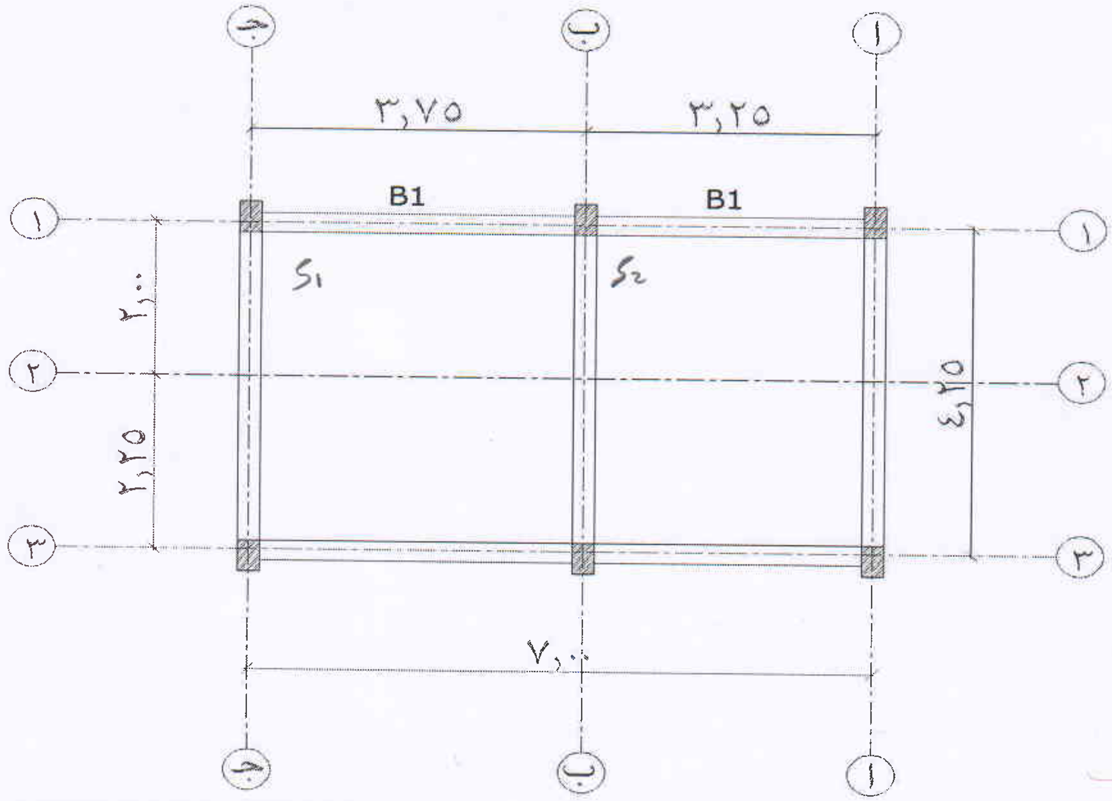
REINFORCED CONCRETE I

EXAMLLE 1 :



-Live Load = 200 kg/m2

-Flooring = 150 kg/m2

-Specific weigh of wall = 1.8 t/m3

- Floor Height = 3.50 m

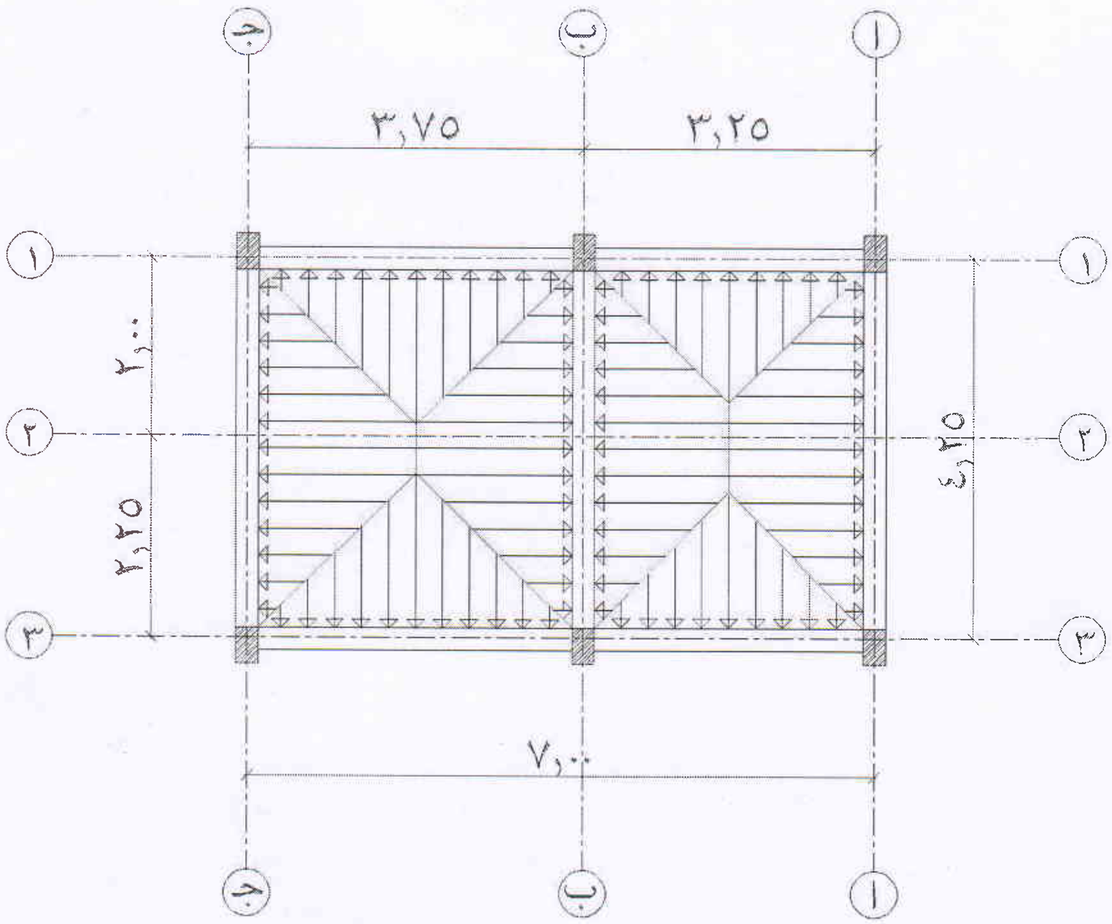
- Fcu = 250 kg/cm2 & Fy = 3600 kg/cm2

- Fyst = 240 kg/cm2 & Dim . column = 30*30 cm

-It is required to find the loads acting on the beam(B1) and draw bending moment and shear .

- Design beam (B1) for moment and shear .

- LOAD DISTRIBUTION OF THE SLABS :



$$r_1 = \frac{L_1}{L_2} = \frac{4.25}{3.75} = 1.13 < 2 \text{ two way}$$

$$r_2 = \frac{L_1}{L_2} = \frac{4.25}{3.25} = 1.3 < 2 \text{ two way}$$

$$\Rightarrow t_{s_1} = \frac{L_{smaller}}{40}$$

$$t_{s_1} = \frac{3.75}{40} = 0.09 \simeq 0.1\,m = 10\,cm$$

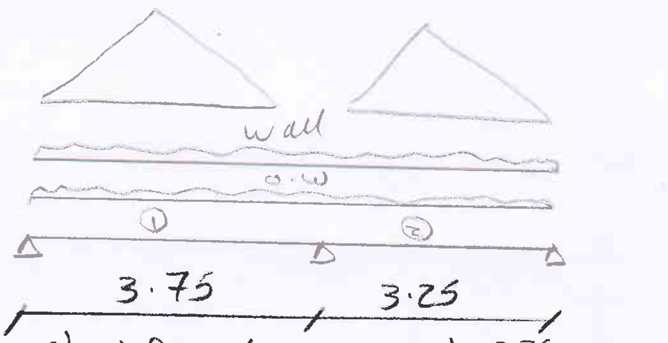
$$\Rightarrow t_{s_2} = \frac{L_{smaller}}{40}$$

$$t_{s_2} = \frac{3.25}{40} = 0.08 \simeq 0.1\,m = 10\,cm$$

⟹ Take all Beams (25 X 50) cm

* Load on B1:-

* Load For moment:-



$$g_{b1} = o.w + wall + \triangle$$

$$g_{b1} = \underbrace{0.25}_{b} * \underbrace{0.5}_{t} * \underbrace{2.5}_{\gamma_c} + \underbrace{0.25}_{t_w} * \underbrace{(3.5 - 0.5)}_{h_w} * \underbrace{1.8}_{\gamma_w} + \underbrace{(0.1*2.5 + 0.15)}_{w_s} * \underbrace{\frac{3.75}{2}}_{x} * \underbrace{0.667}_{\alpha}$$

$$g_{b1} = 2.16 \ t/m^2$$

$$P_b = \triangle = \underbrace{0.2}_{l.l} * \underbrace{\frac{3.75}{2}}_{x} * \underbrace{0.667}_{\alpha} = 0.25 \ t/m^2$$

$$w_{u1} = 1.5 (g_b + P_b) = 1.5 (2.16 + 0.25) = 3.61 \ t/m'$$

$$g_{b2} = o.w + wall + \triangle$$

$$g_{b2} = 0.25 * 0.5 * 2.5 + 0.2 * 3 * 1.8 + 0.4 * \frac{3.25}{2} * 0.667$$

$$g_{b2} = 2.09 \ t/m^2$$

$$P_{b2} = \triangle = 0.2 * \frac{3.25}{2} * 0.667 = 0.2167 \ t/m'$$

$$w_{u2} = 1.5 (0.2167 + 2.09) = 3.46 \ t/m'$$

* Load For Shear :-

$$g_{s_1} = 0.25 * 0.5 * 2.5 + 0.25 * 3 * 1.8 + \underbrace{0.4}_{w_s} * \underbrace{1.875}_{X} * \underbrace{0.5}_{\beta}$$

$$g_{s_1} = 2.037 \ t/m^2$$

$$P_{s_1} = 0.2 * 1.875 * 0.5 = 0.187 \ t/m^2$$

$$wu_{1_s} = 1.5 \ (0.187 + 2.037) = 3.336 \ t/m'$$

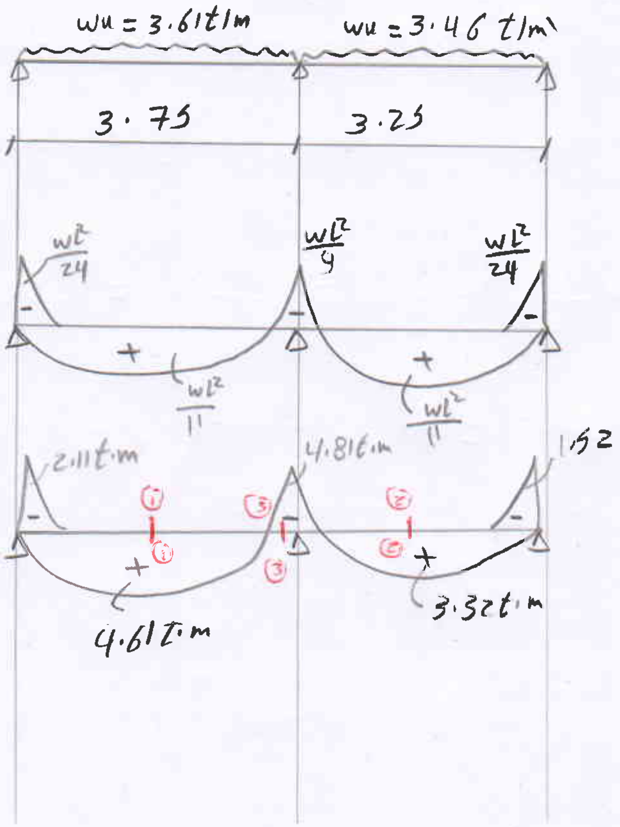
$$g_{s_2} = 0.25 * 0.5 * 2.5 + 0.25 * 3 * 1.8 + 0.4 * 1.625 * 0.5$$

$$g_{s_2} = 1.9875 \ t/m^2$$

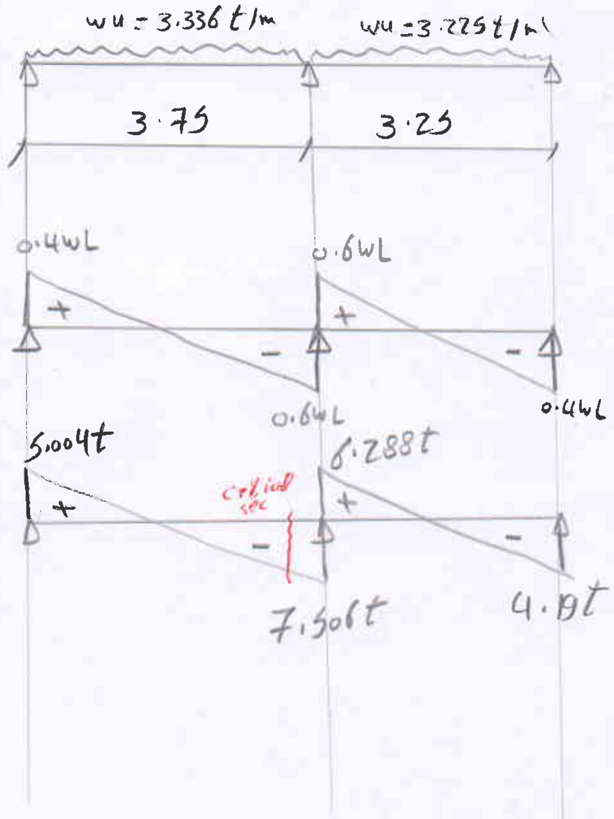
$$P_{s_2} = 0.2 * 1.625 * 0.5 = 0.1625 \ t/m^2$$

$$wu_{2_s} = 1.5 \ (0.1625 + 1.9875) = 3.225 \ t/m$$

Moment



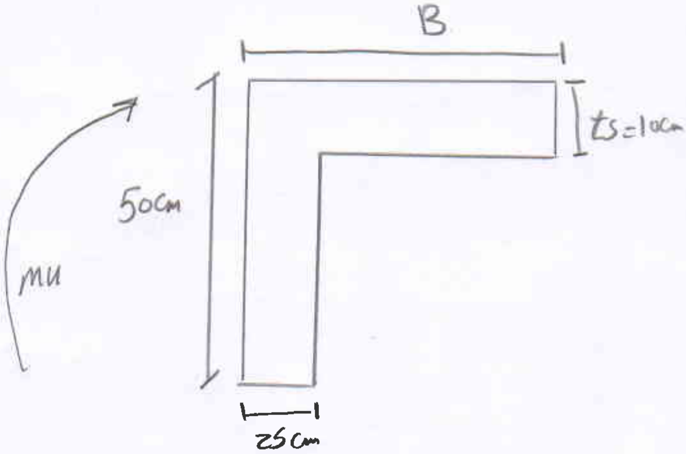
Shear



*Design sec 1-1 by chart :-

$Mu = 4.61 \ t.m$

$\Rightarrow$ Design by C - J Curve



$$d = C_1 \sqrt{\frac{mu}{F_{cu} \cdot B}}$$

$\therefore$ B smaller

- $\rightarrow$ ¢ - edge = 212.5 Cm
- $\rightarrow 6t_s + b = 6*10+25 = 85$ cm
- $\rightarrow K \frac{L}{10} + b = 0.8 \frac{375}{10} + 25 = 55$ Cm

Take $B = 55$ Cm

$d = t - 5\text{cm}_{\text{cover}} = 50 - 5 = 45$ cm

$$45 = C_1 \sqrt{\frac{4.61 * 10^5}{250 * 55}} \Rightarrow C_1 = 7.75$$

$C_1 \rightarrow J = 0.826$

$$A_s = \frac{Mu}{F_y \cdot J \cdot d} = \frac{4.61 * 10^5}{3600 * 0.826 * 45} = 3.44 \ Cm^2$$

Take $A_s = 4 \phi 12$

* Check min :-

N/mm^2

μ_{min} smaller

- $\rightarrow \frac{0.225 \sqrt{F_{cu}}}{F_y} = \frac{0.225 \sqrt{25}}{360} = 0.0031$
- $\rightarrow \frac{1.3 A_s}{b \cdot d} = \frac{1.3 * 3.44 * 100}{450 * 250} = 0.0039$

$\rightarrow 0.0031$

$As_{min} = \mu_{min} \cdot b \cdot d$

$As_{min} = 0.0031 * 25 * 45$
$= 3.51 \ cm^2$

$As_{min} > As$

Take As_{min}

$\Rightarrow$ check max

$\mu_{max} = 5*10^{-5} F_{cu} \cdot B \cdot d$ (From Table 4-1)

$A_{max} = 5*10^{-5} * 250*55*45 = 30.9\ cm^2$

$As_{max} > As$ ok

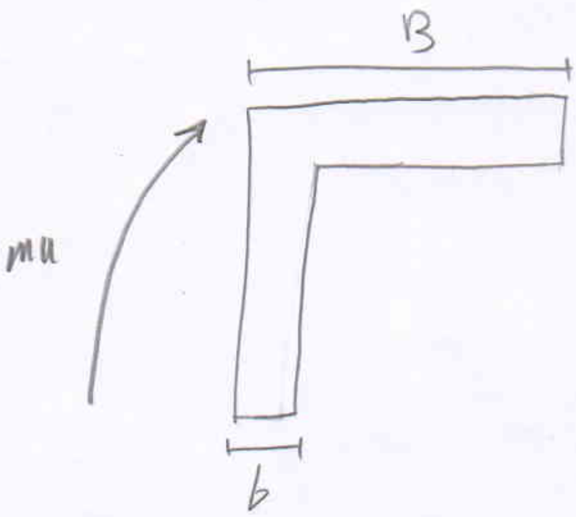
* sec ② - ② :

$M_u = 3.32\ t \cdot m$

$$B \begin{cases} \rightarrow 212.5 \\ \rightarrow 6t_s + b = 85\ cm \\ \rightarrow K\frac{L}{10} + b = 51\ cm \end{cases}$$

Take $B = 51\ cm$

$d = 45\ cm$



$$45 = C_1 \sqrt{\frac{3.32*10^5}{250*51}} \Rightarrow C_1 = 8.8 \Rightarrow J = 0.826$$

$$As = \frac{3.32*10^5}{3600*0.826*45} = 2.48\ cm^2 < As_{min}$$

Take $As_{min} = 4\ \phi 12$

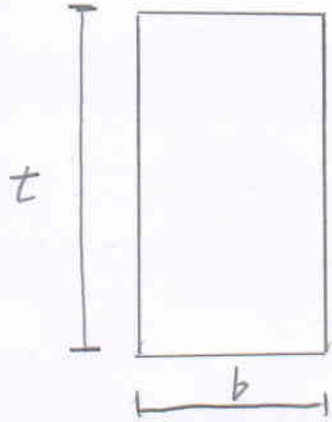
$\Rightarrow$ check max

$As_{max} = \mu_{max} \cdot B \cdot d > As$ ok sec ③ - ③ :

$$M_u = 4.81\ t \cdot m$$

$C_1 - J \Rightarrow$ Curve

$$d = C_1 \sqrt{\frac{M_u}{F_{cu} \cdot b}}$$



$$45 = C_1 \sqrt{\frac{4.81 * 10^5}{250 * 25}}$$

$$C_1 = 5.13 \Longrightarrow J = 0.826$$

$$A_s = \frac{M_u}{F_y \cdot d \cdot J} = \frac{4.81 * 10^5}{3600 * 0.826 * 45} = 3.59\ cm^2 > A_{s\,min}$$

OK

Take $A_s = 4\ \phi 12$

* check max

$$\mu_{max} = 5 * 10^{-5} * F_{cu} = 5 * 10^{-5} * 250 = 0.0125$$

$$A_{s\,max} = \mu_{max} \cdot b \cdot d = 0.0125 * 25 * 45$$

$$= 14.06\ cm^2$$

$A_{s\,max} > A_s$ OK

*Design For shear:-

$$Q = 7.506\ t$$

$$Q_{u\ critical} = Q - w\left(\frac{c}{2} + \frac{d}{2}\right)$$

$$Q_u = 7.506 - 3.336\left(\frac{0.3}{2} + \frac{0.45}{2}\right) = 6.255\ t = 62.55\ KN$$

$$q_u = \frac{Q_u}{b.d} = \frac{62.55 * 10^3}{250 * 450} = 0.556\ N/mm^2$$

$$q_{cu} = 0.24\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.24\sqrt{\frac{25}{1.5}} = 0.979\ N/mm^2$$

$$q_{max} = 0.7\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.7\sqrt{\frac{25}{1.5}} = 2.85\ N/mm^2$$

$$q_u < q_{u\,max}\quad ok$$

$$q_{cu} > q_u$$

use min stirrups

(100-200) mm

$$As_{min} = \frac{0.4}{F_y}.b.S = \frac{0.4}{240} * 250 * 200$$

المسافة بين الكانات

$$As_{min} = 83.33\ mm^2$$

$$As_{one\,leg} = \frac{As_{min}}{n} = \frac{83.33}{2} = 41.66\ mm^2$$

Take stirrups 5Ø8/m'

Example 2 :-

* Design Double sec by R-w curve

$M_u = 32\ t \cdot m$

$\Rightarrow$ by curve R.w $\Rightarrow$ assume $\alpha = 0.3$

$$R = \frac{M_u}{F_{cu} \cdot b\, d^2}$$

$$R = \frac{32 * 10^5}{250 * 65^2 * 25} = 0.121$$

by $R \Rightarrow w = 0.15$

$$A_s = w \cdot b \cdot d \frac{F_{cu}}{F_y}$$

$$A_s = 0.15 * 25 * 65 * \frac{25}{3600}$$

$A_s = 16.92\ cm^2$

$A_s' = \alpha A_s = 0.3 * 16.92 = 5.07\ cm^2$

check min :-

μ_{min} smaller

$$\rightarrow \frac{0.225\sqrt{25}}{360} = 0.003125$$

$$\rightarrow \frac{1.3 * 16.92 * 100}{250 * 650} = 0.0135$$

$\rightarrow 0.003125$

$A_{s\,min} = 0.003125 * 25 * 65 = 5.07\ cm^2$

$(A_s - A_s') = (16.92 - 5.07) = 11.85\ cm^2 > A_{s\,min}$ ok

* Check max :

$$\mu_{max} = 5 * 10^{-5} F_{cu} = 5 * 10^{-5} * 250 = 0.0125$$

From Table

$$A_{s_{max}} = \mu_{max} \cdot b \cdot d$$

$$A_{s_{max}} = 0.0125 * 25 * 65 = 20.31 \text{ cm}$$

$$A_{s max} > (A_s - A_s') \quad \text{ok}$$