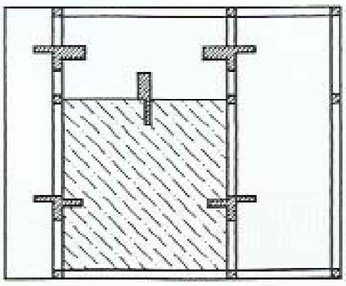
تالته

Mid Term Revision.

Important Examples.

① 

Solid Slabs EX. فى ملزمه
Page 43

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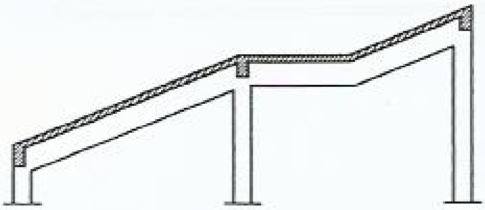
② 

Solid Slabs EX. فى ملزمه
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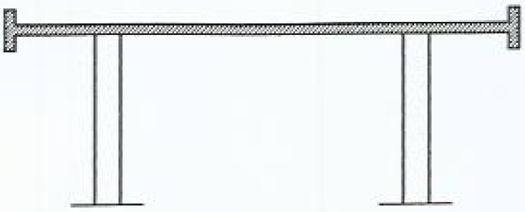
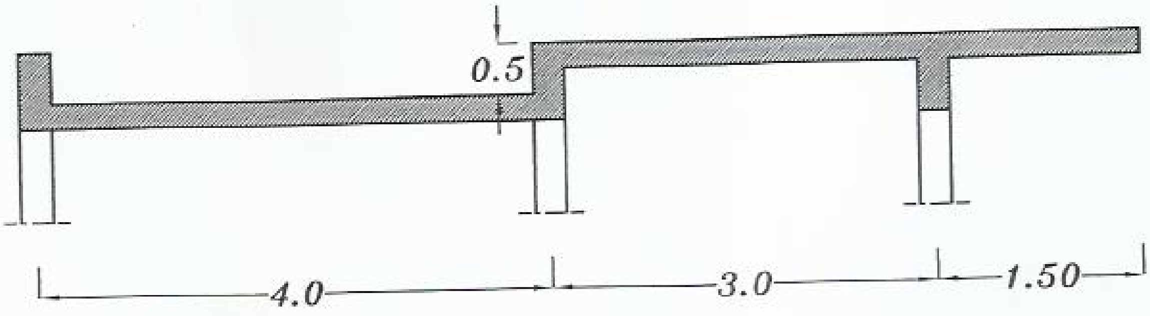
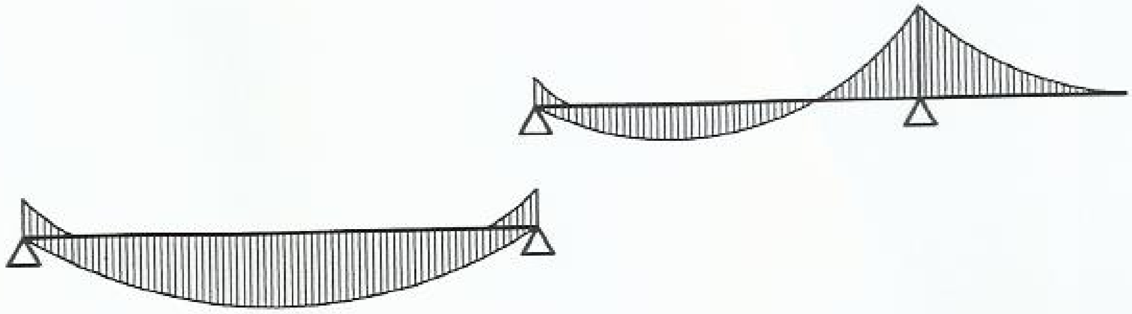
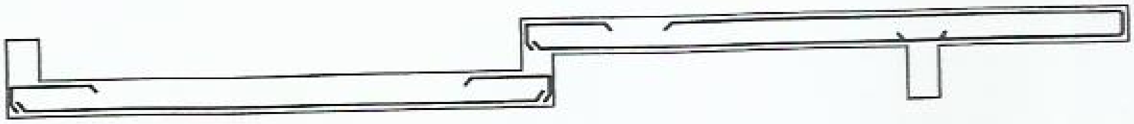
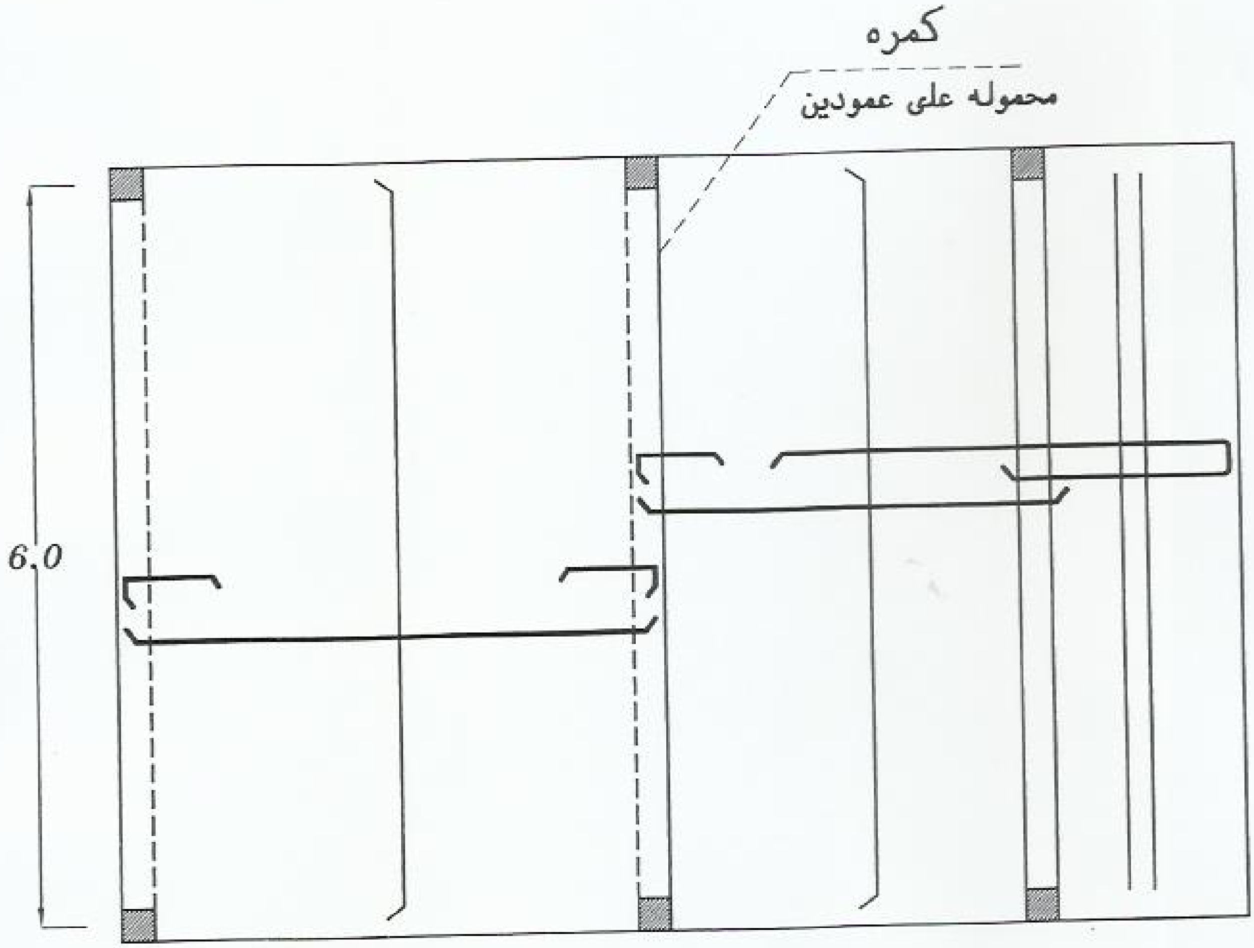
③ 

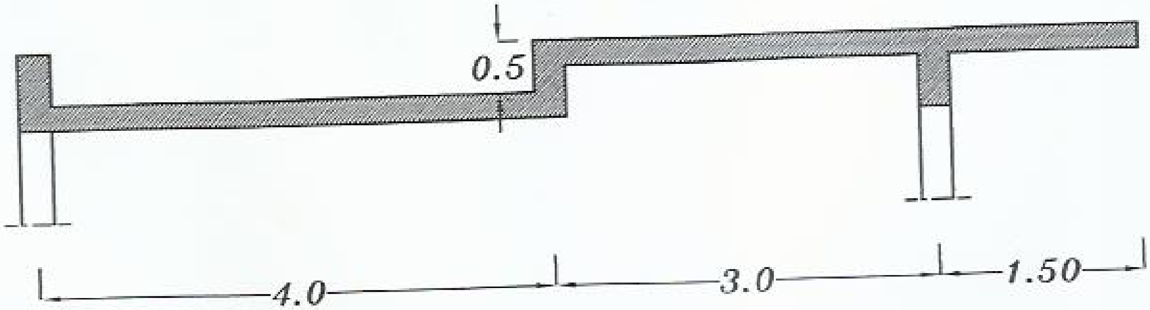
Flat Slabs EX. فى ملزمه
Page 44

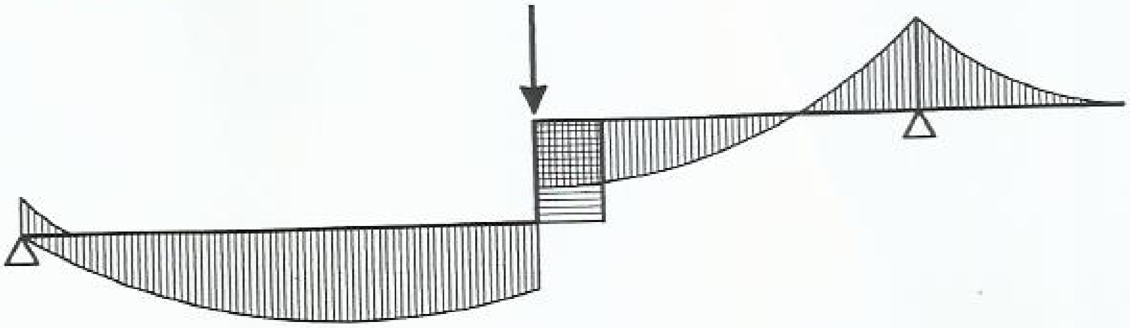

0.5
4.0
3.0
1.50

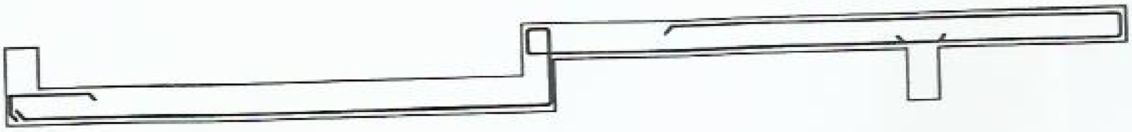


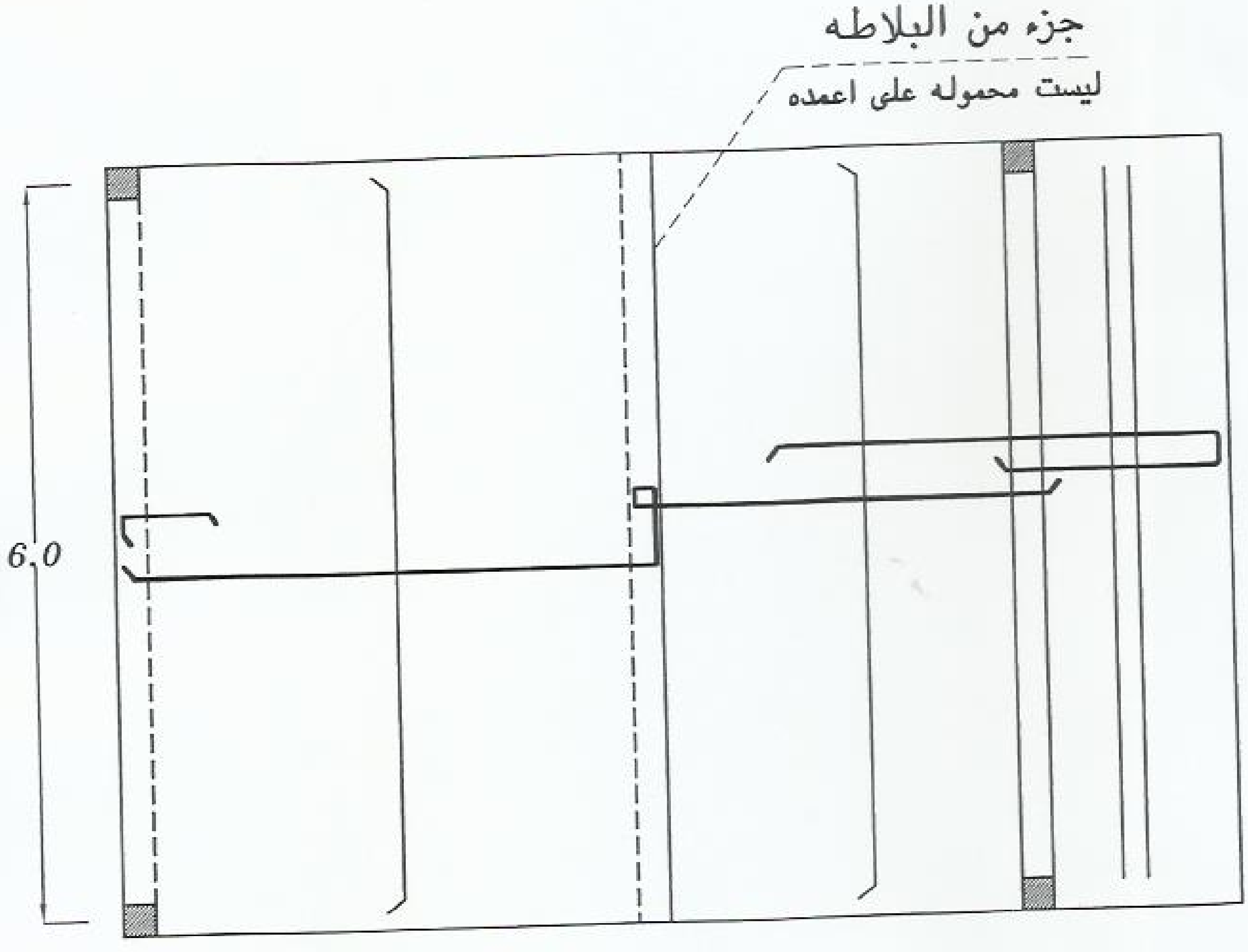



كمره
محمولة على عمودين
6.0


0.5
4.0
3.0
1.50






جزء من البلاطه
ليست محموله على اعمده
6.0

Example.

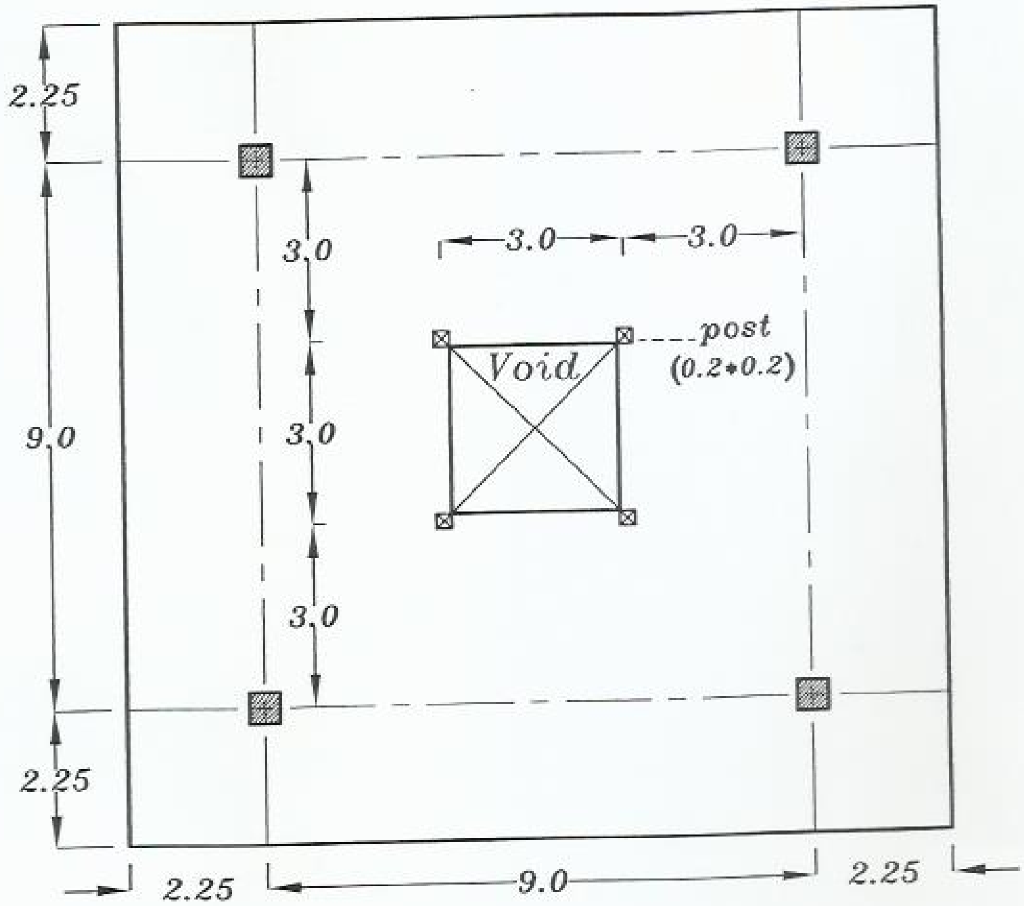
Data. $F_{cu} = 30\ N\backslash mm^2$, $F_y = 360\ N\backslash mm^2$

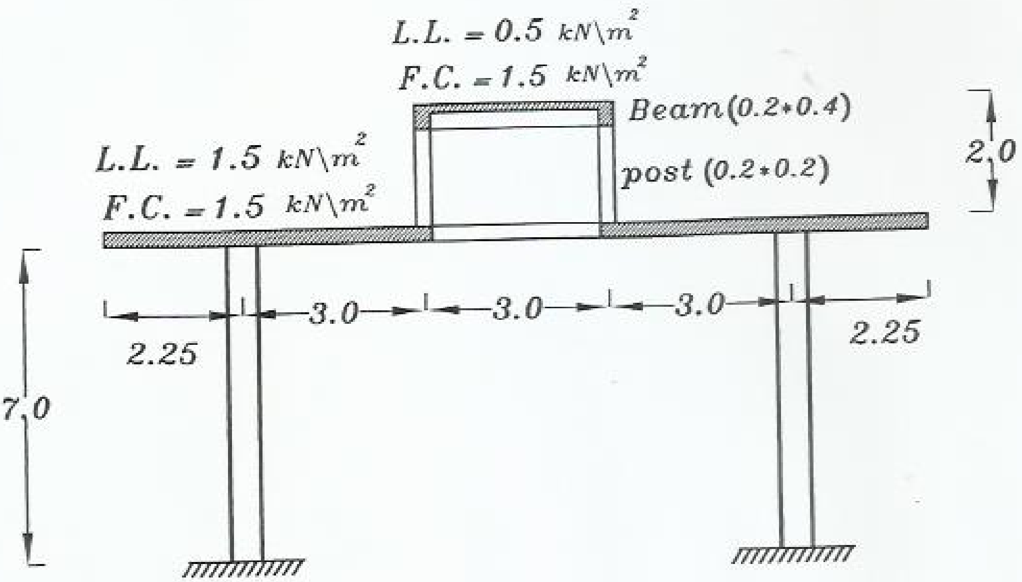
Req.

① Check punching shear of the slab at one of the columns.

② Using Frame analysis method, Design the slab assuming constsnt inertia and uniform load distribution (Case of total load only is required).

③ Draw a half plan showing details of reinforcement in both directions.





Solution.

1-Concrete Dimensions.

Column dimensions.

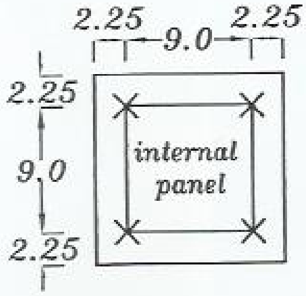
$$b_{Col.} = \begin{cases} 300\ mm \\ \frac{H}{15} = \frac{7000}{15} = 466.6\ mm \\ \frac{L_1}{20} = \frac{9000}{20} = 450\ mm \end{cases}$$

$b_{Col.} = 500\ mm$

$(500*500)$

Slab Thikness.

Flat Slab.



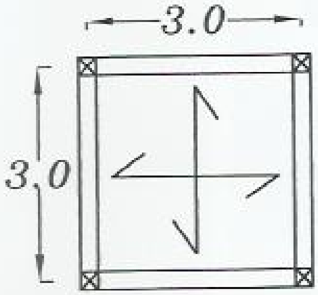
$L_1 = 9.0\ m$

Internal panel $t_s = \frac{L_1}{36} = \frac{9000}{36} = 250\ mm$

Cantilever $t_s = \frac{L_c}{10} = \frac{2250}{10} = 225\ mm$

$t_s = 250\ mm$

Solid slab. Two way



$t_s = \frac{L_s}{35} = \frac{3000}{35} = 85.7\ mm$ $t_s = 100\ mm$

2-Loads on the Slab.

Flat Slab.

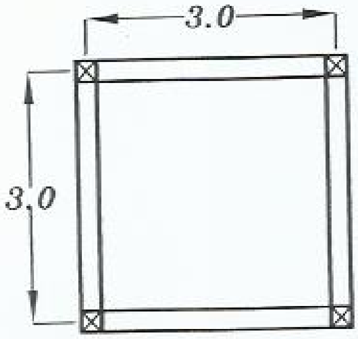
$w_s = 1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)$

$w_s = 1.4\,(0.25*25 + 1.50) + 1.6\,(1.50) = 13.25\ kN\backslash m^2$

Solid Slab.

$w_s = 1.4\,(0.10*25 + 1.50) + 1.6\,(0.50) = 6.40\ kN\backslash m^2$

Loads on the Post.



Beam (200*400)

$o.w._{(beam)} = 1.4 * 0.2 * 0.4 * 25 = \mathbf{2.8}\ kN/m$

Post (200*200)

$o.w._{(Post)} = 1.4 * 0.2 * 0.2 * 2.0 * 25 = \mathbf{2.8}\ kN$

لتحديد الحمل على ال post الواحد

نحسب الوزن الكلى للشخشيخه من بلاطه و كمرات و posts

و نقسم الوزن الكلى على ٤ .

Total Weight = Slab + 4 Beams + 4 Posts

$Slab = w_s * area = 6.40 * (3.0 * 3.0) = 57.6\ kN$

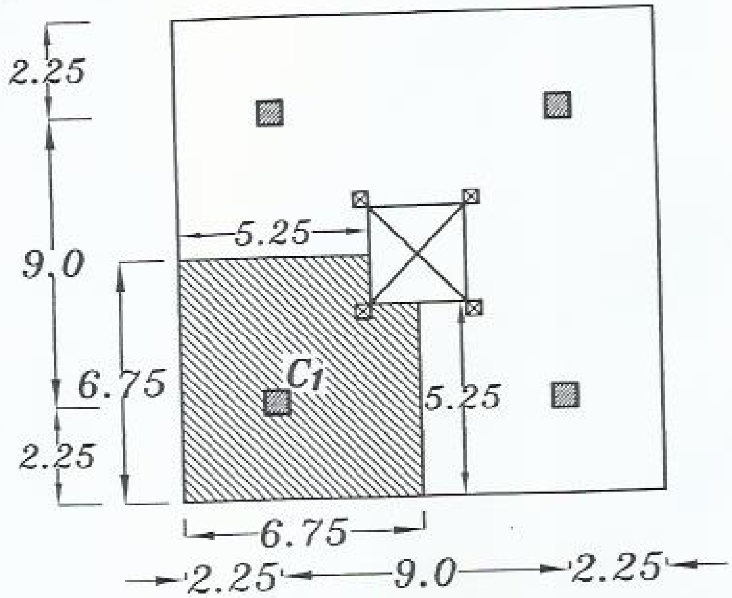
4 Beams = $o.w._{(beam)}$ * طول الكمرات $= 2.8\,(3.0 * 4.0) = 33.6\ kN$

$4\ Posts = 4 * 2.8 = 11.2\ kN$

$Total\ Weight = 57.6 + 33.6 + 11.2 = 102.4\ kN$

$$Load\ on\ One\ Post = \frac{Total\ Weight}{4} = \frac{102.4}{4} = 25.6\ kN$$

Check Punching on interior column C_1

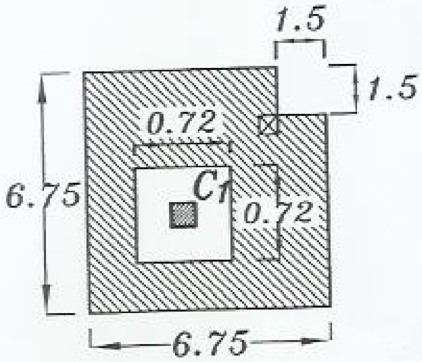


C_1 Interior Column.

$d = t_s - 30\,mm$

$= 250 - 30 = 220\ mm = 0.22\ m$

$C + d = 0.50 + 0.22 = 0.72\ m$



$Q_{pu} = w_s\left[L_1 * L_2 - void - (C_1+d)(C_2+d)\right] + Post$

$Q_{pu} = 13.25\left[6.75 * 6.75 - (1.5 * 1.5) - (0.72 * 0.72)\right] + 25.6$

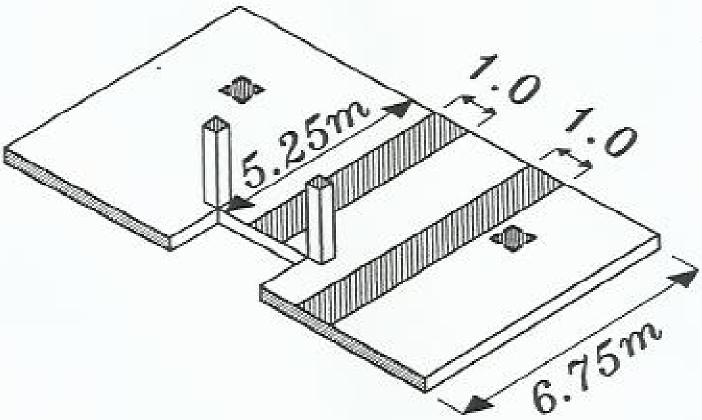
$= 592.6\ kN$

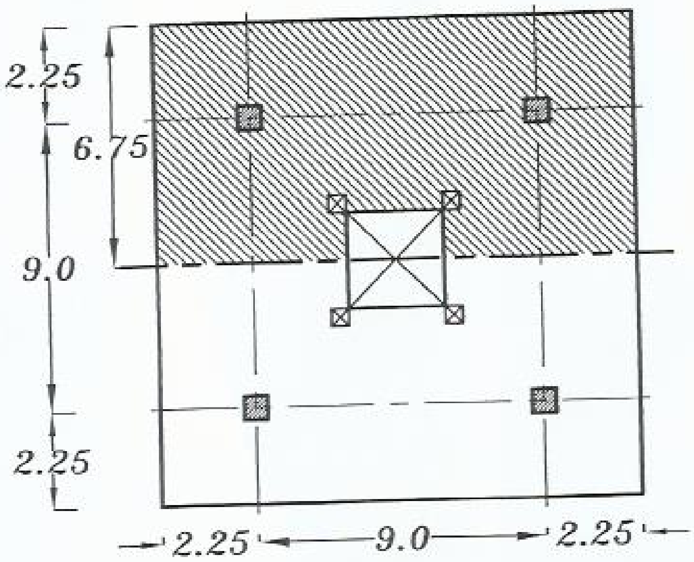
$A_p = (b_o * d) = (4 * 720) * 220 = 633600\ mm^2$

$q_{pu} = \frac{Q_{pu}}{A_p} * \beta = \frac{592.6 * 10^3}{633600} * 1.15 = 1.07\ N/mm^2$

$q_{pcu} = 0.316\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.316\sqrt{\frac{30}{1.5}} = 1.41\ N/mm^2$

$q_{pu} < q_{pcu}$ → Safe Punching.

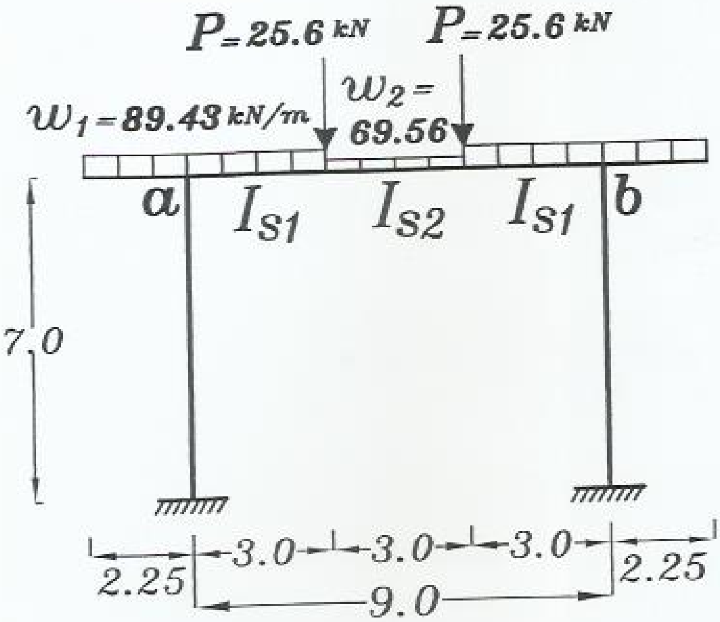


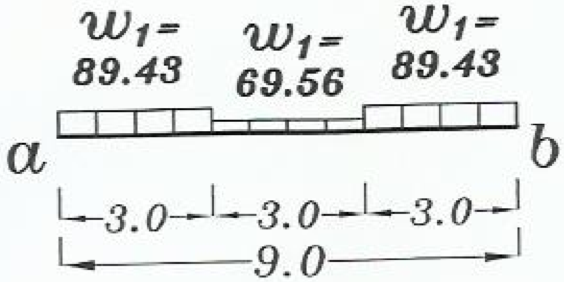


$$w_1 = w_s * L_2 = 13.25 * 6.75 = \mathbf{89.43}\ kN/m$$

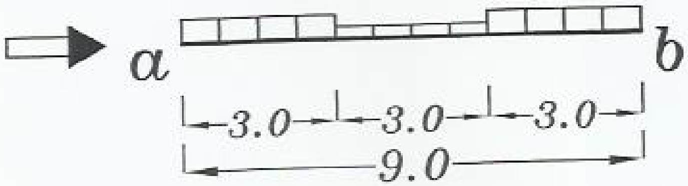
$$w_2 = w_s * L_2 = 13.25 * 5.25 = \mathbf{69.56}\ kN/m$$

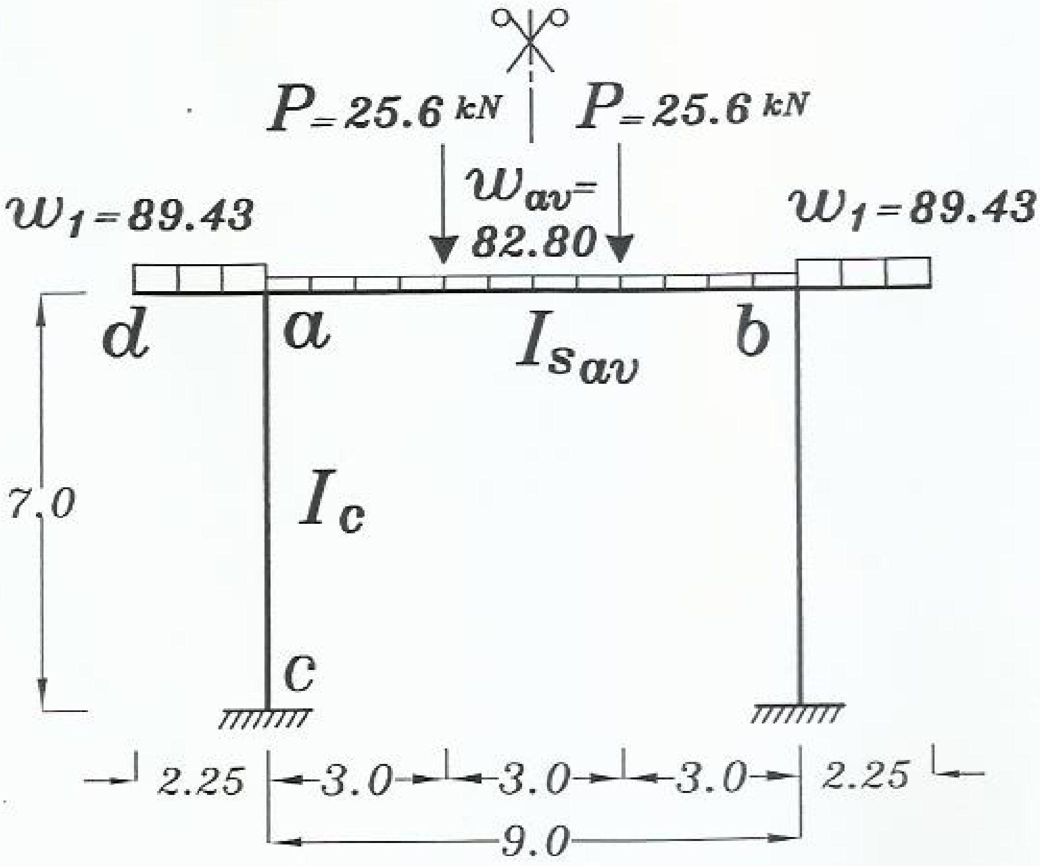
للحل بطريقه
moment distribution
يجب أن يكون كل *member*
عليه حمل منتظم واحد





$$w_{av} = \frac{89.43 * 6.0 + 69.56 * 3.0}{9.0} = 82.80$$

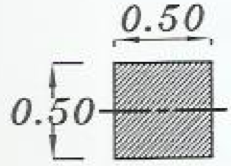




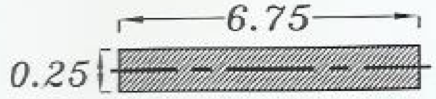
@ *Calculate Moment of Inertia For Slabs & Columns.*

عمود خارجى

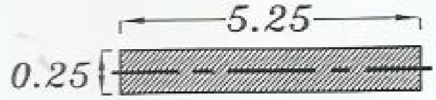
$$I_c = 0.6 * \frac{b(t)^3}{12} = 0.6 * \frac{0.50 * 0.50^3}{12} = 3.125 * 10^{-3}\ m^4$$



$$I_{S1} = \frac{L_2 * t_s^3}{12} = \frac{6.75 * 0.25^3}{12} = 8.79 * 10^{-3}\ m^4$$



$$I_{S2} = \frac{L_2 * t_s^3}{12} = \frac{5.25 * 0.25^3}{12} = 6.83 * 10^{-3}\ m^4$$



$$I_{Sav} = \frac{8.79 * 10^{-3}(6.0) + 6.83 * 10^{-3}(3.0)}{9.0} = 8.13 * 10^{-3}\ m^4$$

ⓑ Calculate the stiffens For each member.

$$K_{ab} = \frac{1}{2} * \frac{I_{sav}}{L} = \frac{1}{2} * \frac{8.13 * 10^{-3}}{9.0} = 4.516 * 10^{-4}$$

$$K_{ac} = \frac{I_c}{h} = \frac{3.125 * 10^{-3}}{7.0} = 4.46 * 10^{-4}$$

ⓒ Calculate the Distribution Factors. (D.F.)

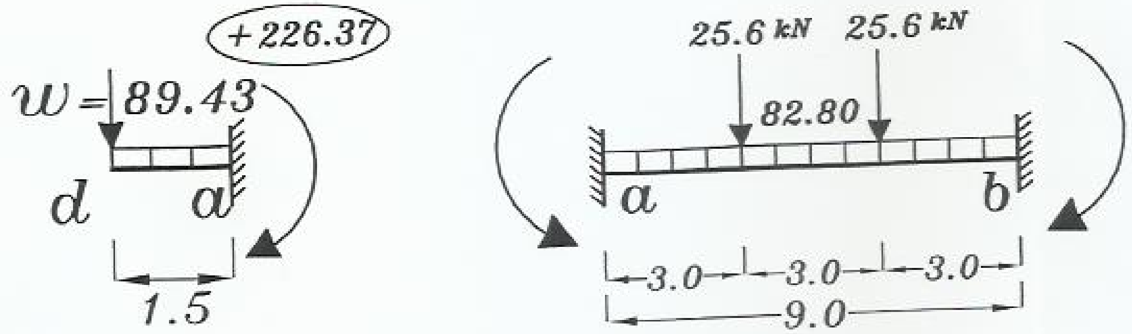
For Joint a

$$\Sigma K = K_{ab} + K_{ac} = 4.516 * 10^{-4} + 4.46 * 10^{-4} = 8.976 * 10^{-4}$$

$$D.F.(ab) = \frac{4.516 * 10^{-4}}{8.976 * 10^{-4}} = 0.503$$

$$D.F.(ac) = \frac{4.46 * 10^{-4}}{8.976 * 10^{-4}} = 0.497$$

ⓓ Calculate Fixed End Moment For the Slab.



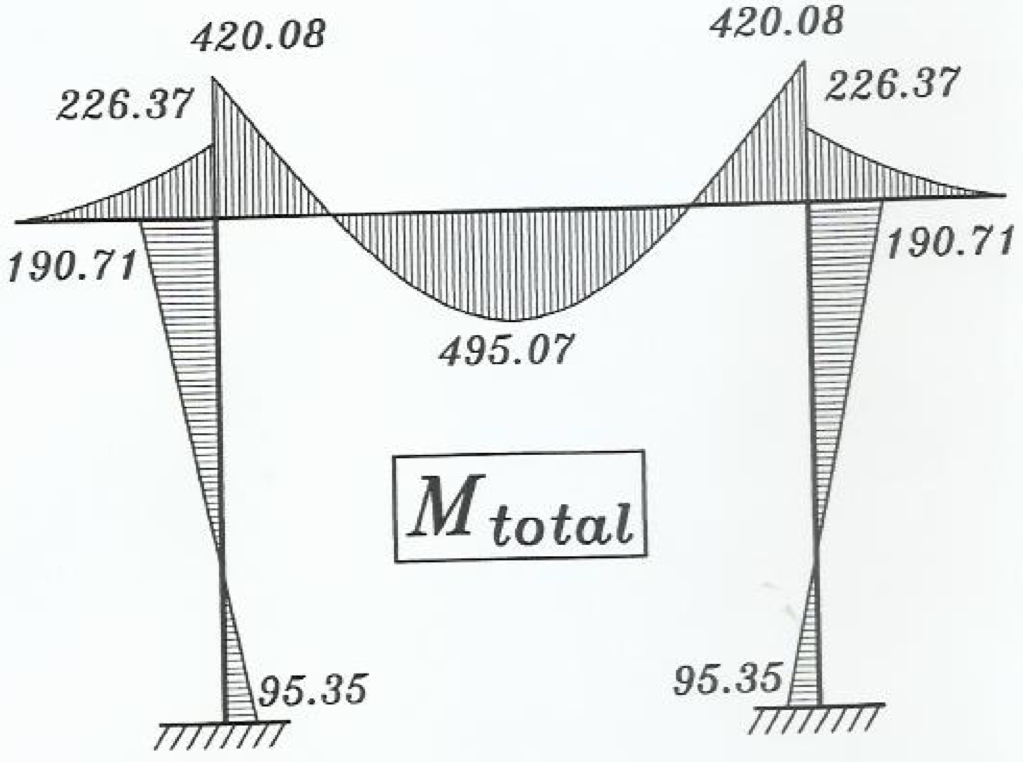
$$F.E.M.(ab) = -\frac{wL^2}{12} - \frac{2}{9}PL = -\frac{82.80 * 9.0^2}{12} - \frac{2}{9}(25.6)(9.0)$$

$$= -610.1 \text{ kN.m.}$$

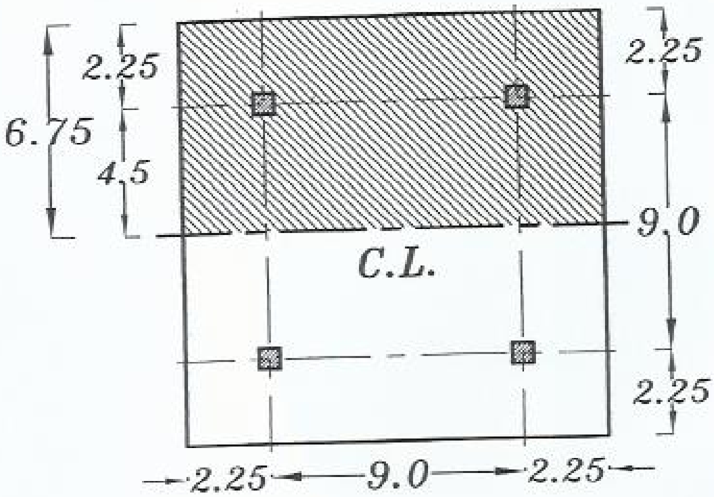
$$F.E.M.(ba) = +\frac{wL^2}{12} + \frac{2}{9}PL = +610.1 \text{ kN.m.}$$

$$F.E.M.(ad) = +\frac{wL^2}{2} = +\frac{89.43 * 2.25^2}{2} = +226.37 \text{ kN.m.}$$

Joint	c	a		
member	c − a	a − c	a − d	a − b
D.F.	0	0.497	0	0.503
F.E.M.	0	0	+226.37	−610.1
B.M.	0	+190.71	0	+193.02
C.O.M.	+95.35	0	0	0
B.M.	0	0	0	0
M_F	+95.35	+190.71	+226.37	−420.08



Modification Factor.



عرض شريحه التصميم الكليه

Total Strip width =

$$= \frac{9.0}{2.0} + 2.25 = \mathbf{6.75}\ m$$

$$b_{C.S.} = \frac{L_2}{4} + \text{Width of the Cantilever}$$

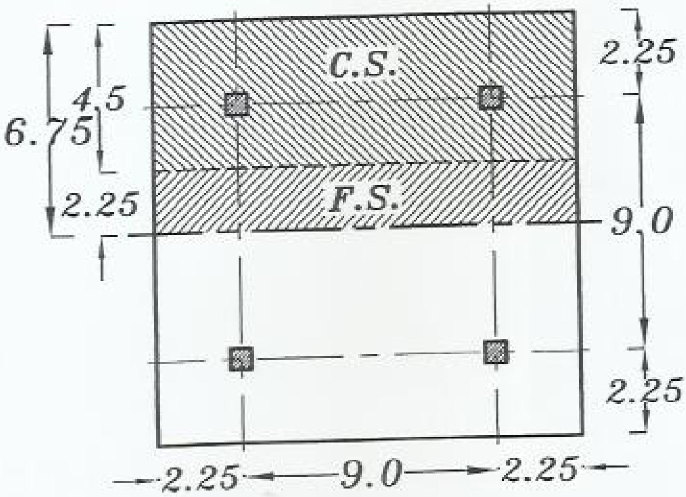
يؤخذ عرض الـ
Column strip

$$b_{C.S.} = \frac{9.0}{4} + 2.25 = \mathbf{4.50}\ m$$

$$b_{F.S.} = \text{Total Strip width} - b_{C.S.}$$

و يؤخذ عرض الـ
Field strip

$$b_{F.S.} = 6.75 - 4.5 = \mathbf{2.25}\ m$$

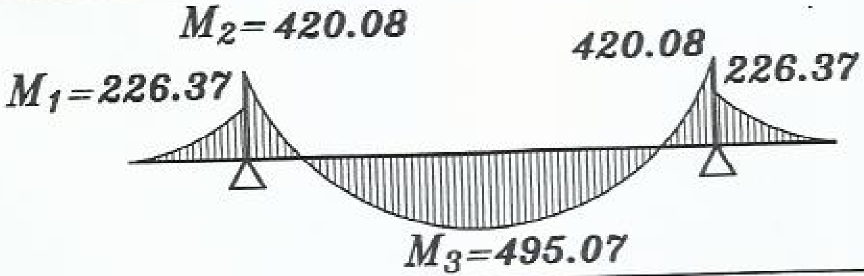


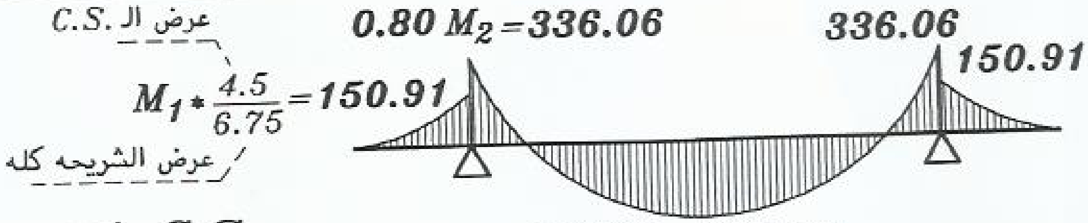
Modification Factor For Field Strip

$$M.F. = \frac{\text{Field strip العرض الحقيقى لل}}{\text{عرض الشريحه الكلى } \frac{1}{2}} = \frac{2.25}{3.375} = 0.667$$

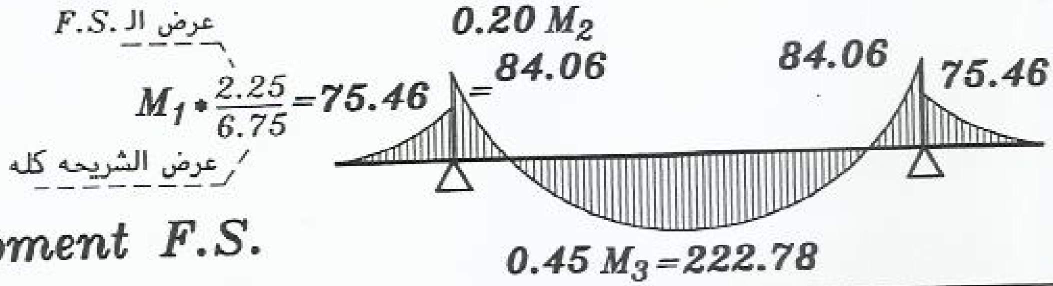
Distribute the moment of the Frame on Column Strip and Field Strip.

M_{total}





moment C.S.



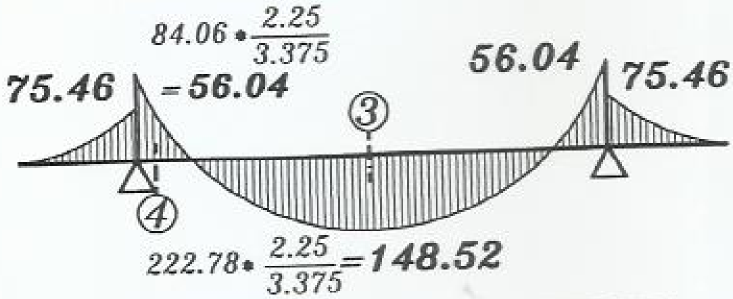
moment F.S.

$$\text{Modification Factor} = \frac{2.25}{3.375}$$

$$(M_{F.S.})_{mod.} = (M_{F.S.}) * \text{Modification Factor} = (M_{F.S.}) * \frac{2.25}{3.375}$$

Modified moment F.S.

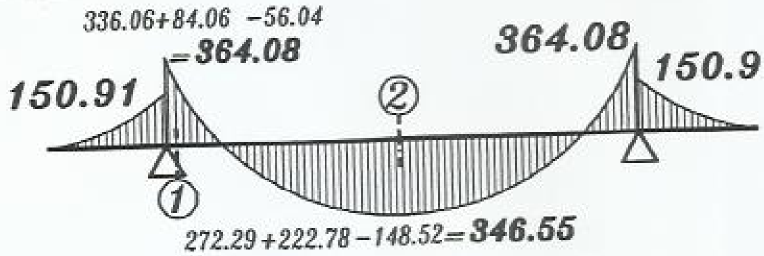
$b_{F.S.} = 2.25\ m$



$$(M_{C.S.})_{mod.} = (M_{C.S.}) + (M_{F.S.}) - (M_{F.S.})_{mod.}$$

Modified moment C.S.

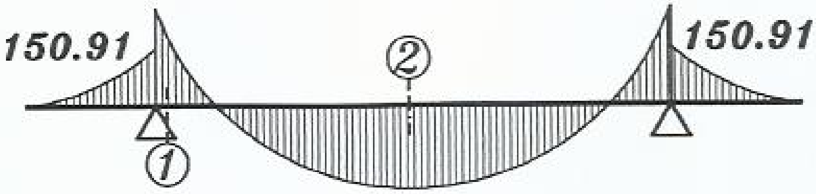
$b_{C.S.} = 4.50\ m$



Design the sections of the slab.

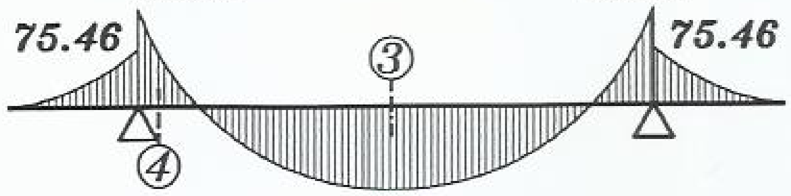
Modified moment C.S.

$b_{C.S.} = 4.50\ m$



Modified moment F.S.

$b_{F.S.} = 2.25\ m$

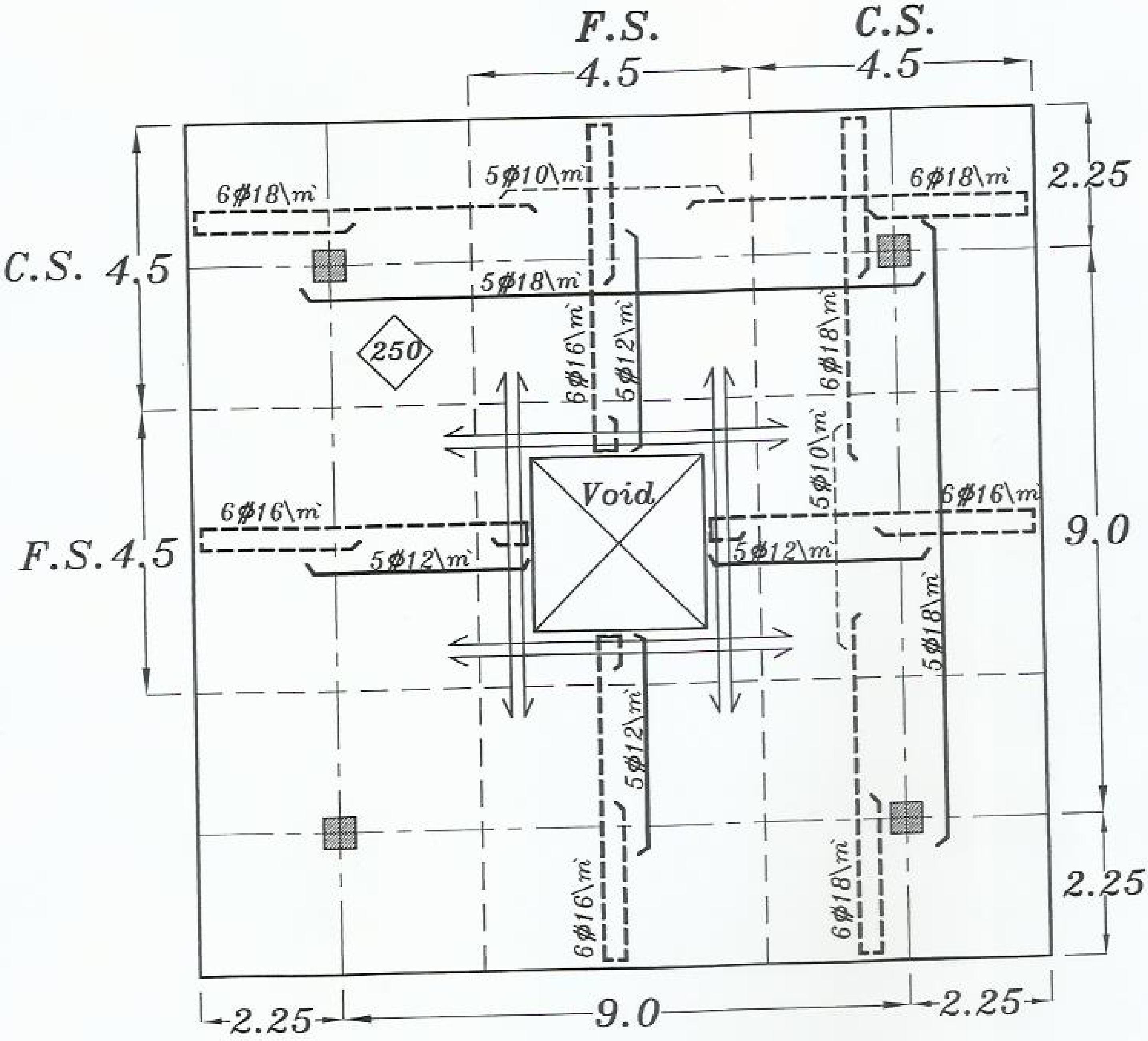


Design of sections.

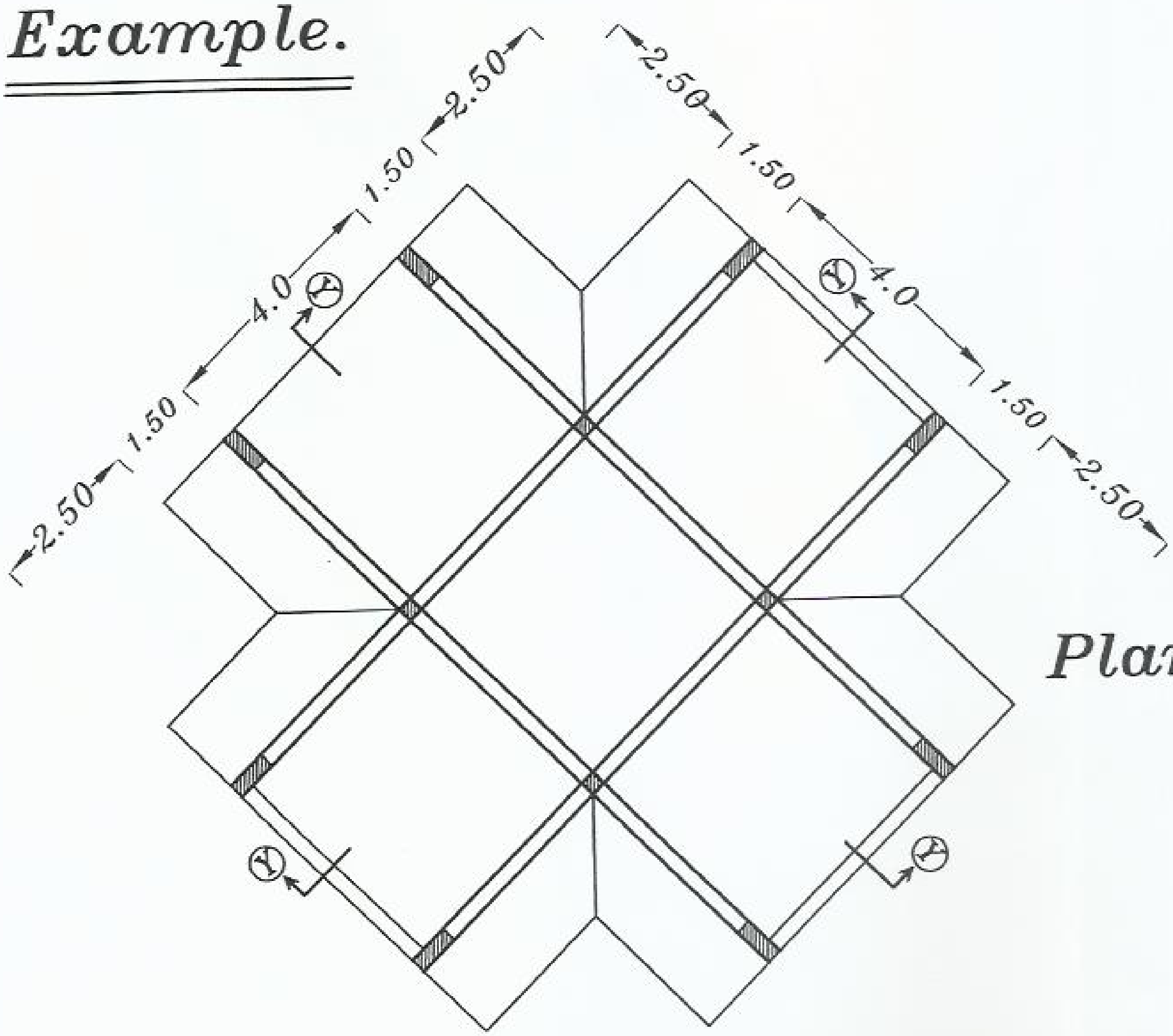
$$d = t_s - 40\ mm = 250 - 40 = 210\ mm$$

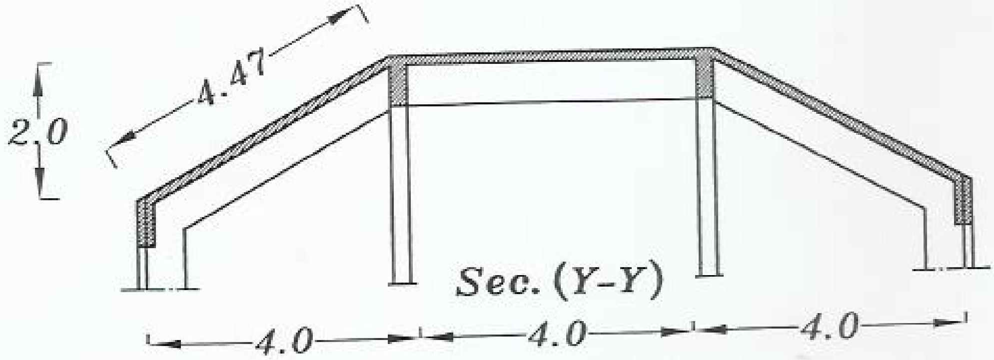
Strip	Sec.	M (kN.m/strip)	b (m)	d (mm)	C_1	J	A_s (mm²/b)	A_s (mm²/m)	No. of bars/m
Column Strip	1	364.08	4500	210	4.04	0.804	5990	1331	6ϕ18\m
	2	346.55	4500	210	4.14	0.808	5673	1260	5ϕ18\m
Field Strip	3	148.52	2250	210	4.47	0.817	2404	1068	6ϕ16\m
	4	56.04	2250	210	7.30	0.826	897	399	5ϕ12\m

Details of RFT.



Example.





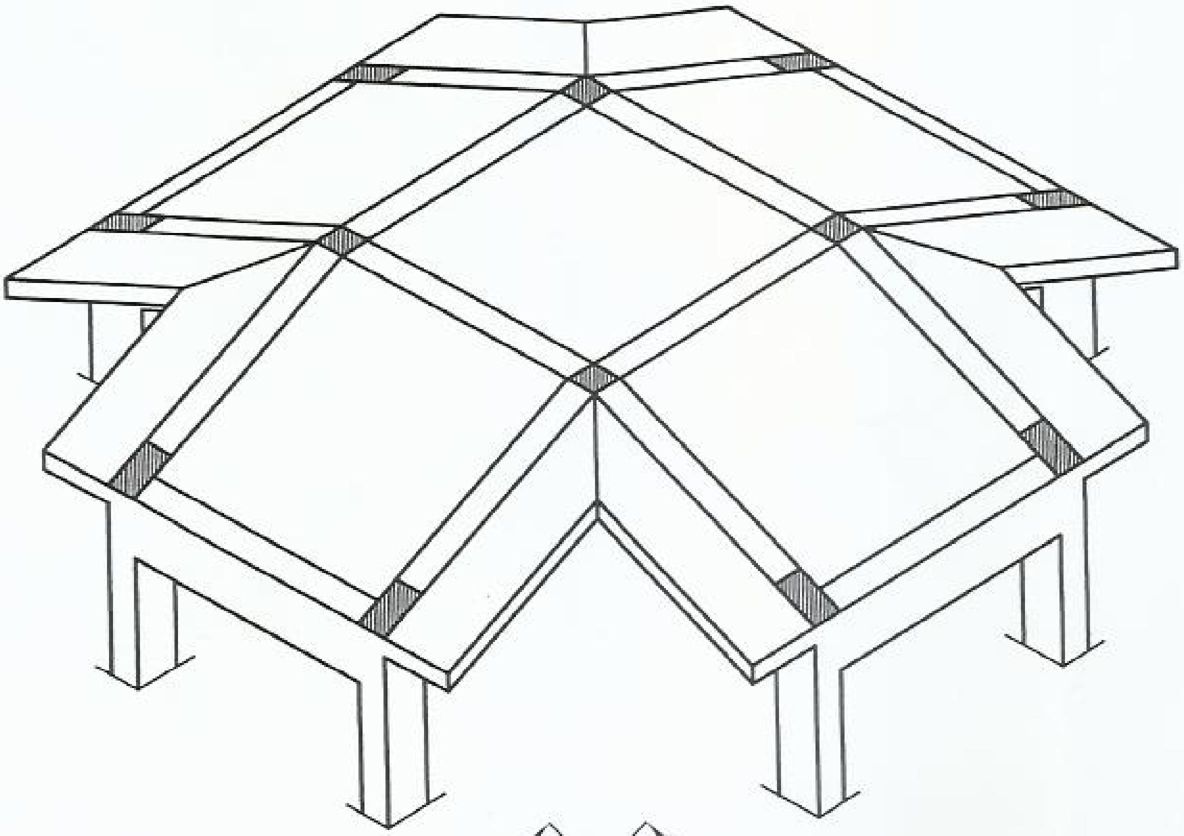
Data.

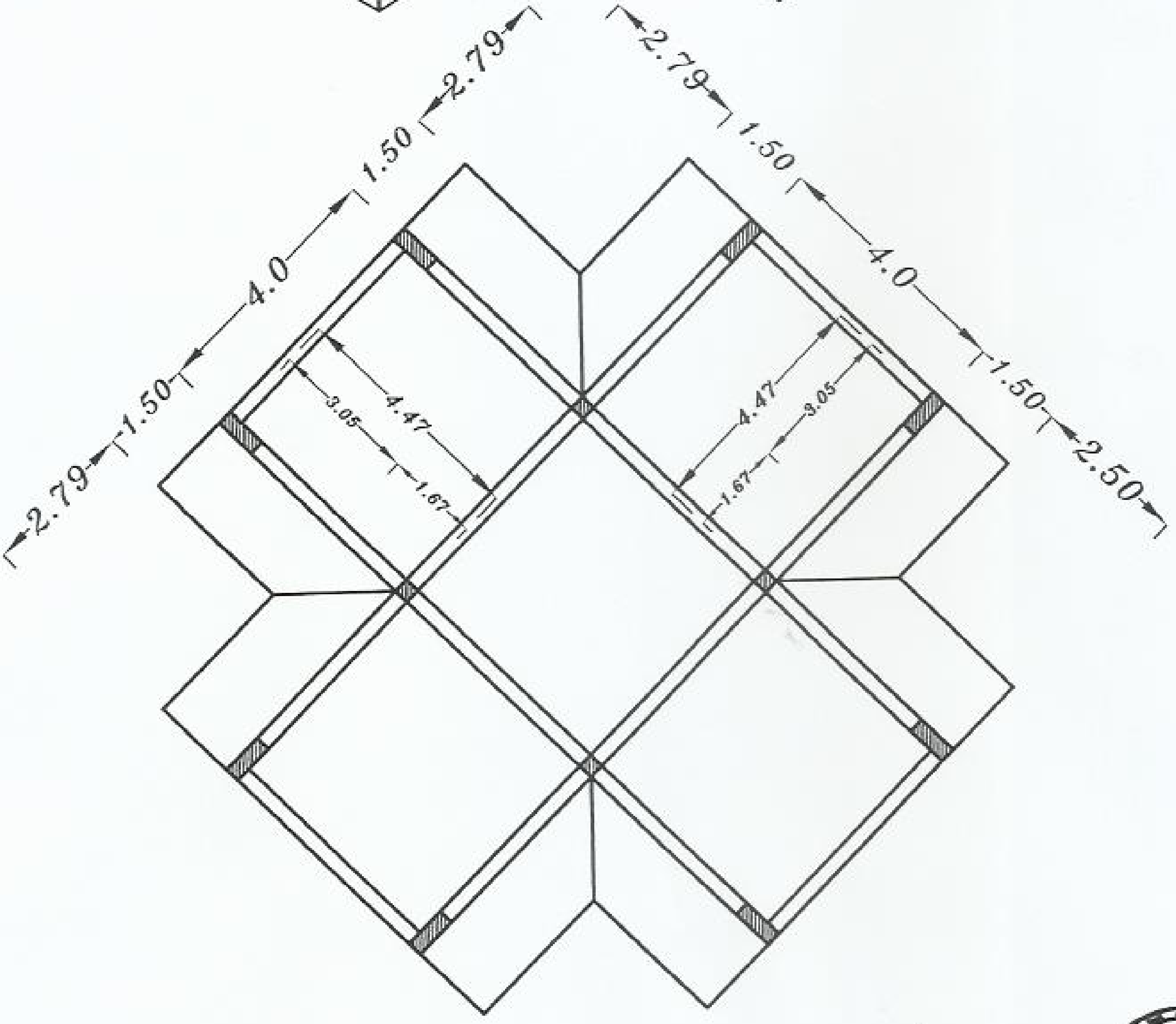
$F_{cu} = 25\ N\backslash mm^2$, $F_y = 360\ N\backslash mm^2$

F.C. + L.L. = 2.5 $kN\backslash m^2$ Horizontal Projection

Req.

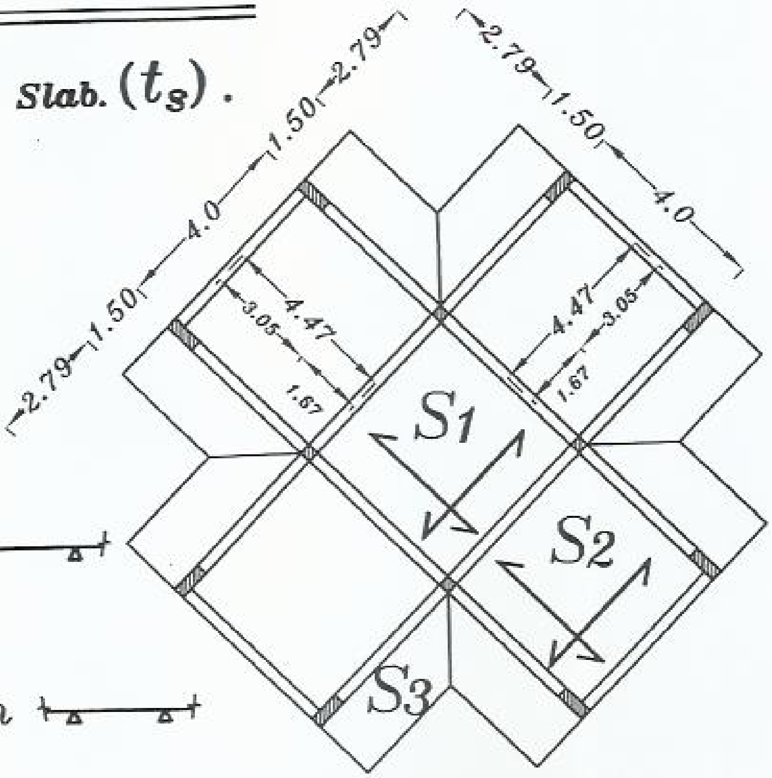
Design all Slabs & Draw RFT. in plan.




2.79
1.50
4.0
1.50
2.79
2.79
1.50
4.0
1.50
2.50
4.47
3.05
1.67
4.47
3.05
1.67

Design the Slabs as Solid Slabs.

a- Choose the Thickness of the Slab. (t_s).



S1 two way $L_S = 4.0\,m$

$$t_s = \frac{4000}{45} = 88.9\ mm$$

S2 two way $L_S = 4.0\,m$

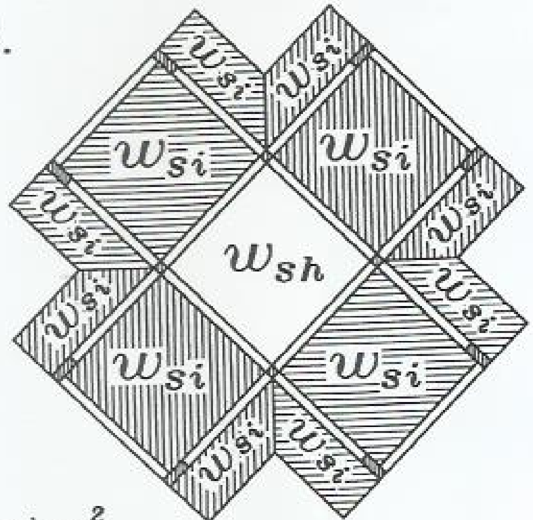
$$t_s = \frac{4000}{45} = 88.9\ mm$$

S3 Cantilever $L_C = 1.5\,m$

$$t_s = \frac{1500}{10} = 150\ mm$$

Take (t_s) the bigger value $\boxed{t_s = 150\,mm}$

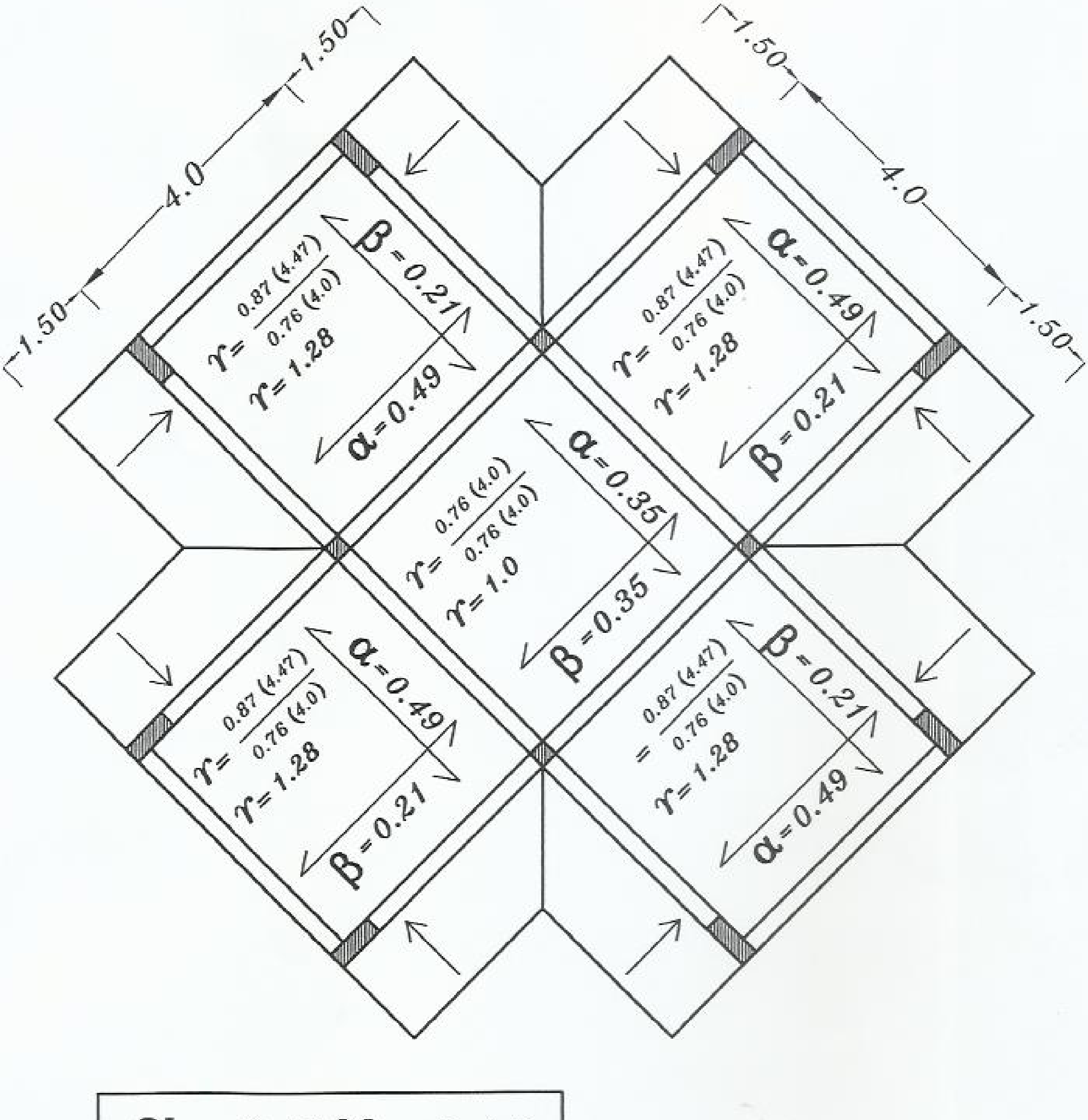
b- Get the Loads on the Slab (w_s).



$$w_{sh} = 1.5\,(0.15 * 25 + 2.5) = \mathbf{9.37}\ kN\backslash m^2$$

$$w_{si} = 1.5\,(0.15 * 25 + 2.5 * \cos 26.56^\circ) = \mathbf{8.98}\ kN\backslash m^2$$

c - Get the Load Factors α, β

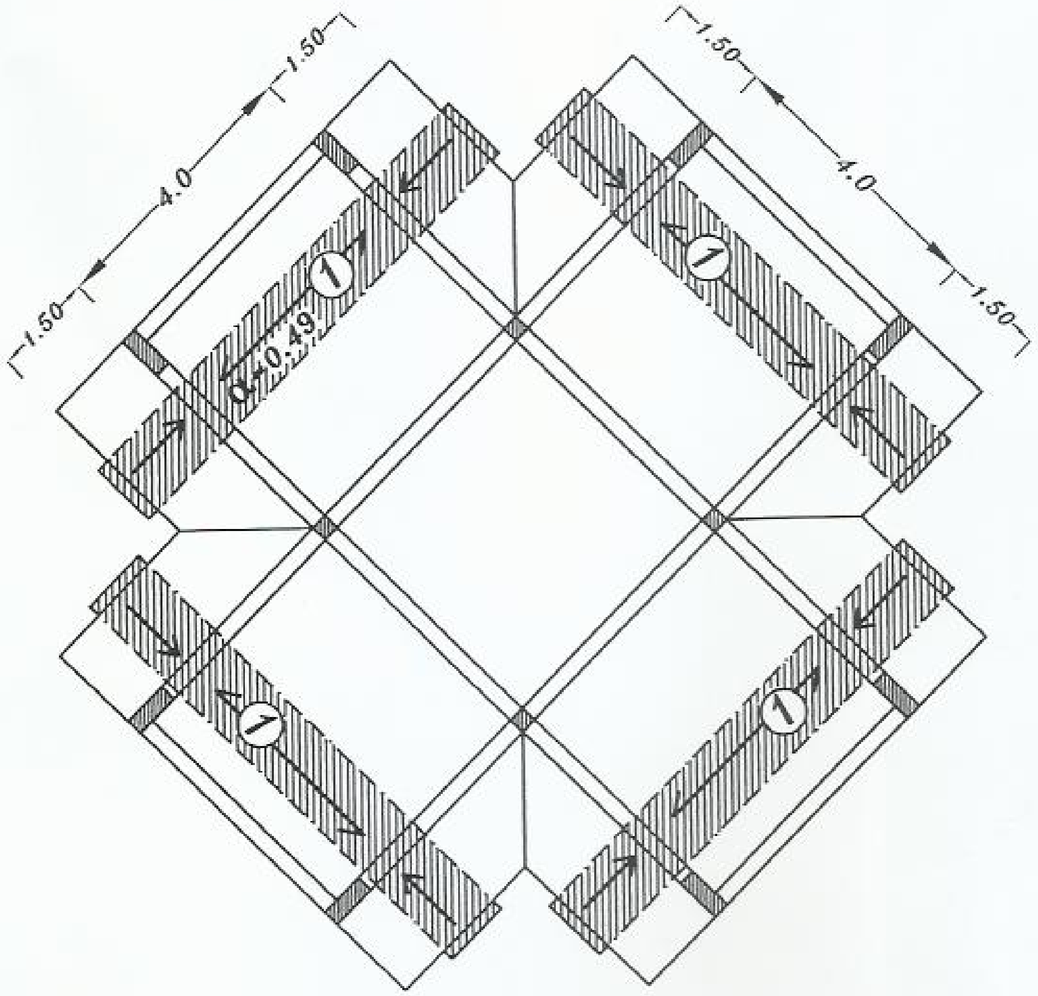


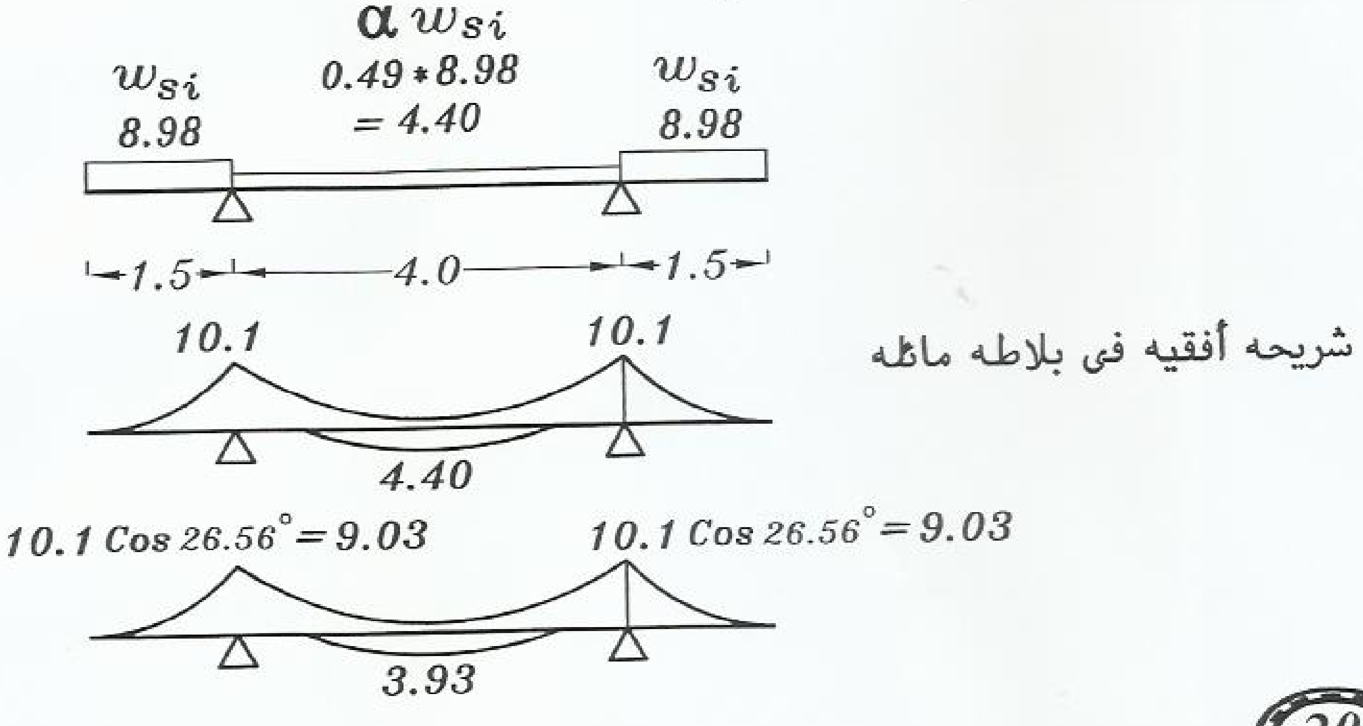
$$\alpha = 0.5\,\gamma - 0.15$$

$$\beta = \frac{0.35}{\gamma^2}$$

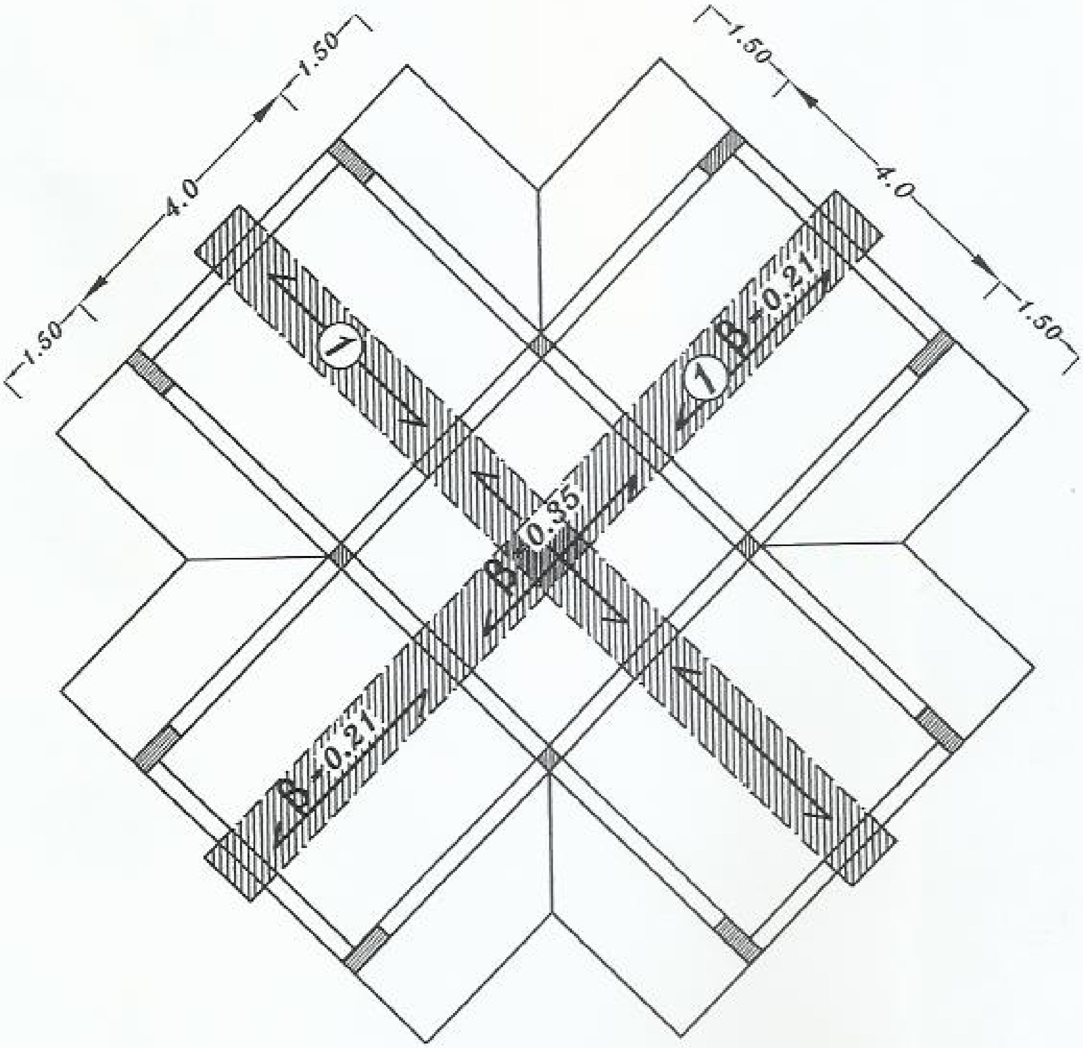
d- *Take a strips in the slab (at the Load direction)*
And then Get (B.M.) on the Slab & Design the slab.

Strip ①

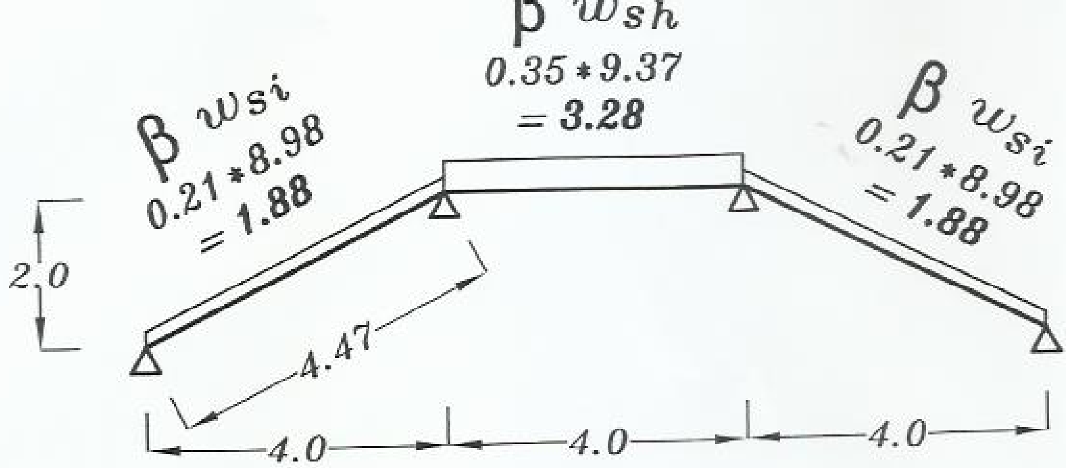




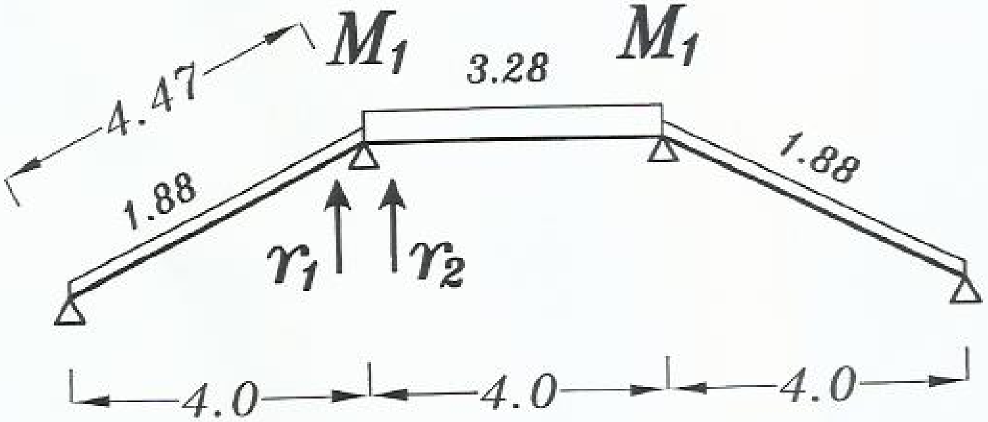
Strip ②



1.50
4.0
1.50
1.50
4.0
1.50
1
1
β=0.21
β=0.35
β=0.21



β wsh
0.35 * 9.37
= 3.28
β wsi
0.21 * 8.98
= 1.88
β wsi
0.21 * 8.98
= 1.88
2.0
4.47
4.0
4.0
4.0

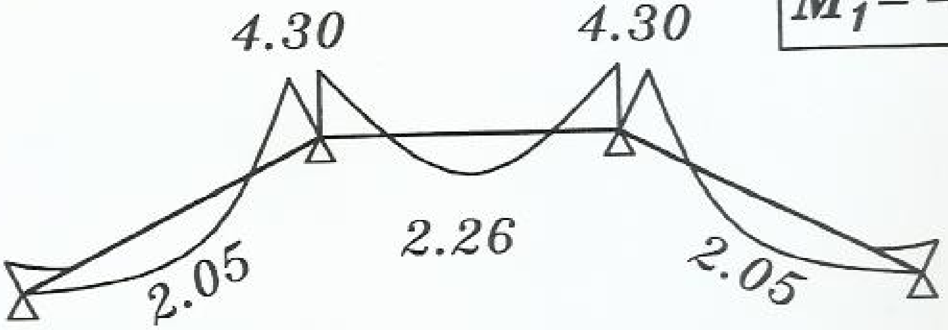


$$\gamma_1 = \frac{wLL'^2}{24} = \frac{1.88 * 4.0 * 4.47^2}{24} = 6.26 \quad , \quad \gamma_2 = \frac{wL^3}{24} = \frac{3.28 * 4.0^3}{24} = 8.74$$

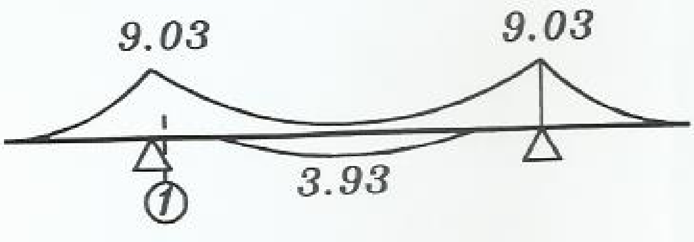
Equation of M_1

$$0.0 + 2M_1(4.47 + 4.0) + M_1(4.0) = -6\,(6.26 + 8.74)$$

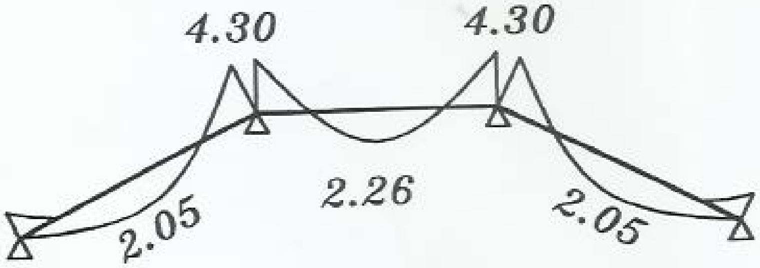
$$\boxed{M_1 = -4.30 \text{ kN.m.}}$$



Strip ①



Strip ②



Sec. ① $M_{U.L.} = 9.03 \ kN.m\backslash m$

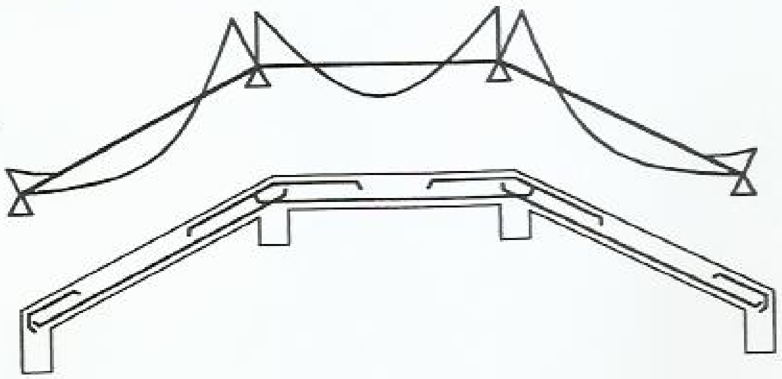
$t_s = 150 \ mm$, $d = 150 - 20 = 130 \ mm$, $B = 1000 \ mm$ عرض الشريحه

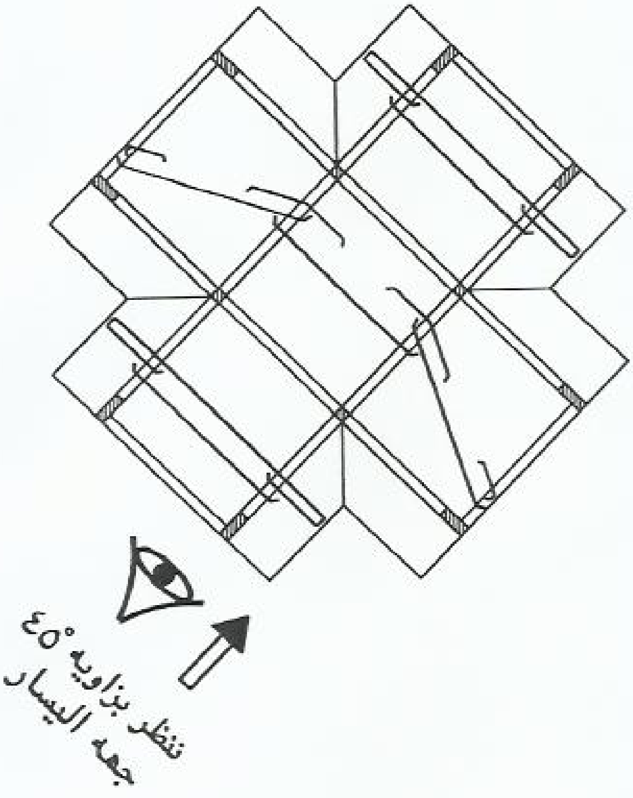
$$130 = C_1\sqrt{\frac{9.03 * 10^6}{25 * 1000}} \longrightarrow C_1 = 6.84 \longrightarrow J = 0.826$$

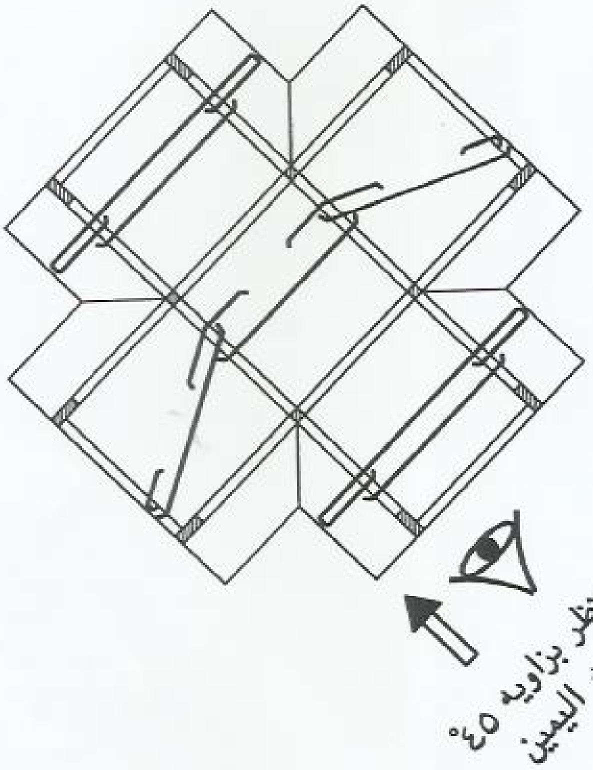
$$A_S = \frac{9.03 * 10^6}{0.826 * 360 * 130} = 235.6 \ mm^2/m` \qquad 5\phi10\backslash m`$$

∴ سيؤخذ تسليح باقى القطاعات $5\phi10\backslash m`$

Details of RFT. For the Slab.







Details of RFT. For the Slab.