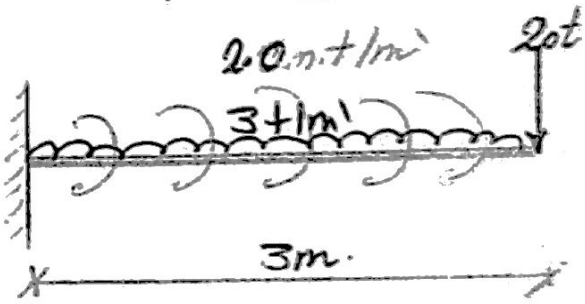
بسم الله الرحمن الرحيم

Q1 Design Cantilever beam subjected To uniform load "3t/m" and Concentrated Force "2t" acting at edge and uniform Torsion load "2.0 m.t/m'"

* with Cross sec 30 x t- and span 3m.

A) Design The beam M&Q,T

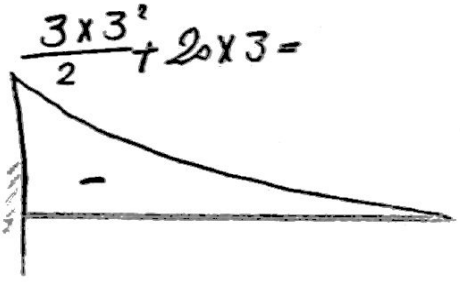
B) check deflection.



I Straing Action

$M_u = 73.5$ m.t

BM.D

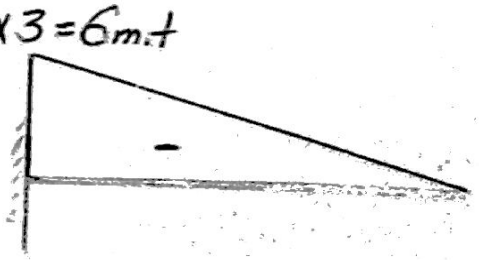


$Q_u = 29t$

S.F.D

$T_u = 6$ m.t

T.D

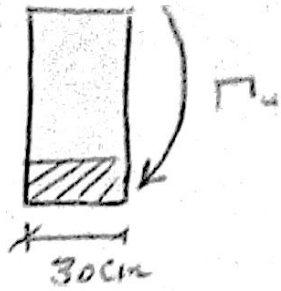


II

1] Design due to Moment

$$d = 3.5 \sqrt{\frac{73.5 \times 10^5}{250 \times 30}} \rightarrow d = 109$$

d = 115cm
t = 120cm



C → 4 → 3

2] Shear & Torsion

Shear

$$q_u = \frac{Q_u}{b\,d}$$

$$= \frac{29 \times 10^3}{30 \times 115} = 8.4 \text{ kg/cm}^2$$

$$S_{si} = \frac{1}{\sqrt{1 + \left(\frac{16.7}{8.4}\right)^2}} = 0.45$$

$$q_{cu} = 0.45 \times 0.75 \sqrt{\frac{250}{1.5}} = 4.36 \text{ kg/cm}^2$$

$q_{max} \Rightarrow 12.7$ kg/cm²

$q_{cu} < q_u < q_{max}$

Torsion

$$q_{tu} = \frac{3 T_u}{b^2 t}$$

$$= \frac{3 \times 6 \times 10^5}{30^2 * 120} = 16.7 \text{ kg/cm}^2$$

$$S_{ti} = \frac{1}{\sqrt{1 + \left(\frac{8.4}{16.7}\right)^2}} = 0.898$$

$q_{cut} = 8.7$ kg/cm²

$q_{max} = 25.5$ kg/cm²

$q_{cu} < q_{ut} < q_{max}$

$$q_{us} = q_u - \frac{q_{cu}}{2}$$

$$= 8.4 - \frac{4.36}{2} = 6.22 \text{ kg/cm}$$

$$q_{us} = \frac{n A_{str} F_y / \gamma_s}{b\, S'}$$

$$6.22 = \frac{2 * A_{str} \times 3600}{30 * S' * 1.15}$$

$$A_{str} = 0.0298\, S$$

$$A_{str} = \frac{(q_{ut} - \frac{q_{cu}}{2}) \frac{b^2 t}{3}\, S}{\frac{F_y}{\gamma_s} * \alpha_t * x_1 y_1}$$

$$x_1 = 30 - 5 = 25 \text{ cm}$$

$$y_1 = 120 - 10 = 110 \text{ cm}$$

$$\alpha_t = 0.66 + 0.33 \frac{110}{25} = 2.1 > 1.5$$

$$\alpha_t = 1.5$$

$$A_{str} = \frac{(16.7 - \frac{8.7}{2}) * \frac{30^2 \times 120}{3} * S'}{\frac{3600}{1.15} * 1.5 * 25 * 110}$$

$$A_{str} = 0.03414\, S'$$

$$[A_{str}]_T = [0.0298 + 0.0344]\, S'$$

$$[A_{str}]_T = 0.0642\, S'$$

* use #10 $\longrightarrow$ $A_{str} = 0.785$

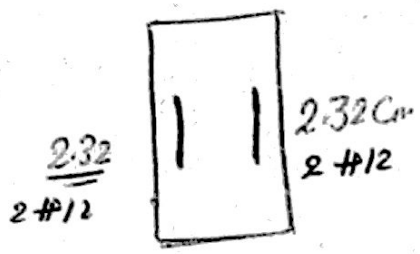
$$S' = 12.22 \text{ cm}$$

$$N.\text{stirrup} = \frac{100}{12.2} = 8.1 \simeq \underline{\underline{9\ \#10/m'}}$$

كانت نقلة

* As long

$$A_{SL} = \frac{\frac{A_{str}}{S}(x_1 + y_1)}{\text{For Tor}} \left(\frac{F_y}{F_y}\right)_1$$



* $A_{SL} = 0.0344 * (25 + 110) = 4.64\ Cm^2$ موزعة على جانبين

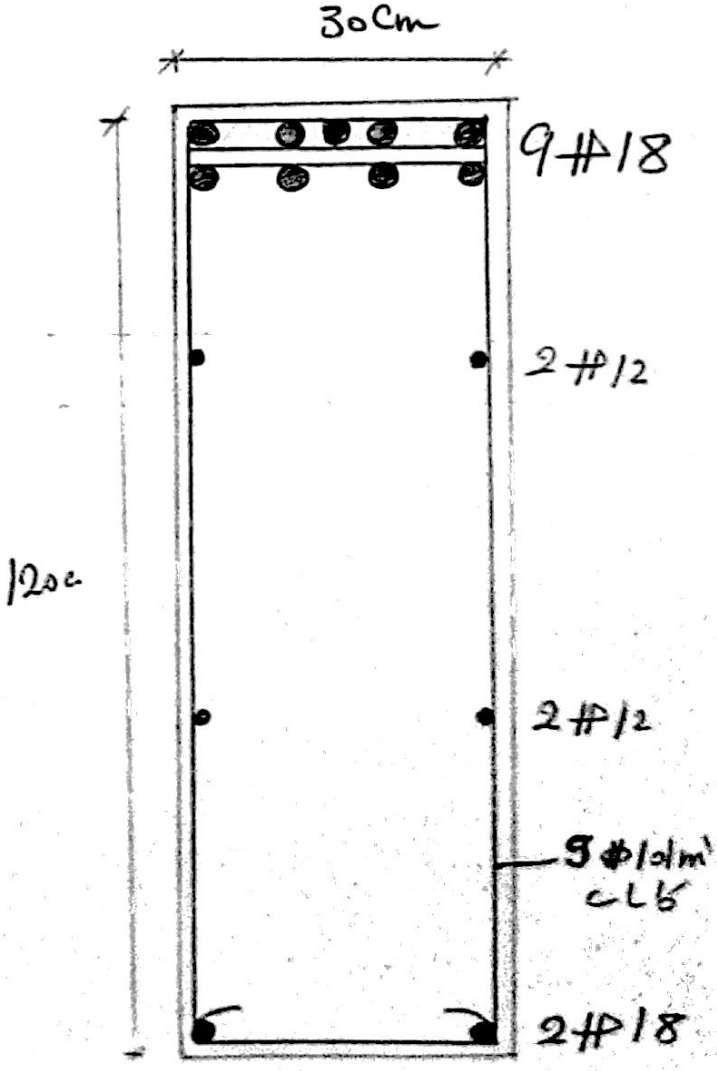
* Get As

$$d = 115 \quad C = \sqrt{\frac{73.5 \times 10^5}{250 \times 30}} \longrightarrow C = 3.67 \longrightarrow J = 0.78$$

$$A_S = \frac{73.5 \times 10^5}{3600 * 0.78 \times 115}$$

$$= 22.76\ Cm^2$$

↳ 9 #18



check Deflection

1. $\sqcap\!\sqcap u = 73.5$ m.t

2. $\sqcap\!\sqcap ap = \frac{73.5}{1.5} = 49$ m.t

3. $Ig = \frac{30 \times 120^3}{12} = 432 \times 10^4$ cm^4

4. $yt = \frac{120}{2} = 60$ cm

5. $Fctr = 1.9\sqrt{f'cu} \simeq 0.75 (f'cu)^{\frac{2}{3}} = .30$ kg/cm^2.

6. $\sqcap\!\sqcap cr = \frac{Fctr \cdot Ig}{y} = 21.6$ m.t

$\sqcap\!\sqcap ap > \sqcap\!\sqcap cr$

7. $Ec = 14000\sqrt{f'cu} = 221359.4$ kg/cm^2

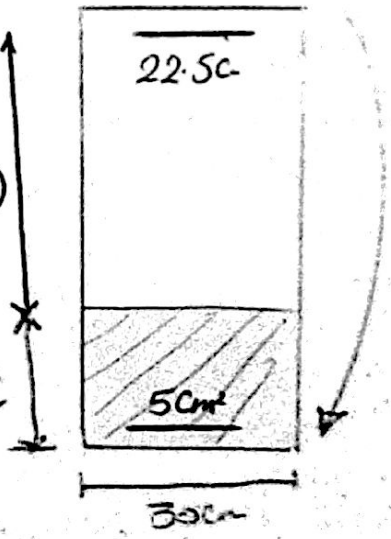
8. $n = 15$ & $As = 9 \times 2.5 = 22.5$ cm^2

$As' = 2 \times 2.5 = 5$ cm^2

9. C.g after cracking

$\frac{30C^2}{2} + 5(C-5) * 15 = 15 \times 22.5 (115-C)$

$15C^2 + 75C - 375 = -337.5C + 38812.5$



$$15C^2 + 412.5C - 39187.5 = 0.0$$

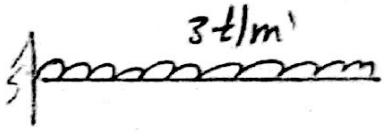
$$C = 38.8\ cm$$

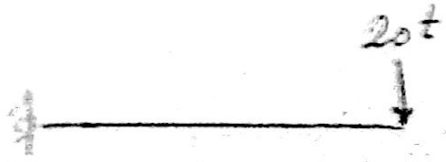
$$I_{cr} = \frac{bc^3}{3} + 15 * 22.5 * (115 - 38.8)^2 + 15 * 5 * (38.3 - 5)^2$$

$$I_{cr} = 26,25950.9\ cm^4$$

$$I_e = \left(\frac{M_{cr}}{M_{af}}\right)^3 I_g + \left[1 - \left(\frac{M_{cr}}{M_a}\right)^3\right] I_{cr}$$

$$I_e = 27719\,75.9\ cm^4$$





$$\Delta_I = \frac{wL^4}{8E_c I_e}$$

$$\Delta_I = \frac{P * L^3}{3E_c I_e}$$

$$w = \frac{30}{1.5} = 20\ kg/cm$$

$$P = \frac{20}{1.5} = 13.3\ t$$

$$\therefore \Delta_I = \left[\frac{W_L L^4}{8} + \frac{P L^3}{3} \right] * \frac{1}{E_c I_e}$$

$$= \left[\frac{26 \times (300)^4}{8} + \frac{133 \times 10^3 \times (300)^3}{3} \right] * \frac{1}{E_c I_e}$$

$$\Delta_I = 0.229 \text{ Cm}$$

$$\therefore \Delta_{D.L} = 0.8 \, \Delta_I = 0.183 \text{ Cm}$$

$$\alpha = 2 - 1.2 \left(\frac{A_s'}{A_s} \right)$$

$$= 2 - 1.2 \left(\frac{5}{22.5} \right) = 1.73$$

$$\Delta_{Long} = \alpha \, \Delta_{D.L}$$

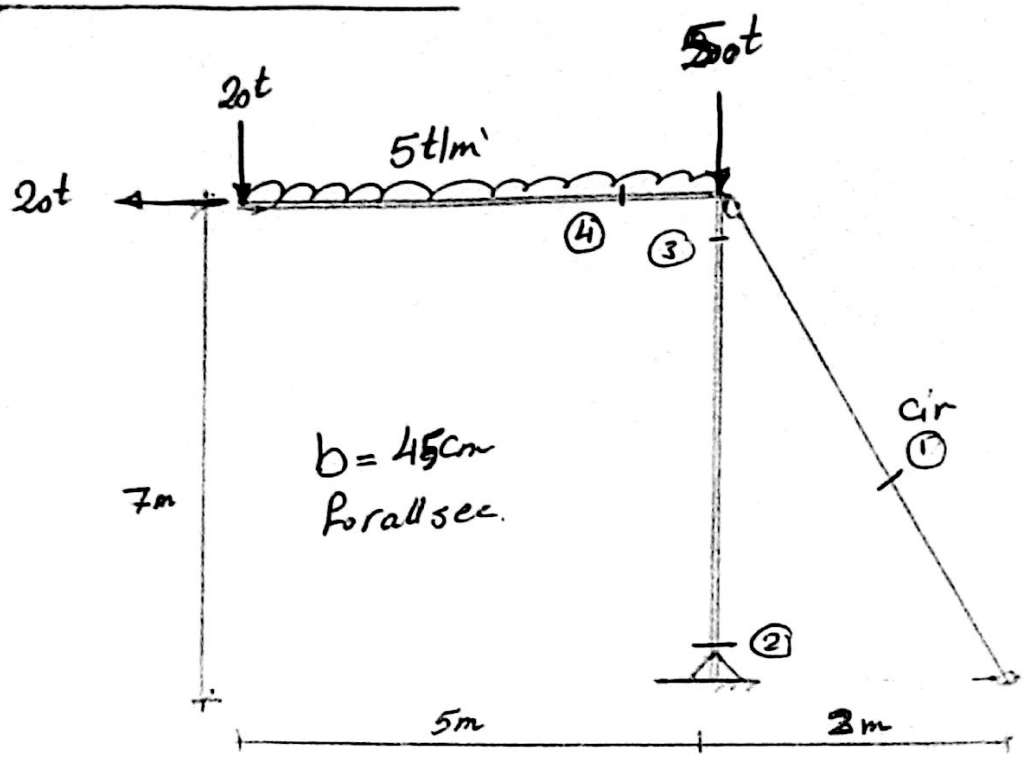
$$\Delta_{Long} = 0.317 \text{ Cm}$$

$$\Delta_t = 0.317 + 0.229 = 0.546 \text{ Cm}$$

$$\Delta_{all} = \frac{L_{cant}}{450} = \frac{300}{450} = 0.67 \text{ Cm} > \Delta_t$$

Safe

Q2 Design all Marked Sec



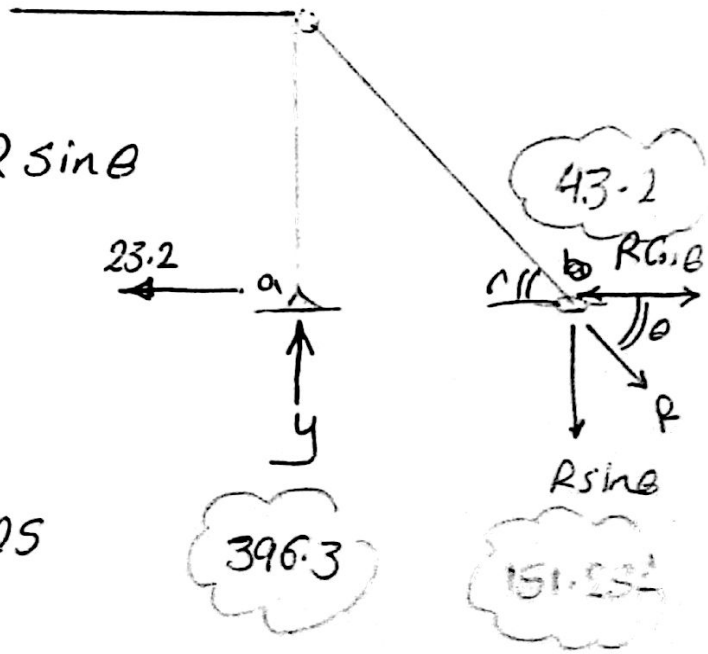
1) $\sin\theta = \frac{7}{7.28}$

$\cos\theta = \frac{2}{7.28}$

$\Sigma M_a = 0.0$ C+

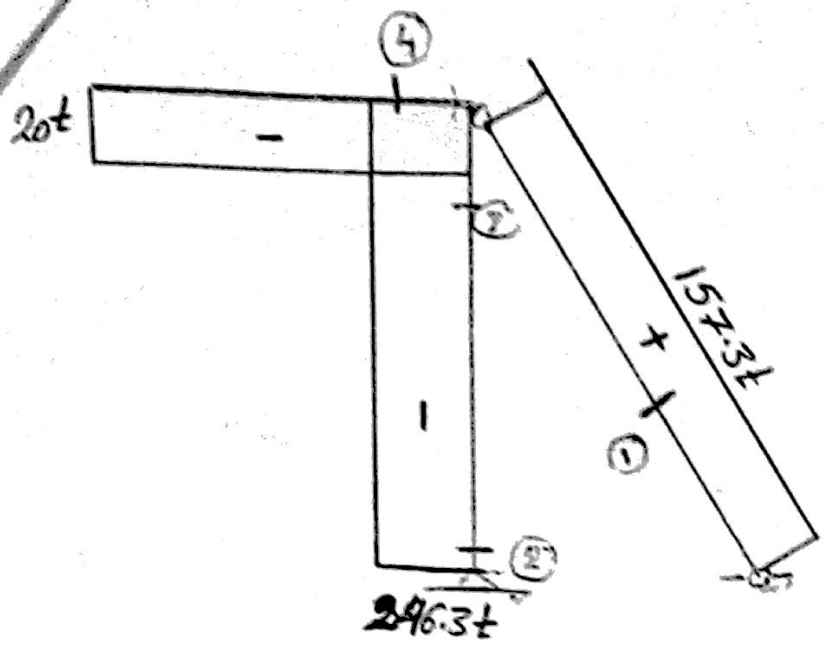
$+20\times5 + 20\times7 + 5\times5\times2.5 = 2R\sin\theta$

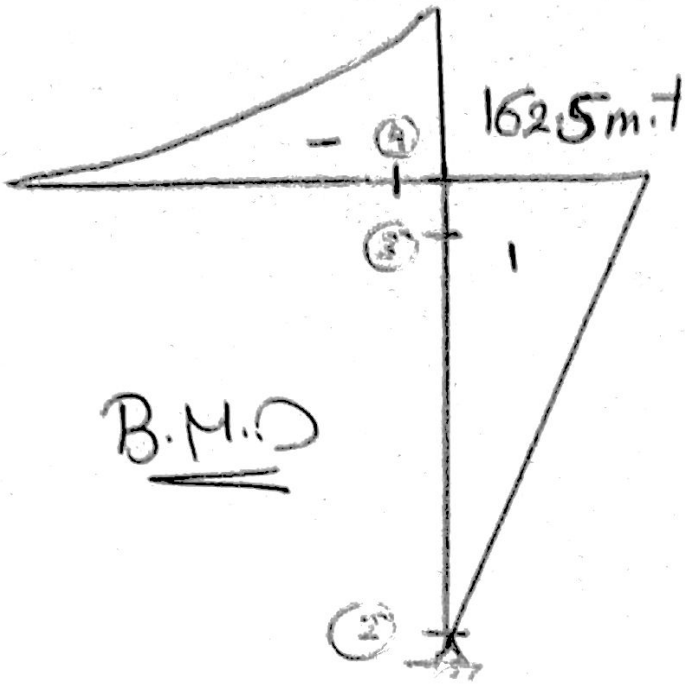
$R = +157.3t$



$\therefore y = 5\times5 + 50 + 20 + 151.25$

$y = 396.3t$





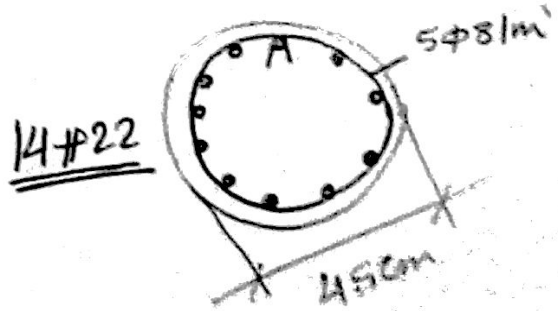
1 Sec 1-1 $\quad T_u = +157.3t$ $\quad$ Cir

$$\therefore A_s = \frac{157.3 \times 10^3}{\frac{3600}{1.15}} \Rightarrow 50.2\,cm^2$$

$$\therefore A_c = 30 A_s \Rightarrow 1500\,cm^2 = \frac{\pi D^2}{4} \rightarrow D = 43$$

$$\boxed{D = 45\,cm}$$

$$N = \frac{50.2}{3.8} = 13.2 \longrightarrow 14 \#22.$$



sec 2-2 $P_u = -246.3\ t$ $b = 45cm$

$$P_u = 0.35 f_{cu} A_c + 0.67 f_y \underbrace{A_s}_{0.01 A_c}$$

$$2463 * 10^3 = 111.62\ A_c$$

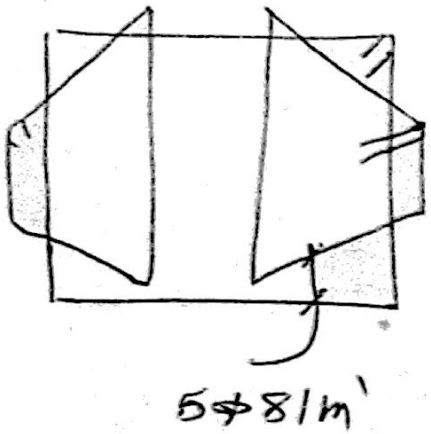
$$A_c = 2206.59\ cm^2 \longrightarrow t = 49cm$$

45 x 55

* check - $\frac{55}{45} \not> 5 \longrightarrow$ o/c.

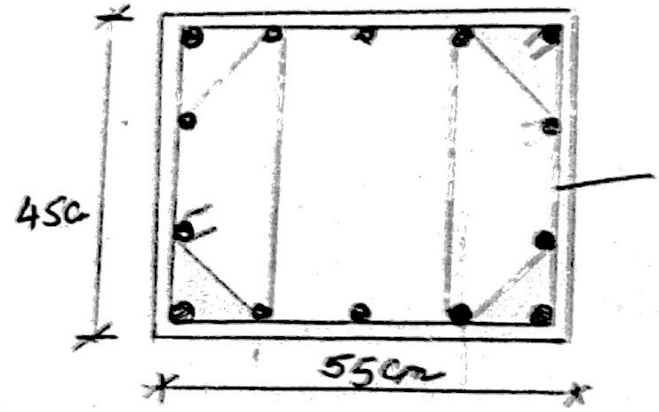
$\therefore A_s = 0.01 * 45 * 55 = 24.75\ cm^2$

عدد الأسياخ $= \frac{24.75}{14} = 1.76$



5 ⌀ 8/m'

14 ⌀16

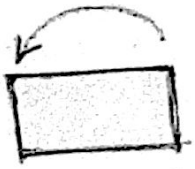


3-3

$M_u = 162.5\ m.t$

$P_u = 246.3\ t$

$b = 45cm$



(o) $d = \frac{L}{4}\sqrt{\frac{162.5 \times 10^5}{25 \times 45}} \longrightarrow d = 154cm$

$d = 160cm$

$t = 165cm$

بزود لتير وتصير
نضرب $d \times 1.1$
نفس بقية الخطوات M & P

* $P_u = 0.35\ f_{cu} A_c + 0.67\ f_y A_s$

$\hookrightarrow t = 55cm$.

∴ $45 \times 165\ cm$

* $e = \frac{162.5}{246.3} = 0.66\ m \quad > 0.05t \longrightarrow M$

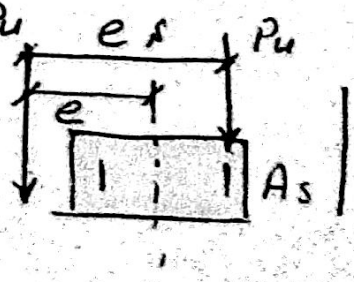
* $\frac{P_u}{f_{cu} A_c} = 0.133 > 0.04 \longrightarrow P$

* $P_b = 2144 \frac{250}{6000 + \frac{3600}{1.15}} bd = 422\ t$

* $P_u < P_b \longrightarrow$ Tension failure.

* $e_s = e + t/2 - cov = .66 + \frac{1.65}{2} - 0.05 = 1.435m$

$M_u = 1.435 \times 246.3 = 353.4\ m.t$



$$\frac{L}{160} = \sqrt{\frac{353.4 \times 10^5}{250 \times 45}} \Rightarrow C_1 = 2.85 > 2.78$$

$$J = 0.73$$

$$* A_s = \frac{353.4 * 10^5}{3600 * 0.73 \times 160} \Rightarrow \frac{246.3 \times 10^3}{\frac{3600}{1.15}} = +5.32\,cm^2$$

$$A_{smin} = \frac{11}{3600} bd = 22\,cm$$

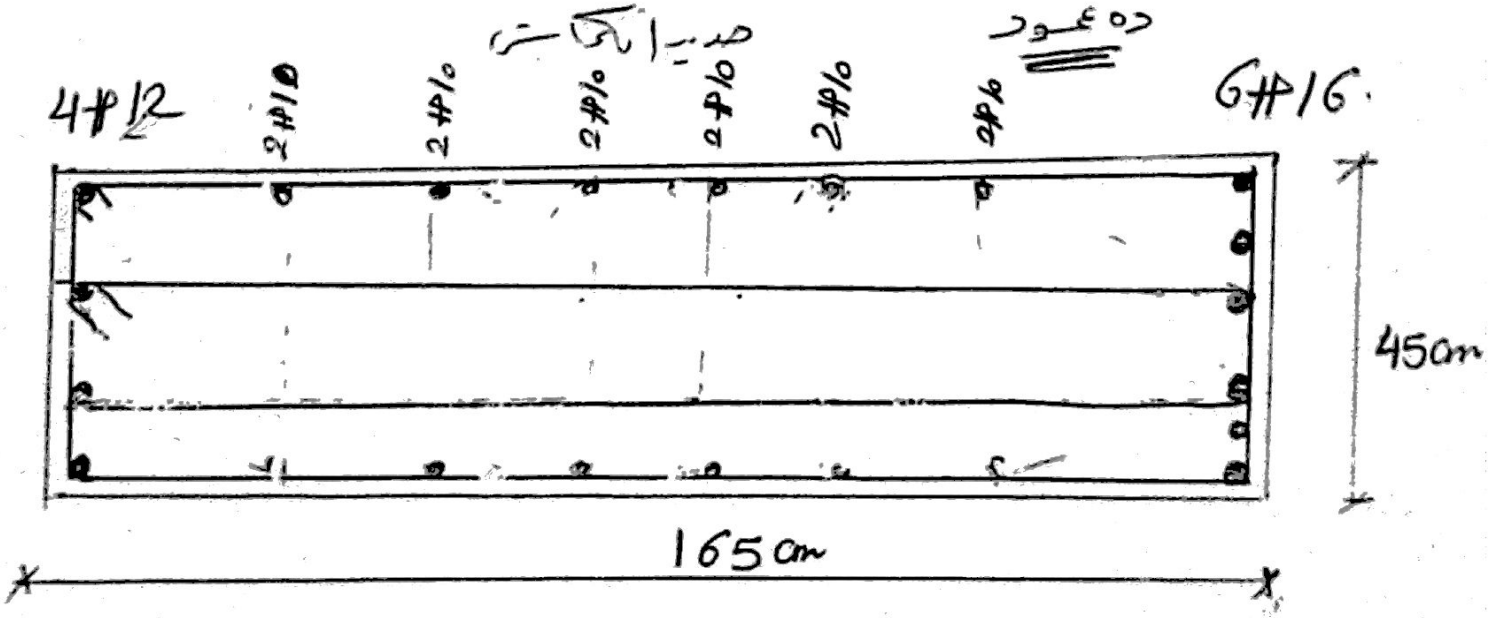
$$1.3 \times 5.32 = 6.9\,cm$$

$$\frac{0.15}{100} bd = 10.8\,cm^2$$

$\rightarrow 6.9$

$\rightarrow A_{smin} = 10.8\,cm^2$

$\hookrightarrow 6\#16.$



4-A

$M_u = 162.5\ m.t$

$T_u = 20\ t$ $\quad b = 45\ cm$

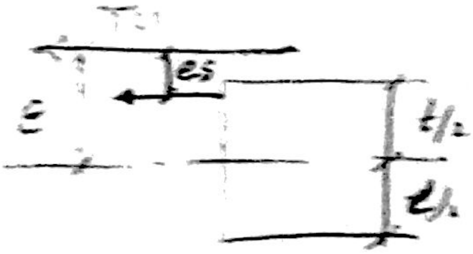
(0) $d = C_1 \sqrt{\dfrac{162.5 \times 10^5}{250 \times 45}} \longrightarrow d = 154\ cm$, with $C_1 = 4$

$d = 155\ cm$ ← مش محتاج ازودها كتير علشان الغلاء M&T

$t = 160\ cm$

45 x 160 Cm

$* \ e = \dfrac{162.5}{20} = 8.125\ m > t/2$



$* \ e_s = e - t/2 + Cv.$

$= 8.125 - \dfrac{1.6}{2} + 0.05 = 7.375\ m$

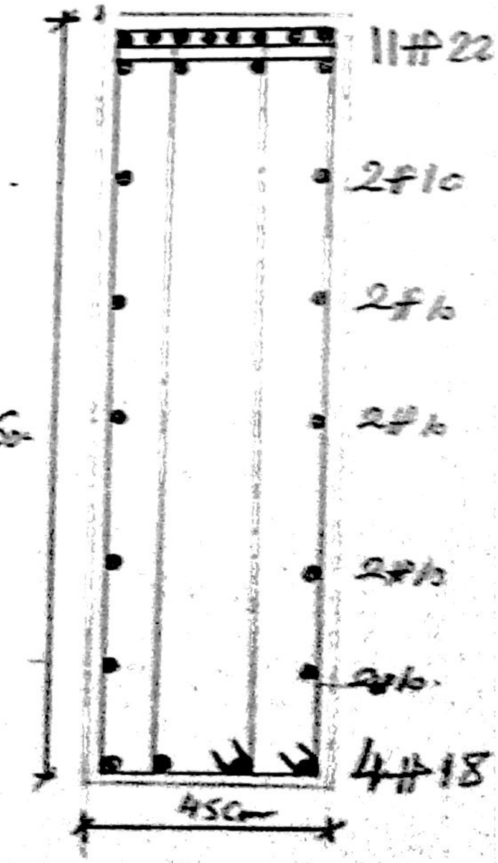
$* \ M_{us} = 7.375 \times 20 = 147.5\ m.t$

$d = C_1 \sqrt{\dfrac{147.5 \times 10^5}{250 \times 45}} \longrightarrow C_1 = 4.28$, with $d = 155$

$J = 0.826$

$A_s = \dfrac{147.5 \times 10^5}{3600 \times 0.826 \times 155} + \dfrac{20 \times 10^3}{\frac{3600}{1.15}} = 38.4\ cm^2$

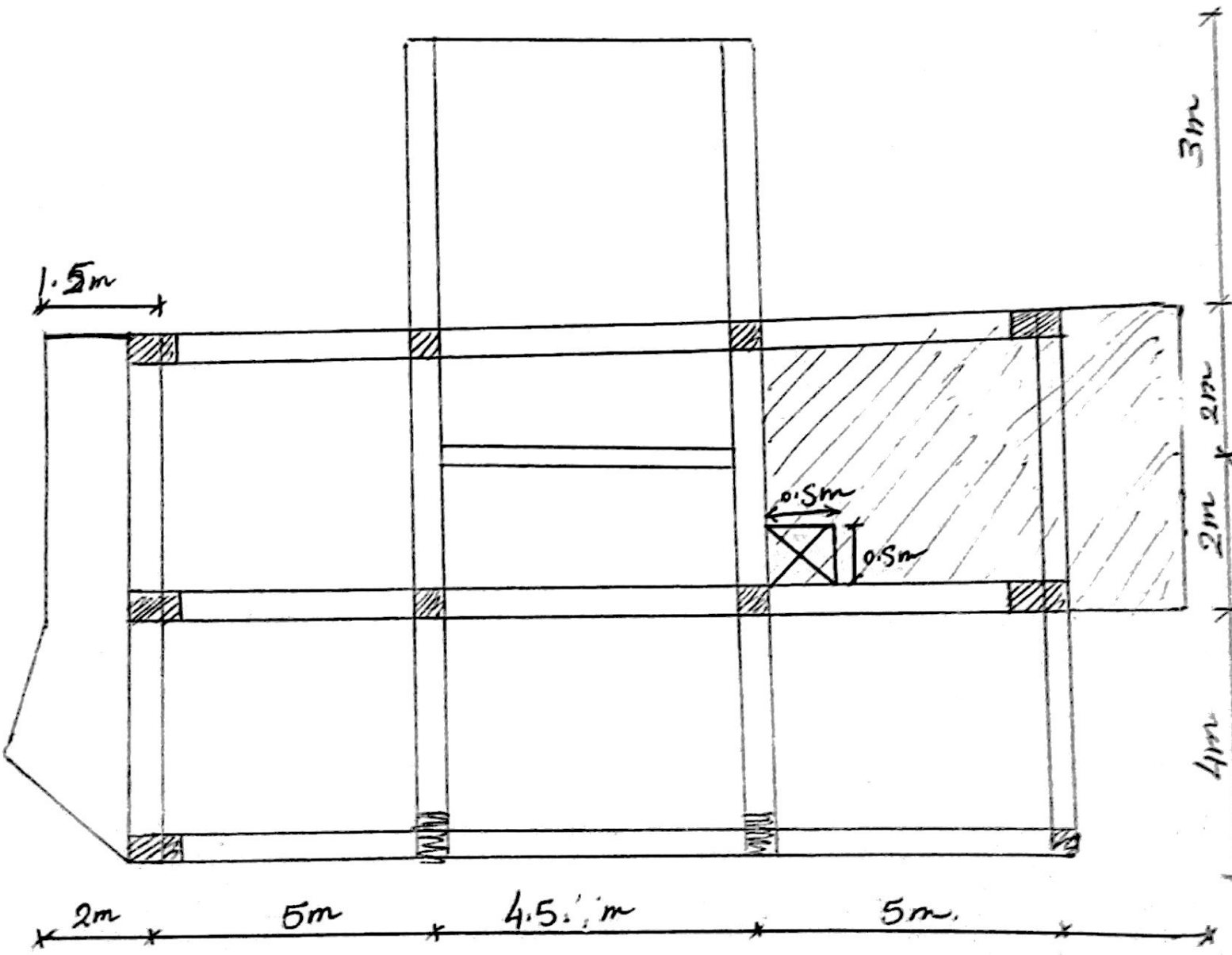
11#22



B

Q3 Design all Slab on Plan and Draw Reinforcement detailing on Plan. Assuming that

$l.l = 200\ kg/m^2$ & $F.C = 300\ kg/m^2$



1] Conc Dim's

* Two way slab (SS) → $\frac{400}{35} = 11.4\,cm$

* Cat liv → $\frac{150}{10} = 15\,cm$

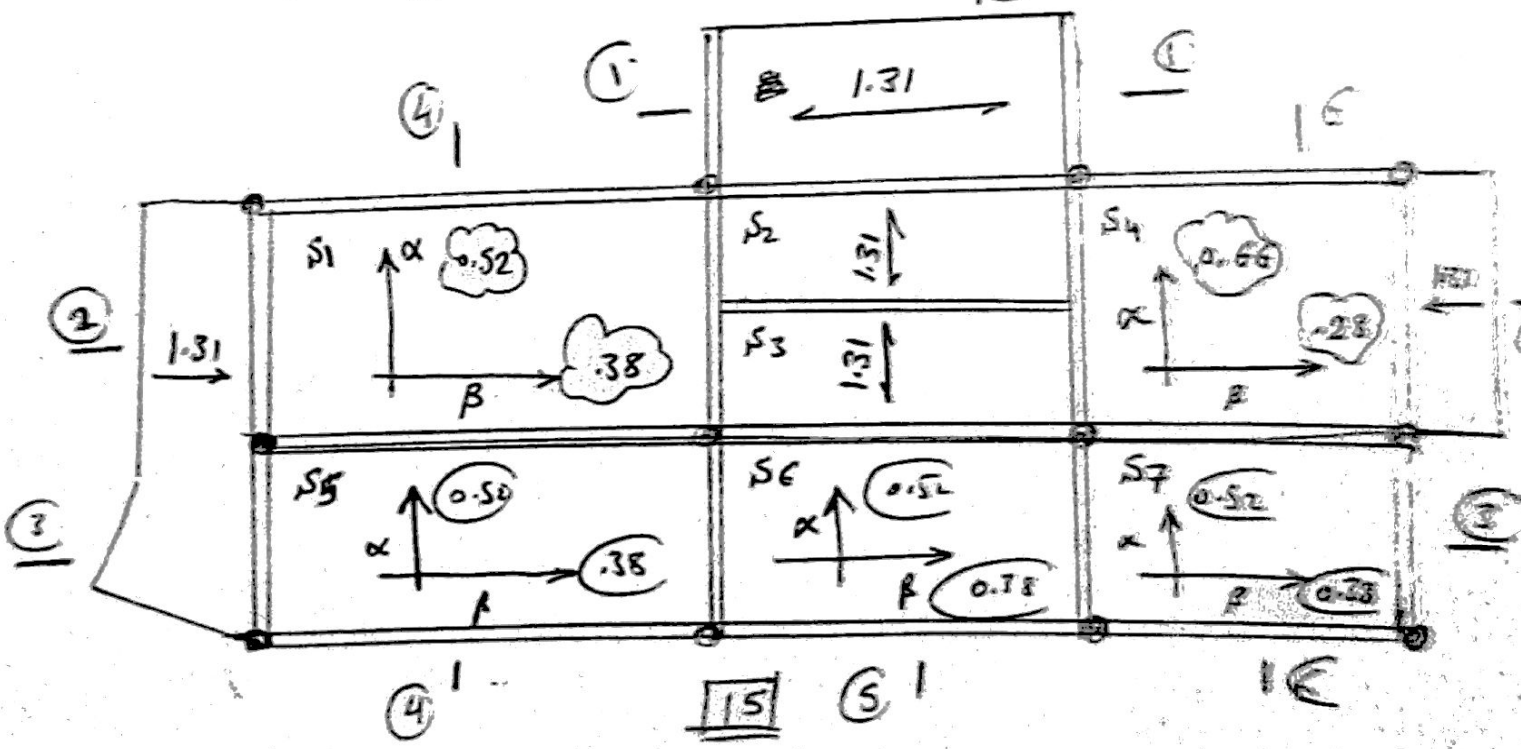
* one way slab ⇒ → $\frac{450}{30} = 15.0$

∴ $t_S = 15\,cm$

2] loads

$W_{su} = 1.5\,(\gamma_c t_s + f.c + l.l)$

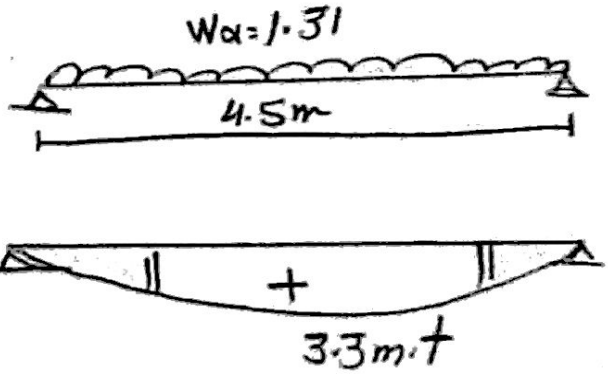
$= 1.5\,(2.5 * 0.15 + 0.3 + 0.2) = 1.31\ t/m^2$

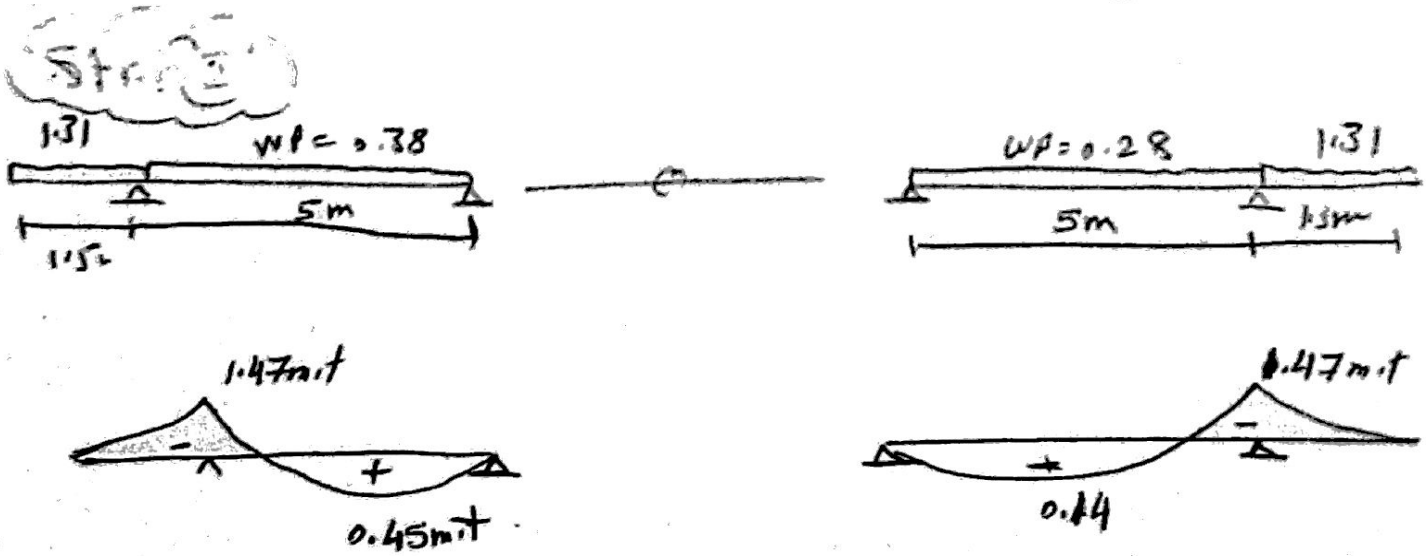


S.No	Lx	mx	Ly	my	r	α	β	w_α	w_β
S1	5	0.76	4	0.86	1.1	0.4	0.29	0.52	0.38
S2	4.5	0.76	2	0.76	2.25	one way		1.31	
S3	4.5	0.76	2	0.76	2.2	——		1.31	
S4	5	1	4	1	1.25	0.5	0.21	0.66	0.28
S5	5	0.76	4	0.86	1.1	0.4	0.29	0.52	0.38
S6	4.5	0.76	4	0.86	1.1	0.4	0.29	0.52	0.38
S7	5	0.86	4	1	1.1	0.4	0.29	0.52	0.38

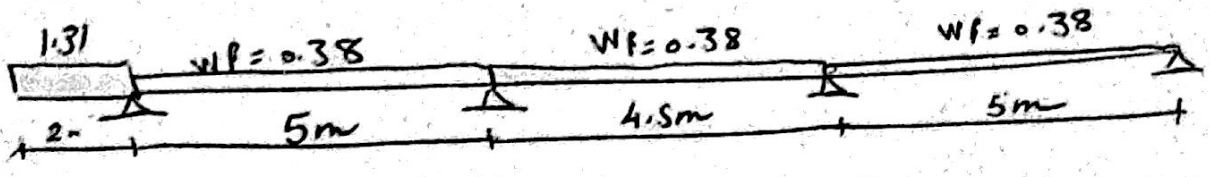
3] Strips الشرائح

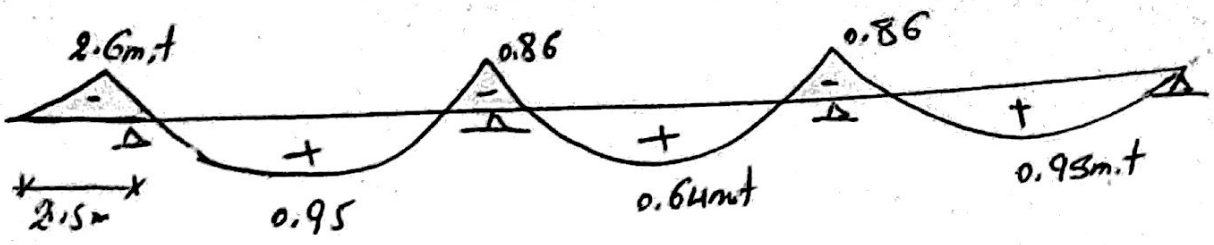
Strip (1) :



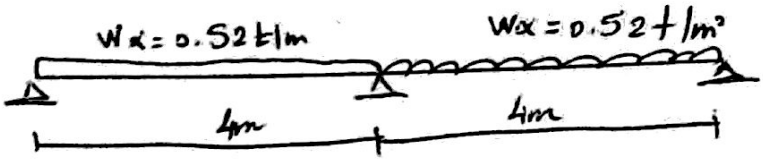


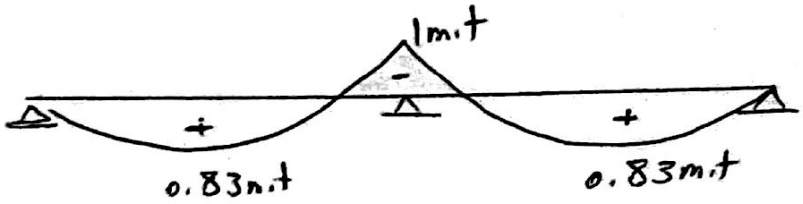
Strip 3





Strip 4

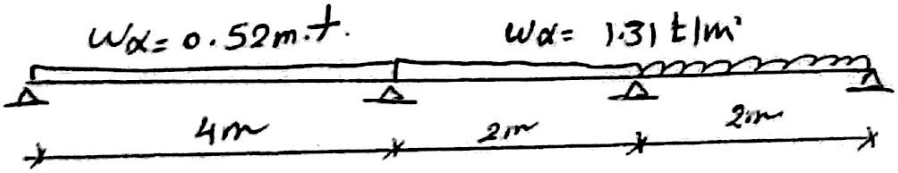


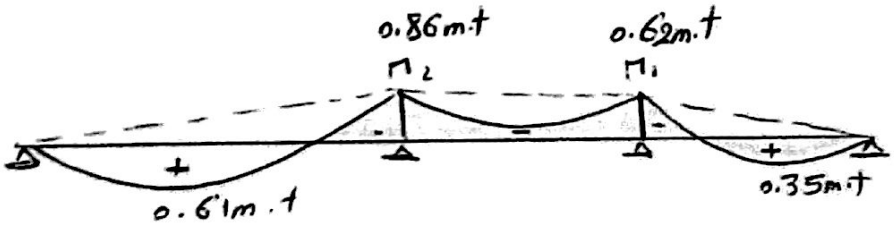


Strip 5

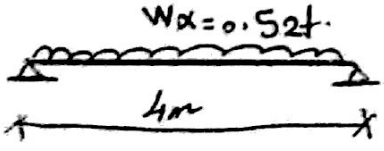
$$M_1 = \frac{1.31 \times 2^3 \times 2}{8.5(2+2)} = 0.62 \text{ m.t}$$

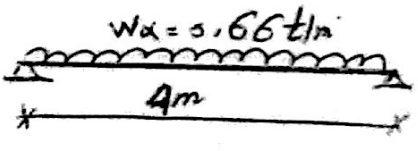
$$M_2 = \frac{1.31 \times 2^3 + 0.52 \times 4^3}{8.5(2+4)} = 0.86$$

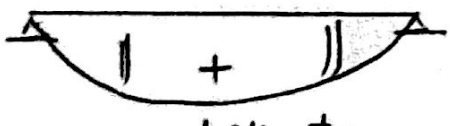


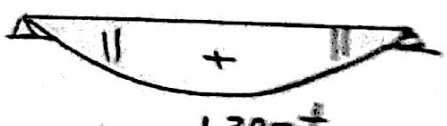


Strip 6









* Design of se:

$\lceil\rceil_{\alpha} = 1.32$ m.t $\qquad d_{\alpha} = 15 - 1.5 = 13.5$ cm

* $d = G\sqrt{\frac{1.32 \times 10^5}{250 \times 100}} \longrightarrow G = 5.8 \longrightarrow J = 0.826$

* $A_s = \frac{1.32 \times 10^5}{3600 \times 0.826 \times 13.5} = 3.23 cm^2 \Rightarrow 5\#10/m'$

For Cant liv → $\lceil\rceil_{\alpha} = 2.6$ m.t $\qquad d = 15 - 1.5 = 13.5$

$A_s = \frac{2.6 \times 10^5}{3600 \times 0.8 \times 13.5} = 6.68 cm^2 \Rightarrow 6\#12/m'$

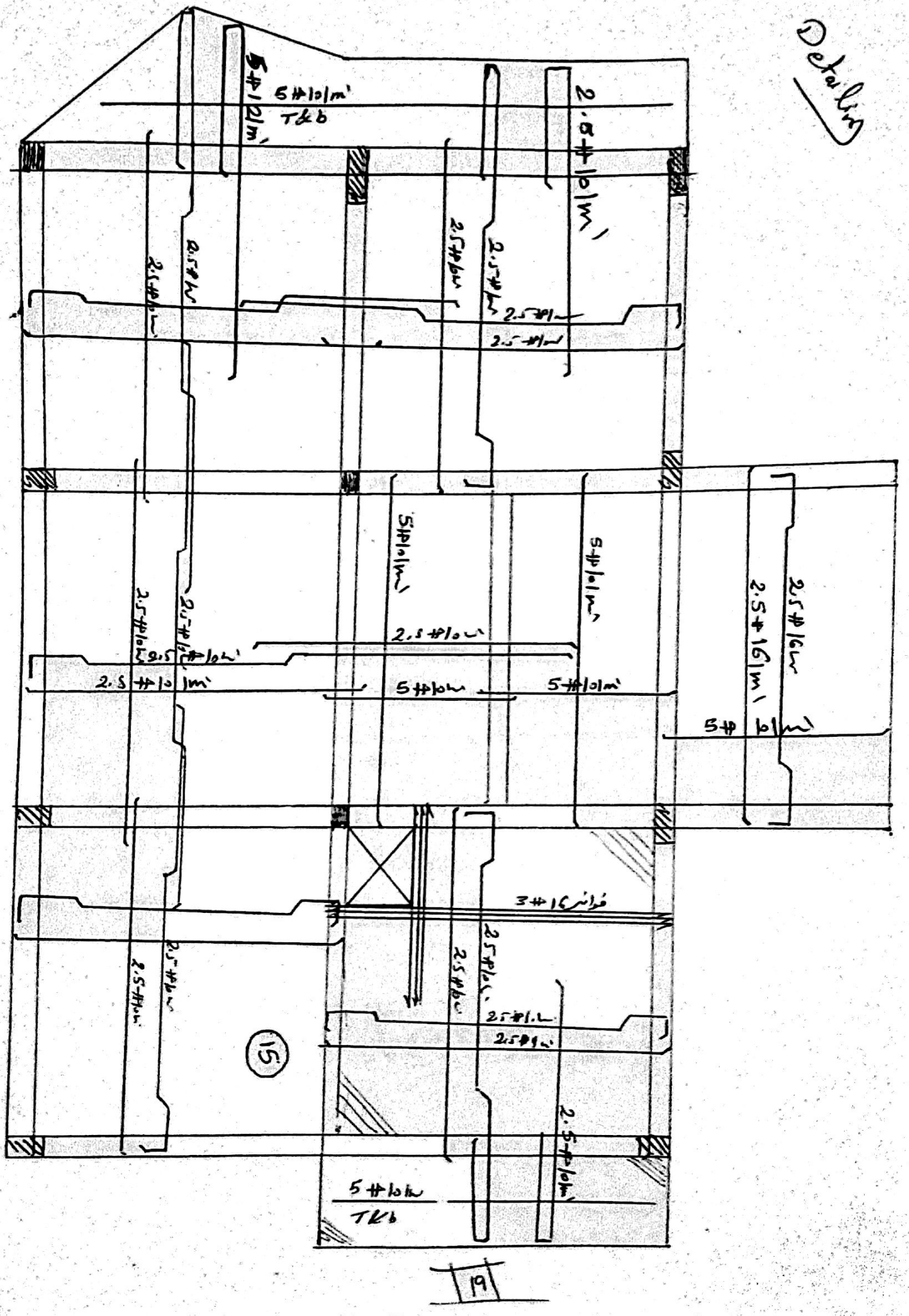
---

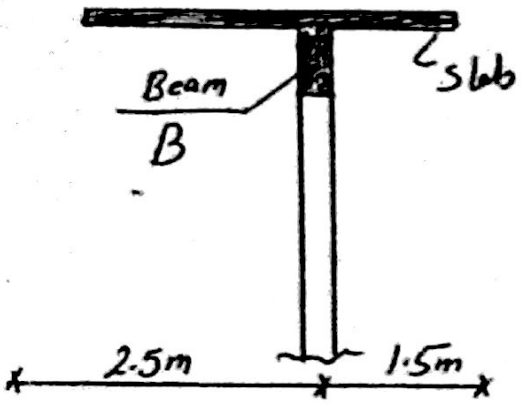
* $\lceil\rceil_{\alpha} = 3.3$ m.t $\qquad d = 13.5$

$d = G\sqrt{\frac{3.3 \times 10^5}{250 \times 100}} \longrightarrow G = 3.7 \longrightarrow J = 0.75$

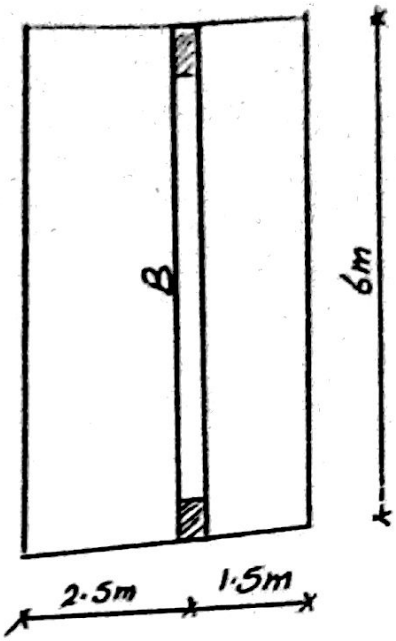
$A_s = \frac{3.3 \times 10^5}{3600 \times 0.75 \times 13.5} = 9.1 cm^2 \Rightarrow 5\#16/m'$

Detailing





Elev.



Plan

→ I.P → F.C = 150 kg/cm²

L.L = 300 kg/m²

t_s = 20 cm

b = 30 cm

---

① Get loads :-

* Assum beam 30 X 80 cm

→ $O.W = b * (t - t_s) \gamma_c * 1.4 = 1.4 * 0.3 \times 2.5 (0.8 - 0.2)$

$O.W = 0.63 \text{ t/m}'$

→ $W_{S.D.L} = 1.4(\gamma_c t_s + F.c)$

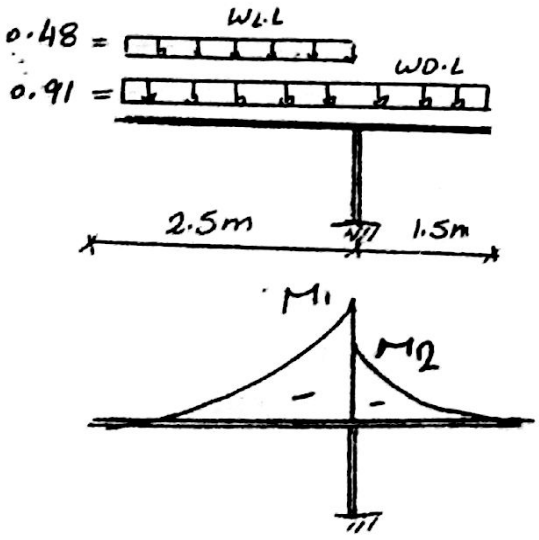
$= 1.4(2.5 \times 0.2 + 0.15) = 0.91\ t/m^2$

→ $W_{S\,L.L} = 1.6 * L.L = 1.6 \times 0.3 = 0.48\ t/m^2$

---

* Case of Loading :-

(A) Case 1 — Max Torsion

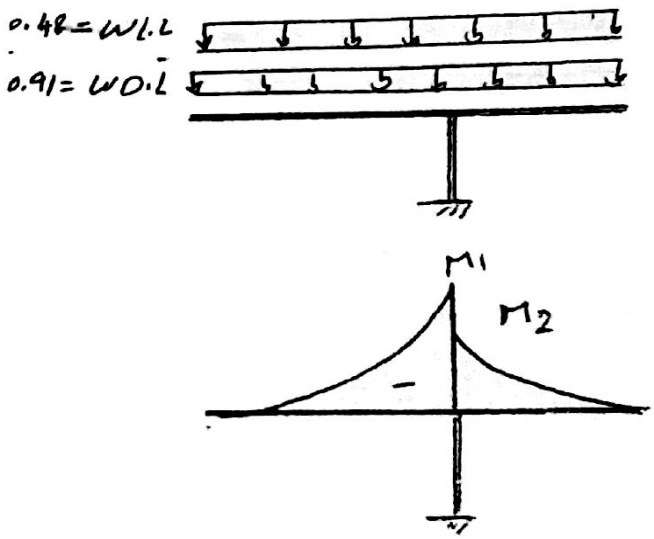


$* M_1 = \frac{(0.48+0.91) * 2.5^2}{2} = 4.34\ t.m$

$* M_2 = \frac{0.91 * 1.5^2}{2} = 1.02\ t.m$

$W_{tor} = 3.32\ t.m/m'$

(B) Case 2 — Max Shear



$* M_1 = \frac{1.39 * 2.5^2}{2} = 4.34\ t.m$

$* M_2 = \frac{1.39 \times 1.5^2}{2} = 1.56\ t.m$

$W_{tor} = 2.78\ t.m/m'$

$W_{u1} = 0.W + (W_s D.L + W_s L.L) \times 2.5$

$+ W_{DL} * 1.5$

$\therefore W_{u1} = 5.47 t/m'$

$W_{u2} = 0.W + (W_{LL} + W_{D.L})(2.5 * 1.5)$

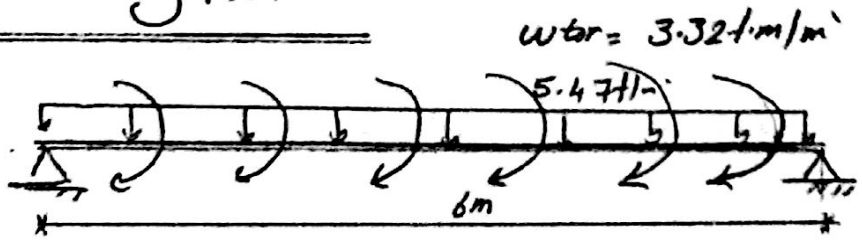
$\therefore W_{u2} = 6.19 t/m'$

Design this Case Critical.

---

[1] Design the beam due to M_{Tu} & Q_u → From Case (1)

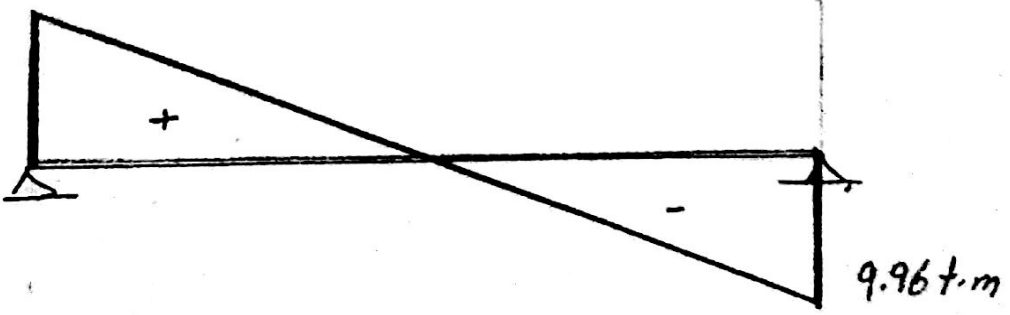
Ⓐ Get straing Action :-



$Q_u = 16.4 t$

S.F.D

$M_{Tu} = 9.96 t.m$



Shear

$$\therefore q_u = \frac{16.4 \times 10^3}{30 \times 135} = 4 \text{ kg/cm}^2$$

$$\therefore \delta_{si} = \frac{1}{\sqrt{1+\left(\frac{23.7}{4}\right)^2}} = 0.17$$

$$\therefore q_{cu} = 0.17 \times 0.75 \times \sqrt{\frac{250}{1.5}} = 1.64 \text{ kg/cm}^2$$

$$q_{max} = 0.17 \times 2.2 \sqrt{\frac{250}{1.5}} = 4.8 \text{ kg/cm}^2$$

Torsion

$$* q_{tu} = \frac{3 M_{tu}}{t b^2}$$

$$= \frac{3 \times 9.96 \times 10^5}{80 * 30^2}$$

$$q_{tu} = 41.5 \text{ kg/cm}^2 > q_{max}$$

Increas Conc Dim

$$* \text{Assume} \rightarrow q_{max} = 2.2 \sqrt{\frac{f'_c}{\delta c}} = 28.4 \text{ kg/cm}^2$$

$$28.4 = \frac{3 \times 9.96 \times 10^5}{t * 30^2}$$

$$\therefore t \approx 116.9$$

Take $t = 140$ cm

$$\therefore q_{tu} = \frac{3 \times 9.96 \times 10^5}{140 \times 30^2} = 23.7 \text{ kg/cm}^2$$

$$\delta_{ti} = \frac{1}{\sqrt{1+\left(\frac{4}{23.7}\right)^2}} = 0.98$$

$$q_{cut} = 9.4 \text{ kg/cm}^2$$

$$q_{max} = 27.83 \text{ kg/cm}^2$$

$q_{cu} < q_u < q_{max\,t}$

* يتم استخدام كانات لتقاوم قوى القص

* $q_{su} = q_u - \frac{q_{cu}}{2}$

$= 4 - \frac{1.69}{2} = 3.18\ kg/cm^2$

* $q_{su} = \frac{n\,A_{str}\,f_y/\gamma_s}{b\,S'}$

$3.18 = \frac{2 * A_{str}\ F_y}{30 * S' * 1.15}$

$A_{str} = 54.86\ \frac{S'}{F_y}$

$q_{cut} < q_{tu} < q_{max}$

* يتم استخدام كانات لتقاوم قوى القص

* $q_{sut} = q_{ut} - \frac{q_{cut}}{2}$

$= 23.7 - \frac{9.4}{2} = 19\ kg/cm^2$

$\therefore A_{str} = \frac{S' * q_{sut} * \frac{b^2 t}{3}}{\alpha_t \cdot x_1 \cdot Y_1 \cdot (\frac{F_{ystr}}{\gamma_s})}$

$\rightarrow x_1 = 30 - 5 = 25\ cm$

$\rightarrow Y_1 = 140 - 10 = 130\ cm$

$\rightarrow \alpha_t = (0.66 + 0.33 * \frac{130}{25}) = 2.3 \neq 1.5$

$A_{st} = \frac{S' * 19 * \frac{30^2 * 140}{3}}{1.5 * 25 * 130 * \frac{F_y}{1.15}}$

$A_{st} = 188.2\ \frac{S}{F_y}$

$$(Astr + Ast) = 243.1 \frac{S}{Fy}$$

* If use #10 → $(Astr + Ast) = 0.785$ $\quad Fy = 3600$

$$\therefore S' = 11.62\ cm > 10\ cm$$

$$\therefore N = \frac{100}{S'} = 8.6 \simeq \text{use } 9\#10/m'$$

عدد الكانات في المتر

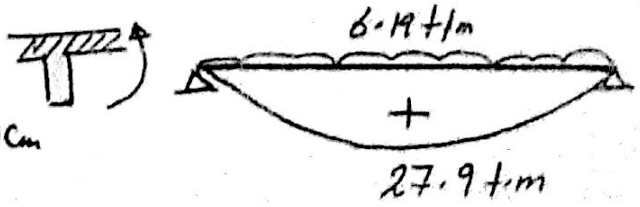
3] Get As long

$$(As)_L = \frac{2\ Astr\ (x_1 + y_1)}{S'} + \left(\frac{Fy}{FjL}\right) \quad (1)$$

$$= \frac{2 * 188.2\ (25+130)}{3600} = 16.1\ cm^2$$

4] Case 2 :- Get Max B.M.

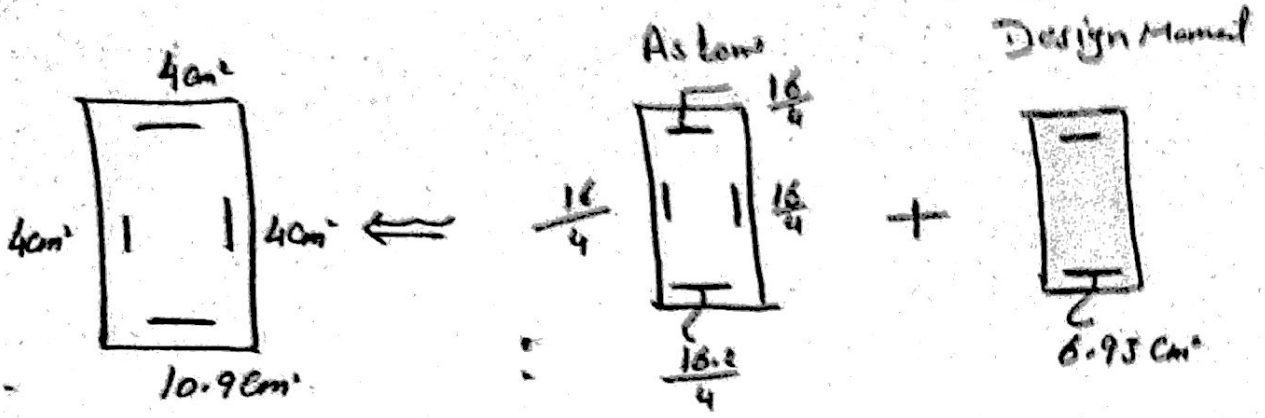
* Bell = $\begin{cases} 16 \times 20 + 30 = 350 \\ \frac{600}{5} + 30 = 150 \\ 250 + 150 = 400 \end{cases}$ Bell = 150 cm



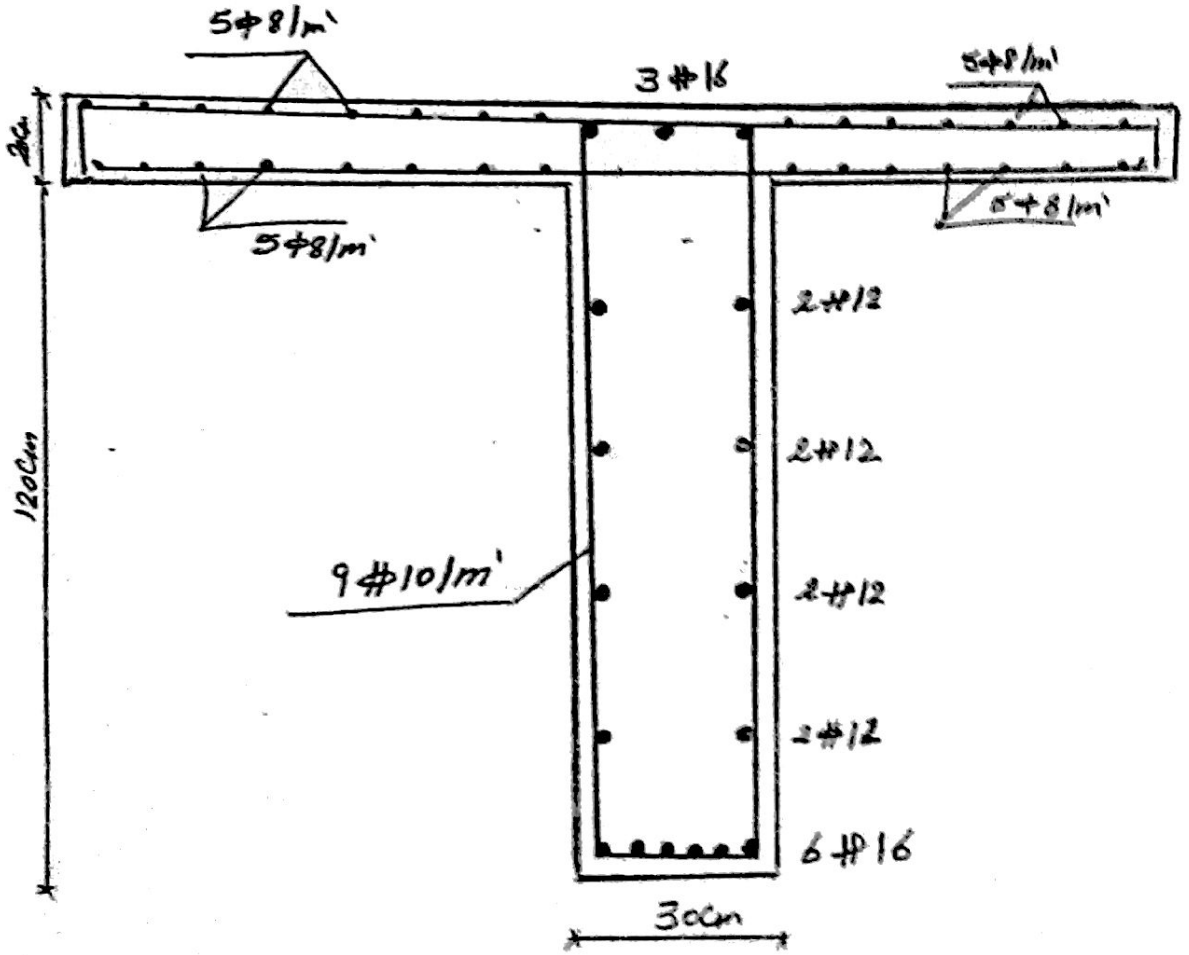
$$* \frac{d}{135} = C \sqrt{\frac{27.9 \times 10^5}{250 * 150}} \longrightarrow C = 15 \longrightarrow J = 0.826$$

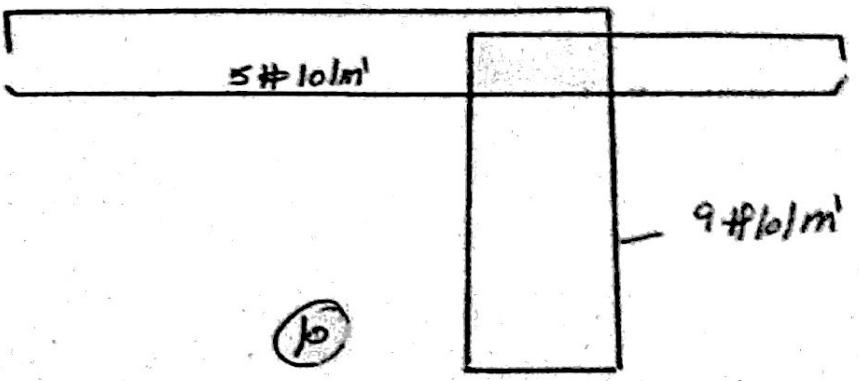
$$\therefore As = \frac{27.9 \times 10^5}{3600 \times 135 * .826} = 6.95\ cm^2$$

(9)



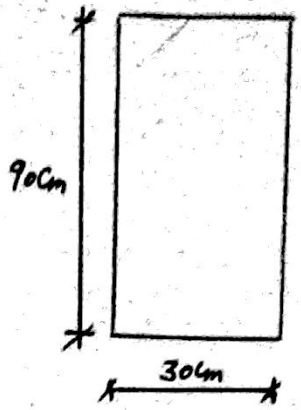
5] Draw Cross-section detailing:-





②/ $A_{sL} = 7 cm^2$ (2010 Ex)

① get $M_{tu} = ??$ ← Height



① $A_{sL} = \dfrac{2 A_{str} (x_1 + y_1)}{s'} \left(\dfrac{f_y}{f_y}\right)$ ①

② $7 = \dfrac{2 A_{str} (25 + 80)}{s'}$

∴ $\dfrac{A_{str}}{s'} = \dfrac{1}{30}$

* $x_1 = 30 - 5 = 25 cm$
* $y_1 = 90 - 10 = 80 cm$
* $\alpha_t = 0.66 + 0.33 \left(\dfrac{y_1}{x_1}\right) = 1.7$

$\boxed{\alpha_t = 1.5}$

③ Assume $\delta_{ti} = 0.7$ ($0.7 \to 0.9$) → Less than "1" because of shear

④ $q_{cu} = \delta_{ti} * 0.75 * \sqrt{\dfrac{250}{1.5}} = 6.8 kg/cm^2$.

⑤ $\dfrac{A_{str}}{s'} = \dfrac{(q_{tu} - q_{cu}/2)\frac{b^2 t}{3}}{\alpha_t y_1 x_1 (f_y/\gamma_s)}$

$\dfrac{1}{30} = \dfrac{(q_{tu} - 6.8/2)\frac{30^2 * 90}{3}}{1.5 * 25 * 80 * (3600/1.15)}$

∴ $\boxed{q_{tu} = 15 kg/cm^2}$

⑥ $q_{tu} = \dfrac{3 M_{tu}}{b^2 t} \Rightarrow 15 = \dfrac{3 M_{tu} * 10^5}{30^2 * 90}$

$M_{tu} = 4 t.m$

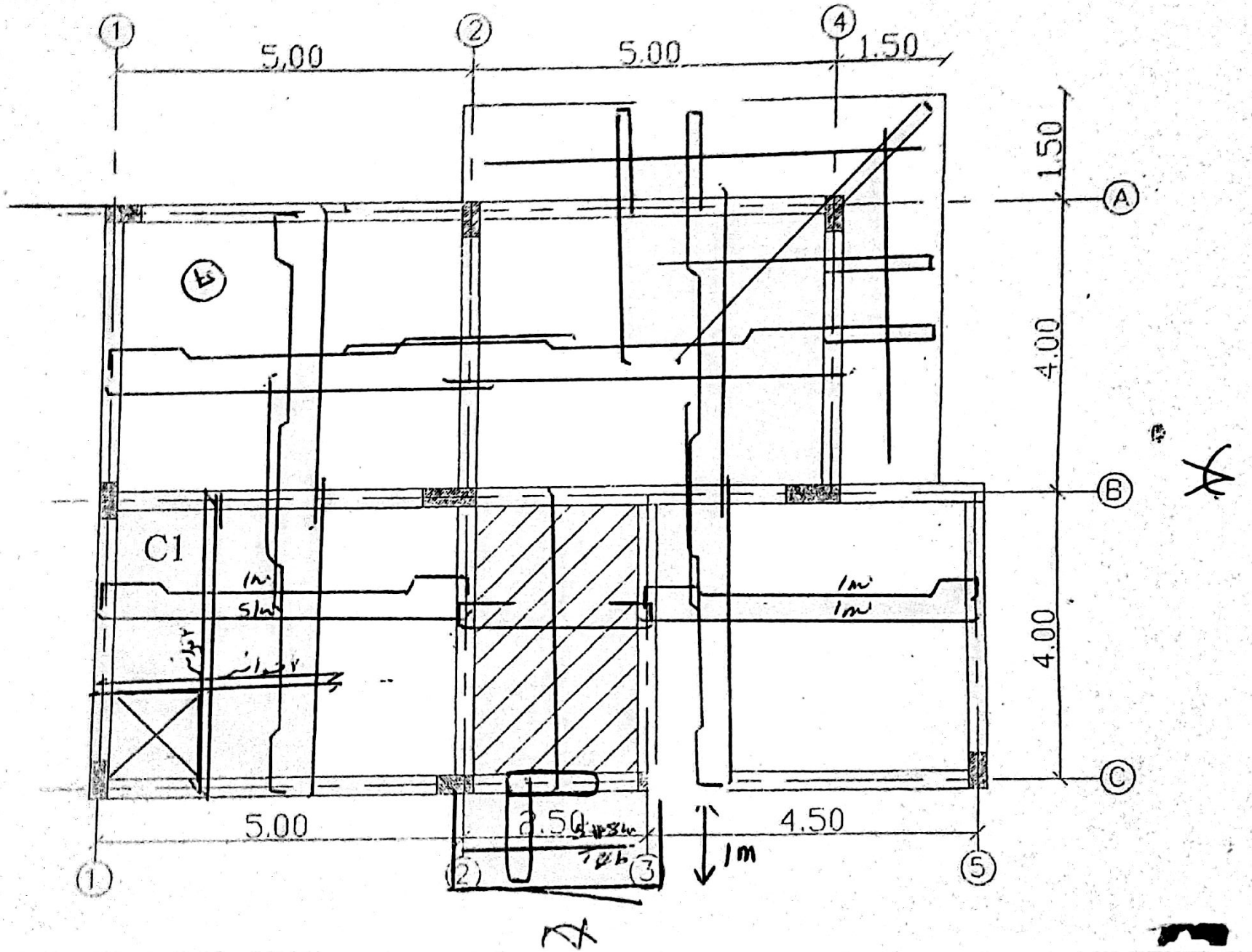
* If $\tau_{tu} = 4 t.m$ $\quad b = 30$

$Q_u = 40t$ $\quad t = 90cm$

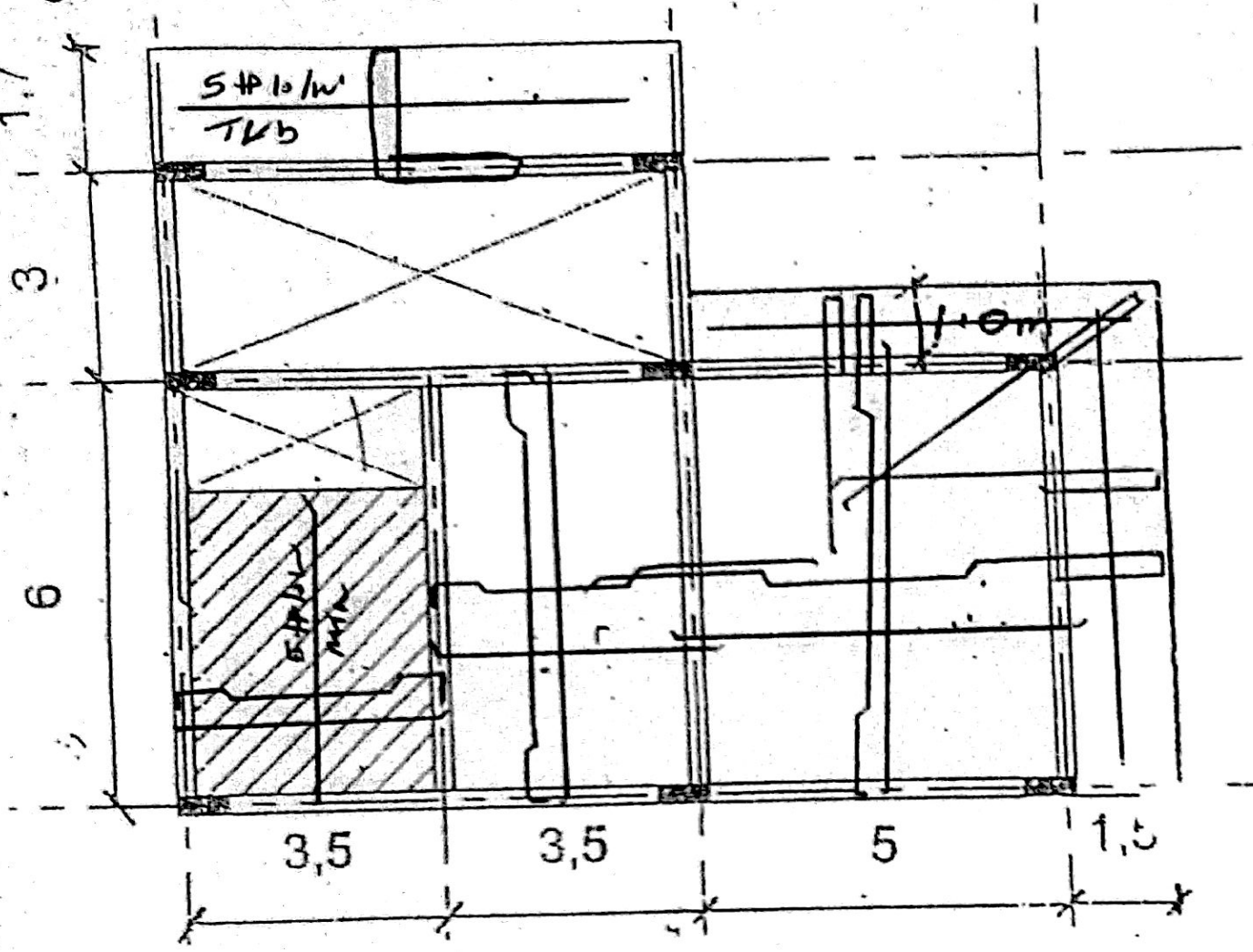
* get required stirrups :- ???

Shear	Torsion
* $q_u = \frac{40 \times 10^3}{30 \times 85} = 15.6 kg/cm^2$	$q_{tu} = \frac{3 M_{tu}}{b^2 t} = 15 kg/cm^2$
* $\delta_{st} = \frac{1}{\sqrt{1+(\frac{15}{15.6})^2}} = 0.72$	$\delta_{ti} = \frac{1}{\sqrt{1+(\frac{15.6}{15})^2}} = 0.69$
* $q_{cu} = 0.72 \times 0.75 \sqrt{\frac{f_{cu}}{\delta_c}} = 6.9 kg/cm^2$	* $q_{cut} = 6.7 kg/cm^2$
* $q_{su} = q_u - \frac{q_{cu}}{2} = 12.15 kg/cm^2$	* $A_{str} = \frac{(15 - \frac{6.9}{2}) * \frac{30^2 * 90}{3} + 1.15 * S'}{1.5 \times 25 \times 80 \ (F_y)}$
* $q_{els} = \frac{n * A_{str} f_y / \delta_s}{b S'}$	$A_{str} = 119.5 \frac{S'}{F_y}$ ← for Tor
$12.15 = \frac{2 * A_{str} * F_y}{30 * S' * 1.15}$	$(A_{st} + A_{str}) = 329 \frac{S'}{F_y}$
$A_{st} = 209.6 \frac{S}{F_y}$ ← for shear	* use ϕ → $A_{str} = 0.785 cm^2$, $F_y = 3600 kg/cm^2$
	∴ $S' = 8.5 < 10$
	* If use #12 → $A_{str} = 1.13$
	$S' = 12.36 cm^2$ → 9 #12/m' كل ٨ سنتي

ree)



bs shown in the Figure and draw the details of steel rei... ...cements to a
(assuming that L.L = 300 kg/2 , wt of cover = 200 kg/m2).



Helwan university
Faculty of Eng., El-Mataria
Second year civil

Design fundamentals of R.C structures
Mid Term exam
May 2012
Time allowed: 2 Hours

For all questions assume f_{cu}=250 kg/cm^2 and f_y= 3600 kg/cm^2 assume any missing data

Question No 1 (15%)

Design a beam of span 6 m carry cantilever slabs of span 2.0 m, slab carry live load 500. Kg/m^2 and ts = 20 cm, draw reinforcement details of beam (b = 30 cm).

Question No 1 (30%)

Design and draw details of RC sections to scale 1:10 that have

1- Mu= 25 mt , Pu= -350t and b= 25 cm
2- Mu= 60 mt , Pu= -80 t and b= 30 cm
3- Mu= 30 mt , Tu= 150 t and b= 30 cm
4- Mu= 40 mt , Tu= 50 t and b= 40 cm

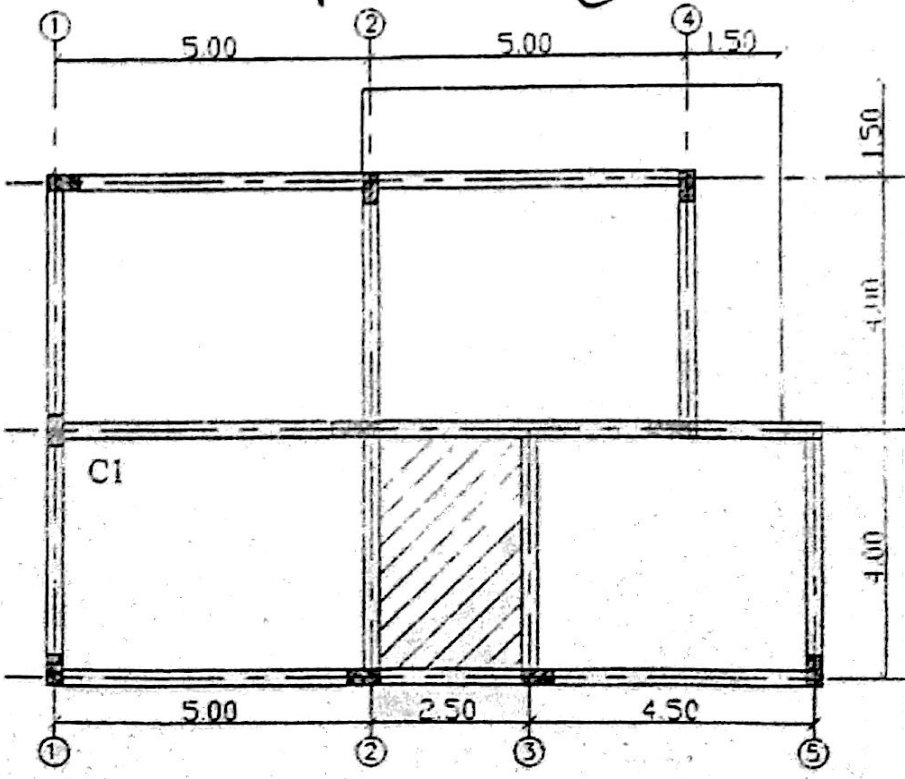
Question No 2 (40% of max. degree)

For the shown plan in Figure, it is required to design all slabs and to draw the details of the slabs reinforcements to scale 1:50. Assuming that: wt of covering materials = 150 kg/m^2 and L.L= 300 kg/m^2

Question No 3 (15% of max. degree)

If the columns shown in Figure are carrying 8 floors of unbraced building, it is required to design column C1 and draw section detail. Assuming that:

- load for one floor is equal to 30 t for C1
- Equivalent load for moment = 5 t/m'.
- Floor height 3.5 m
- Slab thickness ts=12cm
- Beams 25× 60 cm



Best Wishes ***Dr. Moustafa Abd-Elmeged*** ***Dr.Hala Mamdouh***

ورقة القوانين
Curves

VII.1. LOAD DISTRIBUTION ON TWO WAY SLABS

1. Load Distribution According to U.A.R slab

r	1.00	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.00
α	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85
β	0.35	0.29	0.25	0.21	0.18	0.16	0.14	0.12	0.11	0.09	0.08

2. Load Distribution According to Marcus : Hollow Block

r	1.00	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.00
α	.396	.473	.543	.606	.660	.706	.746	.778	.806	.830	.849
β	.396	.323	.262	.212	.172	.140	.113	.093	.077	.063	.053

3. Load Distribution According to Grashoff : P. beam

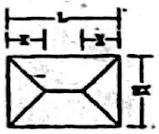
r	1.00	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.00
α	.500	.595	.672	.742	.797	.834	.869	.893	.914	.928	.941
β	.500	.405	.328	.258	.203	.166	.131	.107	.086	.072	.059

$r=\frac{m.b}{m.a}$; where m= 0.87 for continuity at one end of the slab

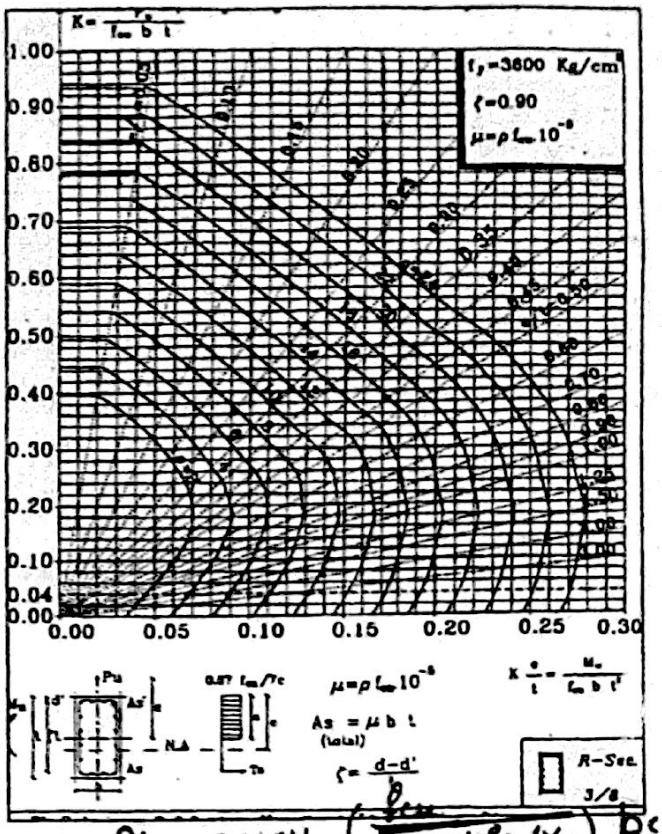
=0.76 for continuity at both ends of the slab

VII.2. EQUIVALENT LOAD FOR DESIGN OF BEAMS :

supporting two way Slabs :



$\frac{L}{2x}$	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
α	.667	.725	.769	.803	.829	.852	.870	.885	.897	.908	.917
β	.500	.545	.583	.615	.643	.667	.688	.706	.722	.737	.750



$P_b = 2144 \left(\frac{6000}{6000+fy/\gamma_s}\right) b c$

Note:- $f_{ctf}=0.75\,(f_{cu})^{2/3}$ in Kg/cm2

$$I_e=\left(\frac{M_{cr}}{M_a}\right)^3 \cdot I_g + \left[1-\left(\frac{M_{cr}}{M_a}\right)^3\right] I_{cr}$$

c/d	C1	J
0.1250	4.854	0.826
0.1375	4.640	0.821
0.1500	4.455	0.817
0.1625	4.291	0.813
0.1750	4.146	0.808
0.1875	4.016	0.804
0.2000	3.899	0.800
0.2125	3.793	0.795
0.2250	3.697	0.791
0.2375	3.608	0.786
0.2500	3.526	0.782
0.2625	3.451	0.778
0.2750	3.381	0.773
0.2875	3.316	0.769
0.3000	3.255	0.765
0.3125	3.199	0.760
0.3250	3.146	0.756
0.3375	3.098	0.752
0.3500	3.049	0.747
0.3625	3.004	0.743
0.3750	2.963	0.739
0.3875	2.923	0.734
0.4000	2.885	0.730
0.4125	2.850	0.726
0.4250	2.816	0.721
0.4375	2.784	0.717
0.4500	2.753	0.713
0.4625	2.724	0.708
0.4750	2.696	0.704
0.4875	2.670	0.700
0.5000	2.645	0.695

$J=\frac{1}{\gamma_s}(1-0.4c/d)$

$C1=\frac{1}{\sqrt{0.393\,c/d\,(1-0.4c/d)}}$