cdot d}$$

↳ WSM

$$Ast = \frac{Muy}{0.87 f_y J \cdot d}$$

For total width B total Reinforcement

$= B \times Ast$.

$$\text{Total No of bars } (n) = \frac{B \times Ast}{\frac{\pi}{4} \times \phi^2}$$

↳ distribute equally on full width B