Reinforced Concrete Design of Hydraulic Structures

SLABS :

Slabs are constructed to provide flat surfaces, usually horizontal in building floors, roofs, bridges, and other types of structures. The slab may be supported by walls or by reinforced concrete beams usually cast monolithically with the slab or by structural steel beams or by columns, or by the ground.

FLAT SLAB :-

The flat slab is a reinforced concrete slab supported directly by concrete columns or caps. Flat slab doesn't have beams so it is also called a **beam-less slab**. They are supported on columns itself. Loads are directly transferred to columns.

Advantages of Flat Slab:

1. Less construction time.
2. It increases the shear strength of the slab.
3. Reduce the moment in the slab by reducing the clear or effective span.

Disadvantages of Flat slab:

1. In a flat plate system, it is not possible to have a large span.
2. Not suitable for supporting brittle (masonry) partitions.
3. Higher slab thickness.

There are four different types of concrete Flat Slabs:-

1. Slab without drop and column without column head (capital).
2. Slab with drop and column without column head.
3. Slab without drop and column with column head.
4. Slab with drop and column with column head.

Slab without drop and column without column head

Slab with drop and column without column head

Slab without drop and column with column head

Slab without drop and column with column head

Conventional Slab :-

The slab which is supported on beams and columns is called a conventional slab. In this kind, the thickness of the slab is small whereas the depth of the beam is large and load is transferred to beams and then to columns.

Based on the length and breadth of Conventional Slab is classified into two types:

1. One-Way Slab
2. Two-Way Slab

Hollow core ribbed slab or hollow core slab :-

Hollow core ribbed slabs derive their name from the voids or cores which run through the units. The cores can function as service ducts and significantly reduce the self-weight of the slabs.

Hollowcore slab Advantages:

1. Hollow core ribbed slab not only reduces building costs it also reduces the overall weight of the structure.
2. Excellent fire resistance and sound insulation are other attributes of hollow core slab due to its thickness.
3. Easy to install and requires less labor.
4. Fast in construction.

Hollowcore slab Disadvantages:

1. If not properly handled, the hollow core ribbed slab units may be damaged during transport.
2. It is necessary to arrange for special equipment for lifting and moving of the precast units.
3. Not economic for small spans.
4. Difficult to repair.

HARDY SLAB :-

Hardy slabs are generally seen in Dubai, China and Jordon. Hardy slab is constructed by hardy Bricks. Hardy bricks are hollow bricks and made up of concrete Hollow blocks. These blocks are used to fill portions of the slab. Hardy slabs save the amount of concrete and hence the own weight of the slab is reduced. This kind of slab has a more thickness 0.27m when compared with the conventional slab.

Advantages of Hardy Slab:

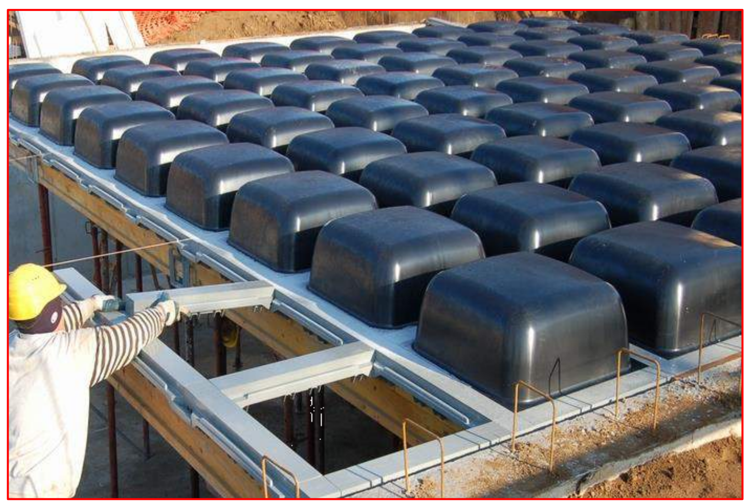
1. Reducing slab weight by reducing the amount of concrete below the neutral axis.
2. Ease of construction.
3. Economic for spans > 5m with moderate live load: hospitals, office and residential buildings.
4. Improved insulation for sound and heat.

Disadvantages of Hardy Slab:

1. If not properly handled, the hollow core ribbed brick units may be damaged during transport.
2. Not economic for small spans.
3. Difficult to repair.

Waffle Slab :-

Waffle slab is a reinforced concrete roof or floor containing square grids with deep sides and it is also called as grid slabs. This kind of slab is majorly used at the entrance of hotels, Malls, Restaurants for good pictorial view and to install artificial lighting. This a type of slab where we find a hollow hole in the slab when the formwork is removed.



Advantages of Waffle slabs:

1. Waffle slabs are able to carry heavier loads.
2. Suitable for spans of 7m – 16m; longer spans may be possible with post-tensioning.

Disadvantages of Waffle slabs:

1. The casting forms or molds required for precast units are very costly and hence only economical when large scale production of similar units are desired.
2. Construction requires strict supervision and skilled labor.

Dome Slab :-

This kind of slab is generally constructed in temples, Mosques, palaces .. etc. The thickness of Dome slab is 0.15m. Domes are in the semi-circle in shape and shuttering is done on a conventional slab in a dome shape and concrete is filled in shuttering forming dome shapes.


Post Tension Slab :-

The slab which is tensioned after constructing a slab is called Post tension slab. Reinforcement is provided to resist the compression. In Post tension slab the reinforcement is replaced with cables/ steel tendons.


Advantages of Post tension slab:

1. Post tension slabs are excellent ways to construct stronger structures.
2. It reduces or eliminates shrinkage cracking-therefore no joints, or fewer joints, are needed
3. It lets us design longer spans in elevated members, like floors or beams.

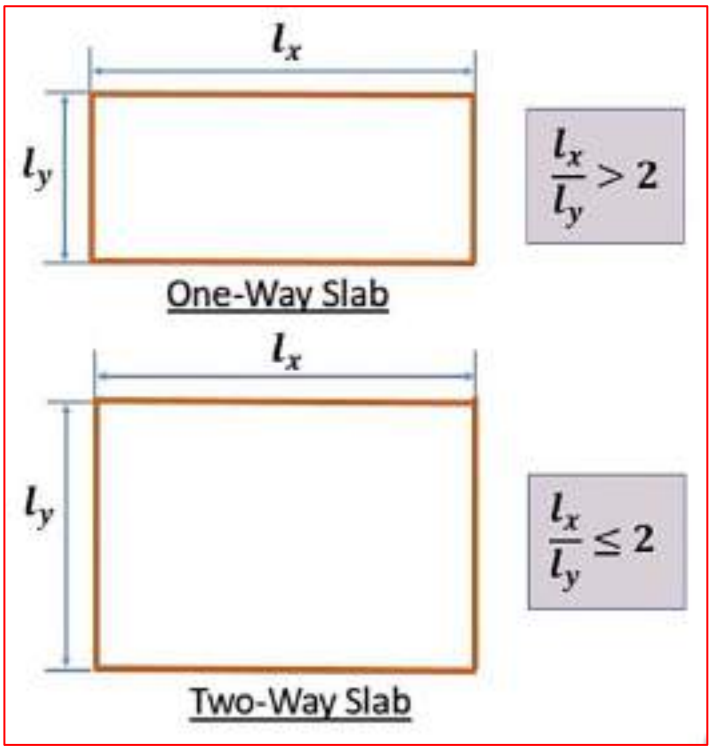
Disadvantages of Post tension slab:

1. The Post tension slab can be made only by skillful professionals.
2. The main problem with using Post tension slab is that if care is not taken while making it, it can lead to future mishaps. Many times, ignorant workers do not fill the gaps of the tendons and wiring. These gaps cause corrosion of the wires which may break untimely, leading to some failures unexpectedly


Reinforced Concrete Slabs:

1-One way slabs.

2-Two way slabs.



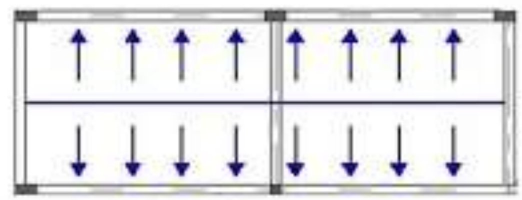


Figure of a one way slab load distribution. It is supported by beams in only 2 sides.

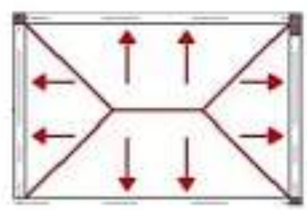
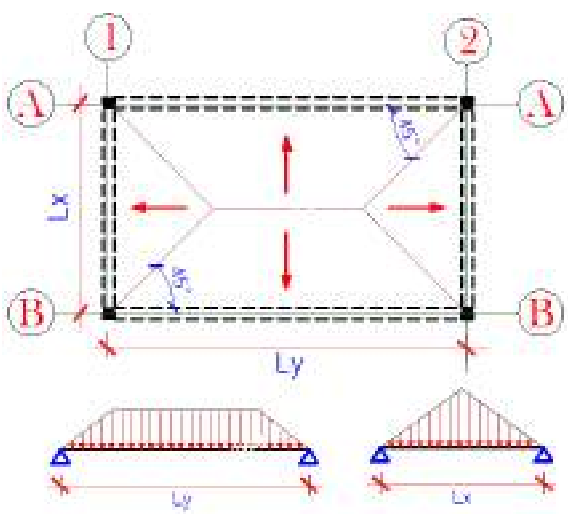
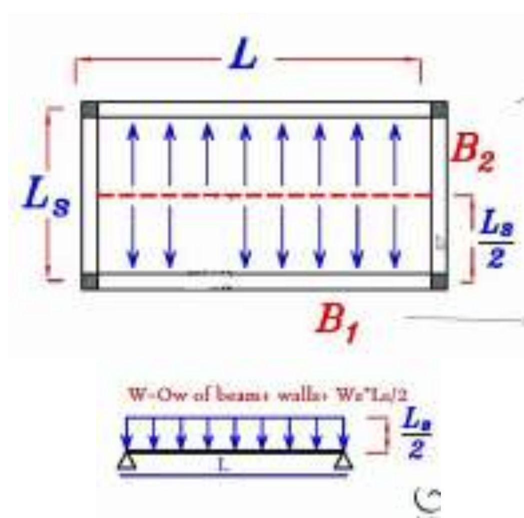
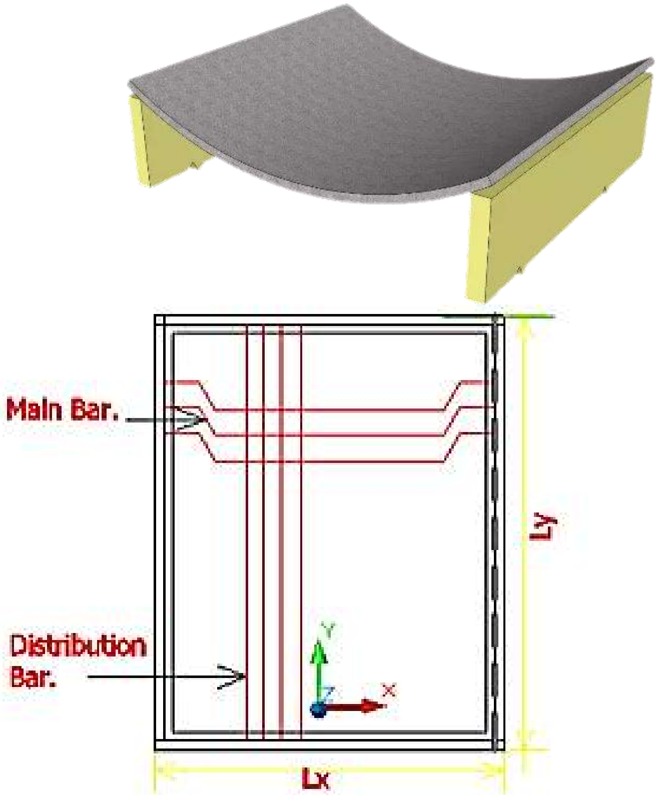


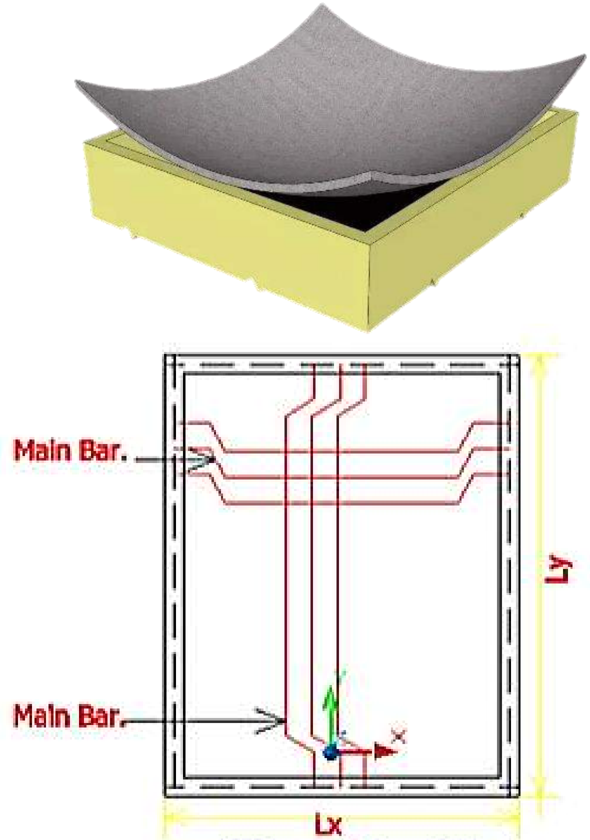
Figure of a two way slab load distribution. It is supported by beams in all 4 sides.



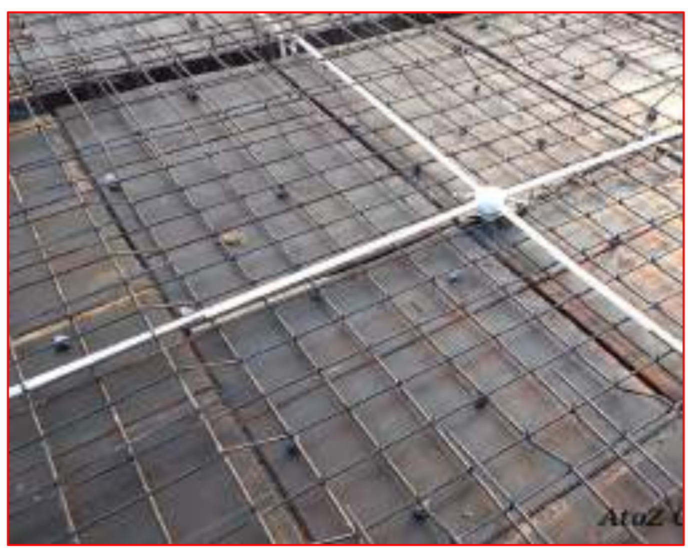




One Way Slab



Two Way Slab

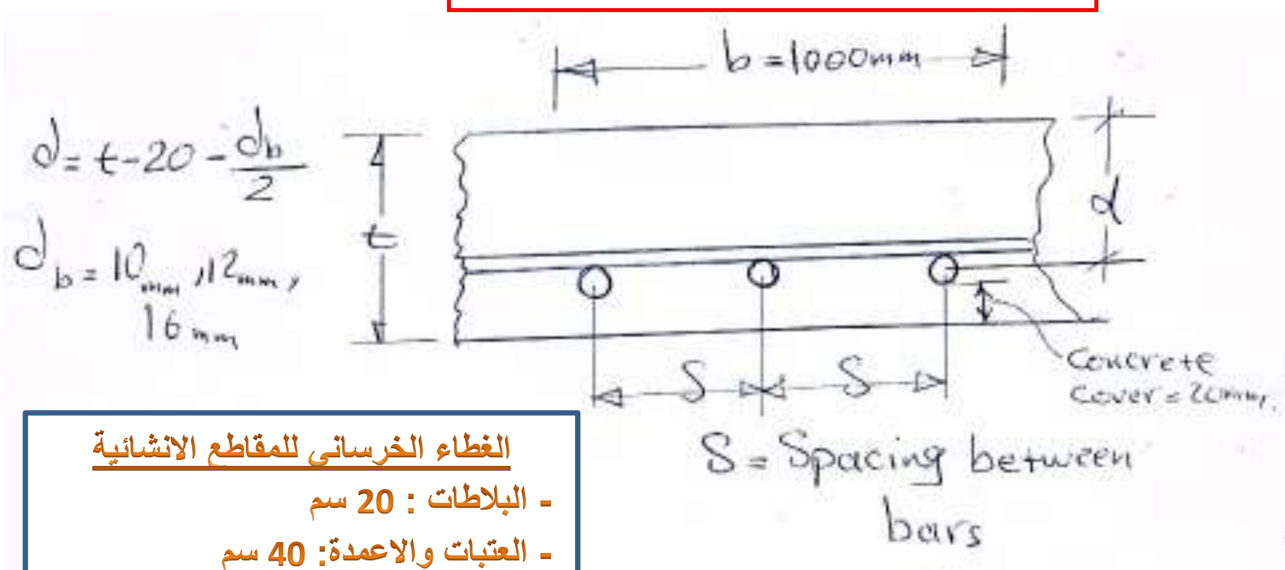


Design of One Way Slab:

1- Minimum slab thickness according to **(ACI-Code 9.5.2.1)** to control deflection as:

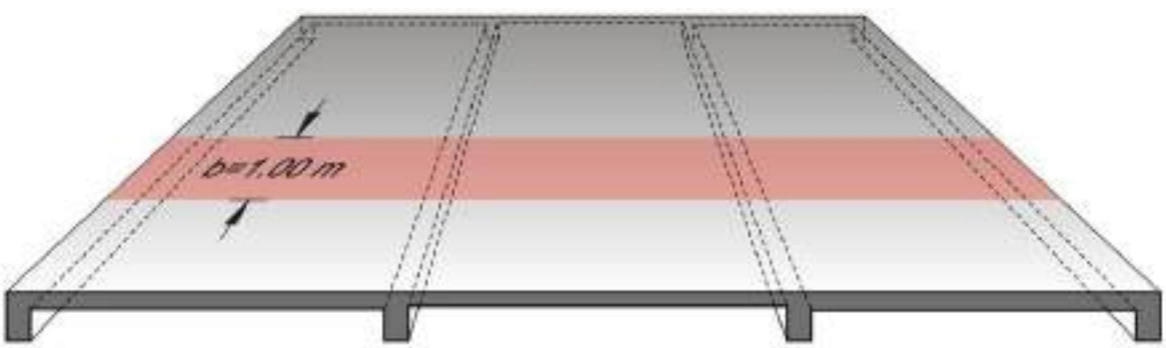
Element	Simply supported	One end continuous	Both ends continuous	Cantilever
One-way solid slabs	l/20	l/24	l/28	l/10

b (تأخذ دائما (1000 ملم) والتي تمثل عرض الشريحة)



الغطاء الخرساني للمقاطع الانشائية

- البلاطات : 20 سم
- العتبات والاعمدة: 40 سم
- الاسس: 75 سم



Load factors and combinations According to ACI 318M-14, the required strength (U or Wu) shall be at least equal to the effects of factored loads:

Load combination
$U = 1.4D$
$U = 1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)$
$U = 1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (1.0L \text{ or } 0.5W)$
$U = 1.2D + 1.0W + 1.0L + 0.5(L_r \text{ or } S \text{ or } R)$
$U = 1.2D + 1.0E + 1.0L + 0.2S$
$U = 0.9D + 1.0W$
$U = 0.9D + 1.0E$

U : Ultimate Load
D: Dead Load
L: Live Load
W: Wind Load
S: Snow load
R: Rain Load
L_r: Roof Live Load
E: Earthquake Load

$$Wu = 1.2\ D.L + 1.6\ L.L$$

Check the effective depth according to shear requirements:

The design of shear strength in concrete (ϕVc) must be equal or greater than design the shear force at critical section . If not, we must change (increase) the thickness of slab (h).

Summary of One Way Solid Slab Design Procedure

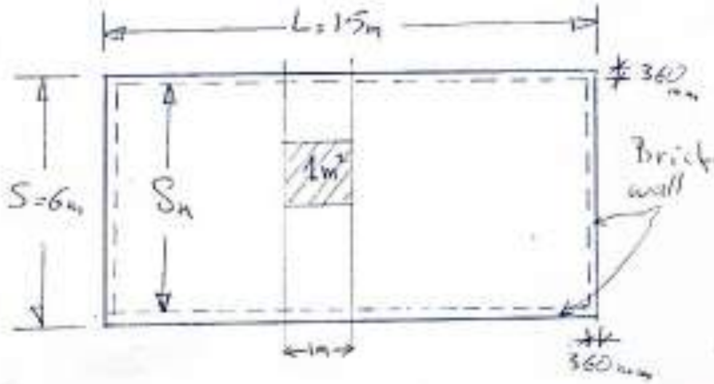
1. Select a strip of 1 meter width in short direction.
2. Choose a slab thickness to satisfy deflection requirement.
3. Calculate the factored load (Wu).
4. Draw the shear and bending moment for each strip.
5. Check the adequacy of slab thickness in term of shear resistance.
6. Design the flexural reinforcement.
7. Check the minimum steel reinforcement ratio.
8. Compute the area of temperature and shrinkage reinforcement.
9. Draw the detail of section and reinforcement

Ex.: Design the slab (Roof) showing in the Fig. below:-

WL = 1.5 kN/m², Tiles = 1.0 kN/m², Earth filling = 2 kN/m²

assuming the average thickness of earth filling = 100 mm

Solution:-



$* \frac{L}{S} = \frac{(15 - 2*0.36)}{(6 - 2*0.36)}$

$= 2.70 > 2$

∴ The slab is one way slab.

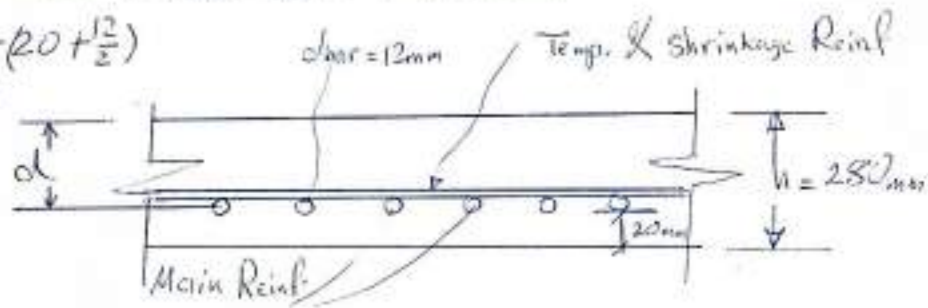
$* \; h = \frac{6 - 2*0.36}{20} * 1000 = 264 \, mm$ use $h = 280 \, mm$

$* \; W_D = W_{tiles} + W_{earth} + W_{self} = 1 + 2 + 24 \times 1 \times 1 \times 0.28 = 9.72 \; kN/m^2$

$W_u = 1.6 * 1.5 + 1.2(9.72) \simeq 14.1 \; kN/m^2$

$d = 280 - (20 + \frac{12}{2})$

$d = 254 \, mm$



* Checking for shear

$V_{us} = \frac{14.1 * 5.28}{2} = 37.22\ kN$

$V_{ud} = V_{us} - W_u d = 37.22 - 14.1 * 0.254 = 33.643\ kN$

$\phi V_c = 0.75 * \frac{1}{6}\sqrt{f'_c} * b * d = 0.75 * \frac{1}{6}\sqrt{20} * 1000 * 254 * 10^{-3}$

$\phi V_c = 142\ kN > V_{ud} = 33.64\ kN$

∴ The thickness is adiquate for shear.

* Bending Moment :-

$M_{u_{max}} = \frac{W_u\ S_n^2}{8} = \frac{14.1 * (5.28)^2}{8} = 49.14\ kN.m$

$\rho_{max} = 0.0206$

$M_u = \phi \rho f_y b d^2 (1 - \frac{0.59 \rho f_y}{f'_c})$

$49.14 * 10^6 = 0.9 * 300 * \rho * 1000 * 254^2 (1 - \frac{0.59 * \rho * 300}{20})$

$49.14 * 10^6 = 1.742 * 10^{10} \rho - 1.542 * 10^{11} \rho^2$

$\rho^2 - 0.113\rho + 0.00031 = 0$

$\rho = \frac{-0.113 \pm \sqrt{0.113^2 - 4 \times 1 \times 0.00031}}{2}$

$\rho = 0.0028 < \rho_{max} = 0.0206$

$A_{s_{min}} = 0.002\ bh = 0.002 * 1000 * 280 = 560\ mm^2/m$

$A_s = \rho b d = 0.0028 * 1000 * 254 = 711.2\ mm^2/m > A_{s_{min}}$

$\rho_t = 0.018 > \rho$ ∴ $\phi = 0.9$ ok

$A_{s\,bar} = \frac{\pi}{4} \times 12^2 = 113\ mm^2$, $S_{max} \leq \begin{cases} 450\ mm ✓ \\ 3h = 3 \times 280 = 840\ mm \end{cases}$

$S = \frac{1000}{712/113} = 158.7\ mm\ c/c$ use $S = 150\ mm\ c/c < 450\ mm$

A_s for Temperature & shrinkage

$A_s = A_{s\,min} = 560\ mm^2/m$

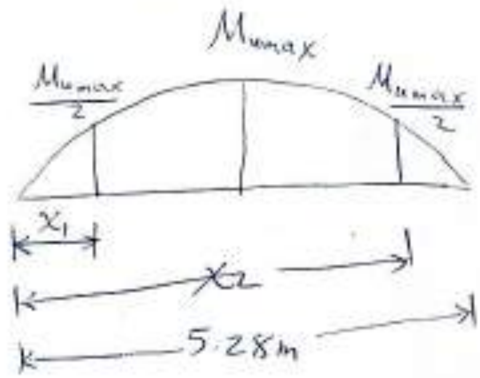
$S = \frac{1000}{560/113} = 201.8$ $S_{max} \leq \begin{cases} 5h = 1400\ mm \\ 450\ mm ✓ \end{cases}$

$\therefore$ Use $S = 200\ mm\ c/c$

نقرر قطع نصف حديد التسليح

The B.M. value in any Point at distance $= x$

is $M_x = \frac{w l_n}{2} * x - \frac{w x^2}{2}$



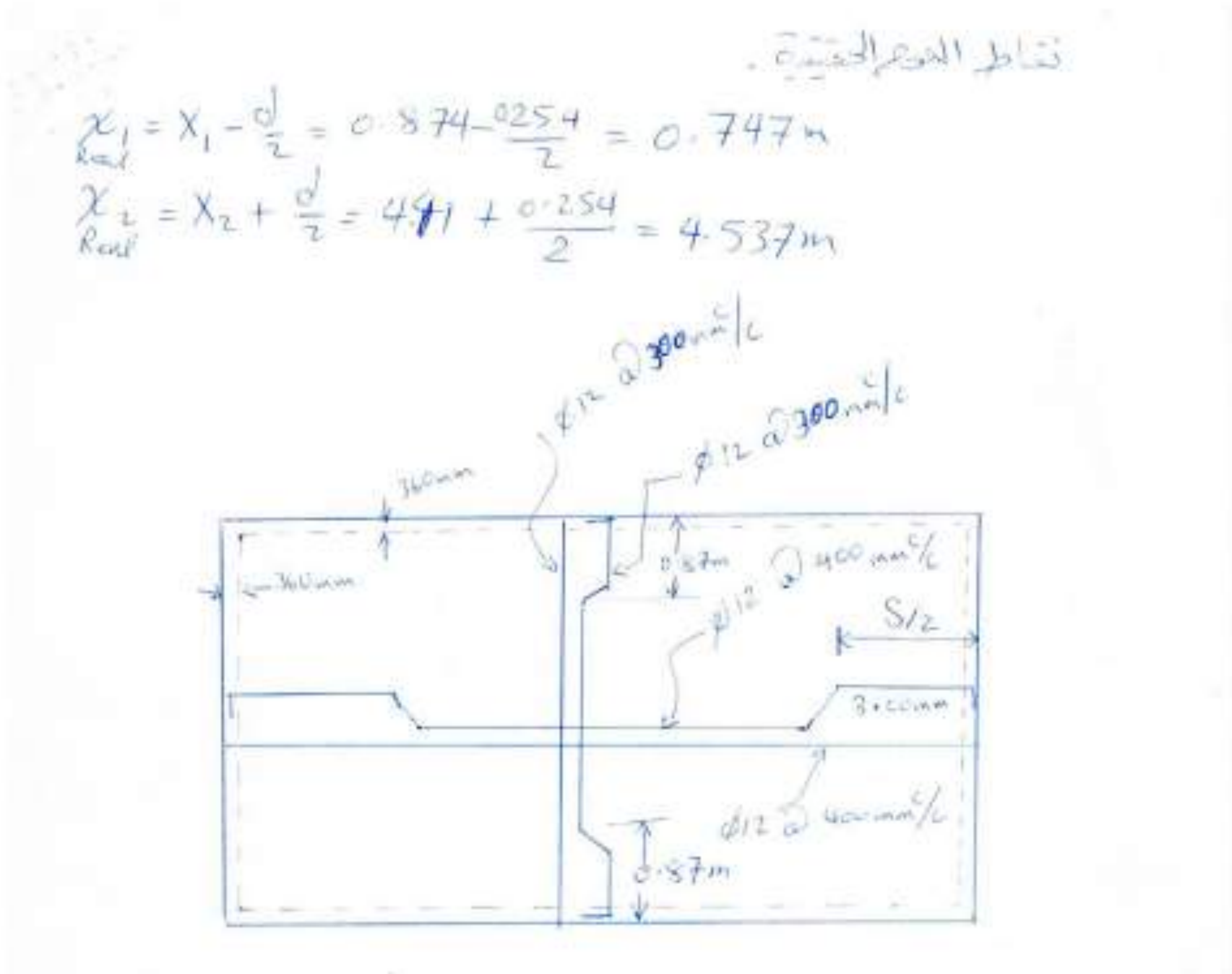
$\left(\frac{49.14}{2}\right) = \frac{14.1 * 5.28}{2} * x - \frac{14.1 x^2}{2}$

$24.57 = 37.224x - 7.05x^2$

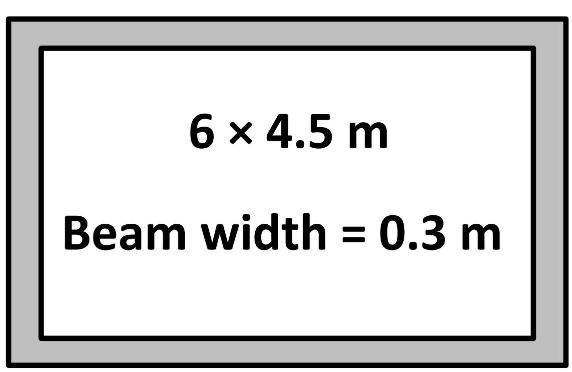
$x^2 - 5.28x + 3.485 = 0$

$x = \frac{5.28 \pm \sqrt{5.28^2 - 4 \times 1 \times 3.85}}{2}$

$x_1 = \frac{1.748}{2} = 0.874\ m$, $x_2 = \frac{8.812}{2} = 4.41\ m$



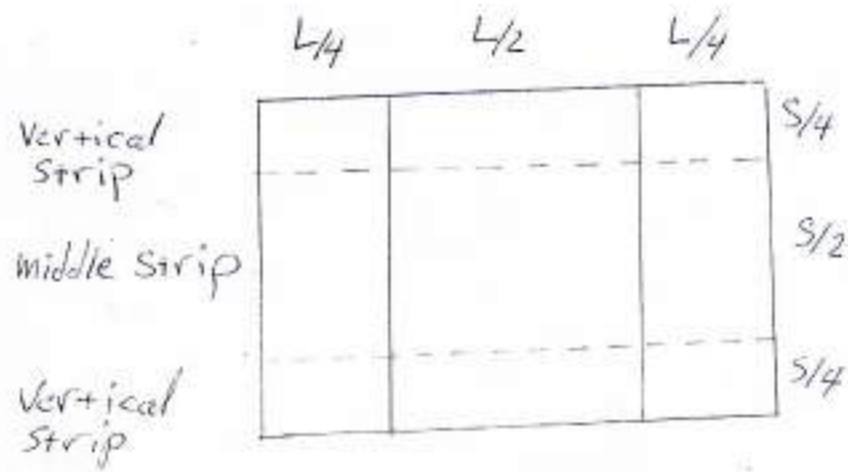
H.W.: A reinforced concrete slab is built integrally with support as shown in Figure. Design the slab to carry service live load 4.8 kN/m^2 . f'c = 28 MPa and fy = 420 MP.

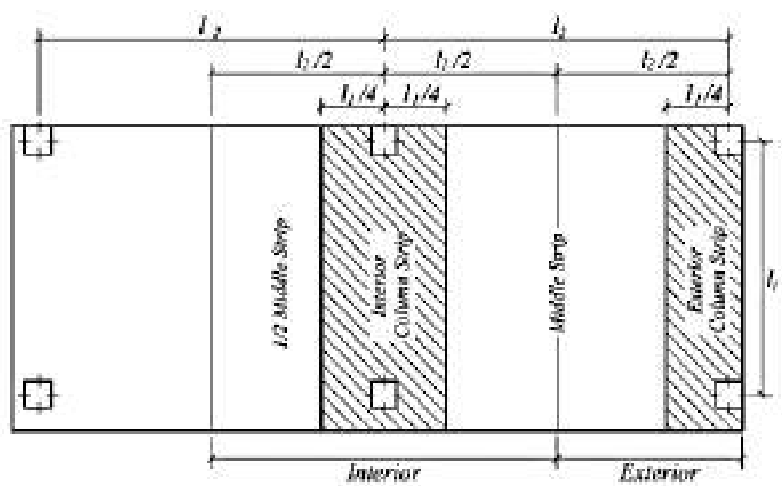


Design of Two Way Slab:

Design of Edge Supported Slabs :-

* There are three method for design this type of slab
* We will use the second method for the design.





- * ρ must be equal or less than ρ_{max}

$$\rho \leq \rho_{max}$$

if not, then the thickness must be increased.

* $A_{s\,min}$ must equal to area of steel for temperature & shrinkage.

- Calculations of Posative & Negative Moments in both directions.

$$M_u = C\, W_u\, S^2.$$

C: Coeffecint, W_u: Ultimate load, S: short span length

$$\text{Bending Moment for Vertical strip} = \frac{2}{3} * \text{Bending Moment for middle Strip}$$

- <u>Steel Reinforcement for middle Strip. :-</u>

Finde ρ & it must equal or less than ρ_{max}

*See table (B)

- <u>Distribution of Steel Reinforcement :-</u>

$$S = \frac{1000}{A_s/A_b} = \frac{1000}{N}, \quad S \leq 2h$$

In sane places we mus add bars ($A_{s\,add}$).

Procedure of Design :-

- Thickness of slab.

$$h \geq \begin{cases} \frac{P}{180} \\ 90\,mm \end{cases}$$

محيط البلاطة

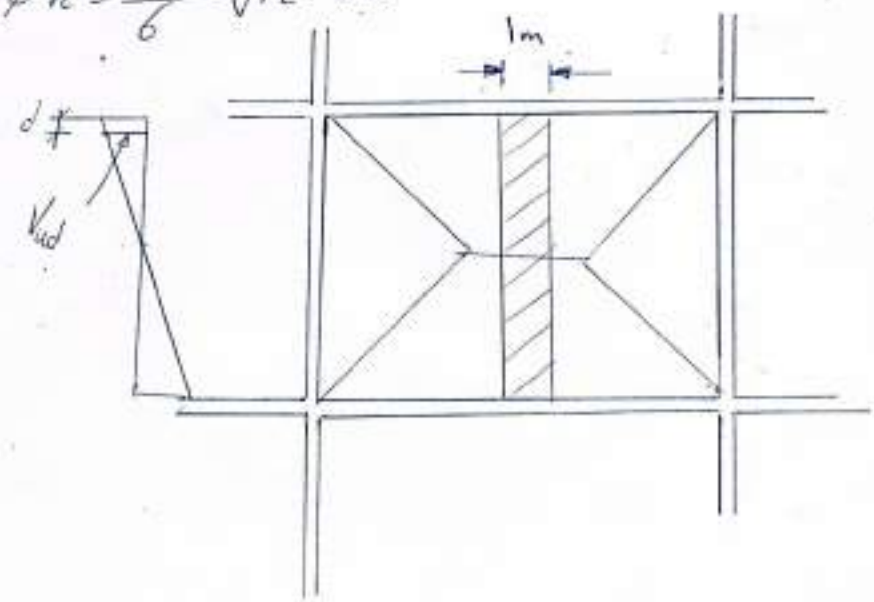
- $W_u = 1.2D + 1.6L$
- Check of slab thickness according to shear requirements

$$V_{ud} = W_u\left(\frac{S_n}{2} - d\right)$$

where S_n – Short Span

Comparing between shear force with shear strength design which is calculated as follow:-

$$\phi V_c = \frac{0.75}{6}\sqrt{f_c'}\,bd$$



Then $V_{ud} \leq \phi V_c$

- Distribution of loads on beams :-

* for short beams $W_e = \frac{W_u S}{3}$

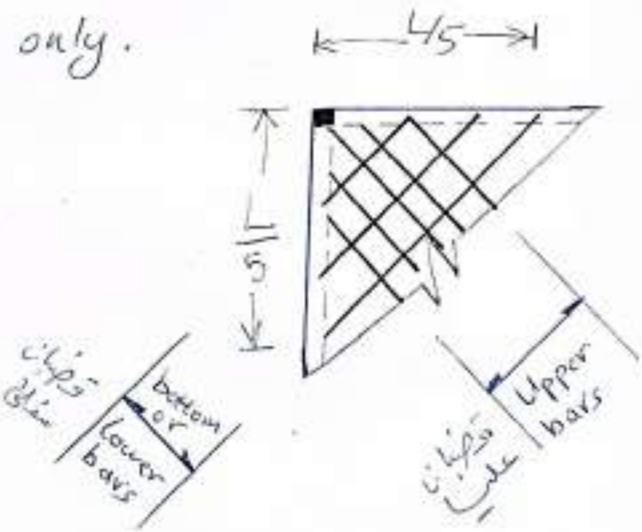
* for long beams $W_e = \frac{W_u S}{3}\left(\frac{3-m^2}{2}\right)$

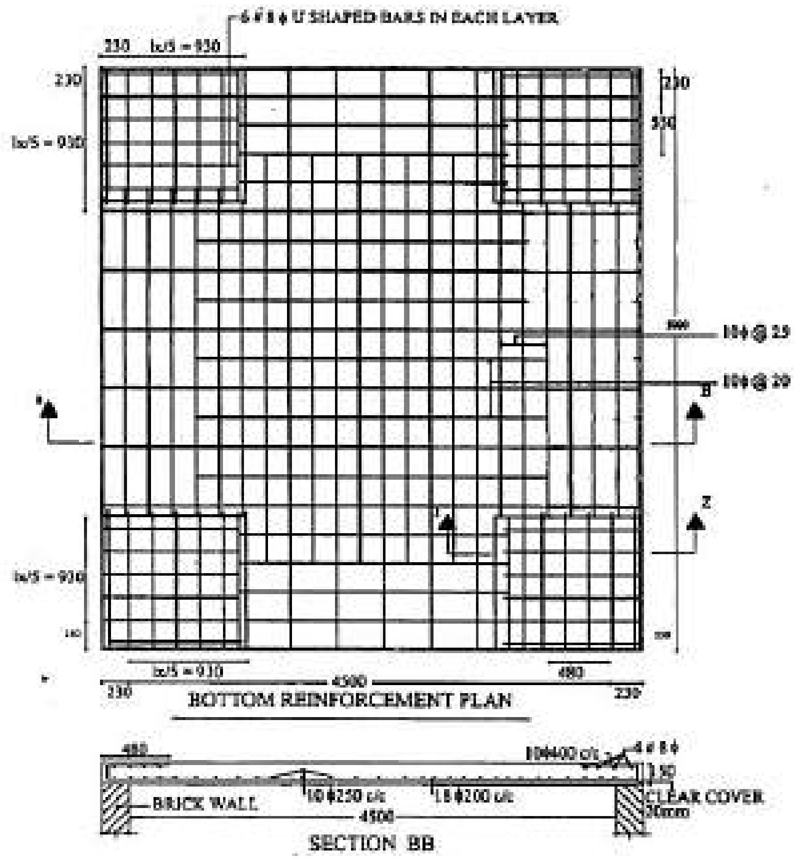
when W_e is equivelant uniformly distrebuted load.

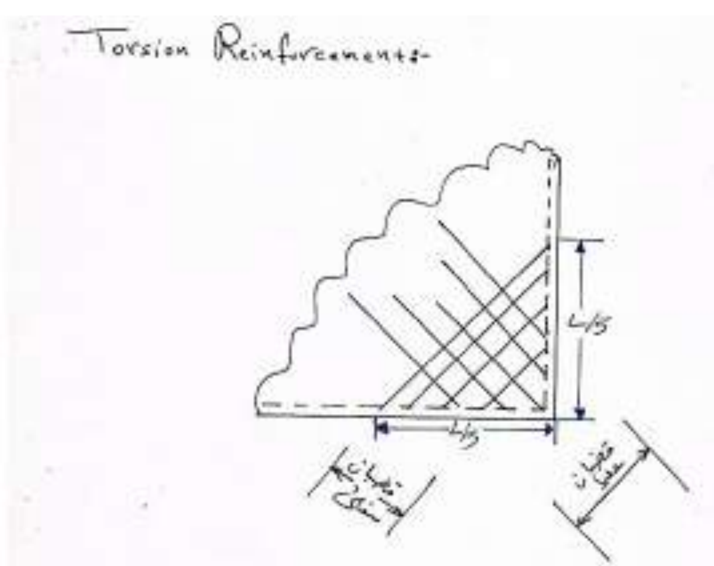
W_u: Factord load for one squared meter of slab area.

- Torsion Reinforcement :-

This reinforcement is added for extiror corner (edge) only.



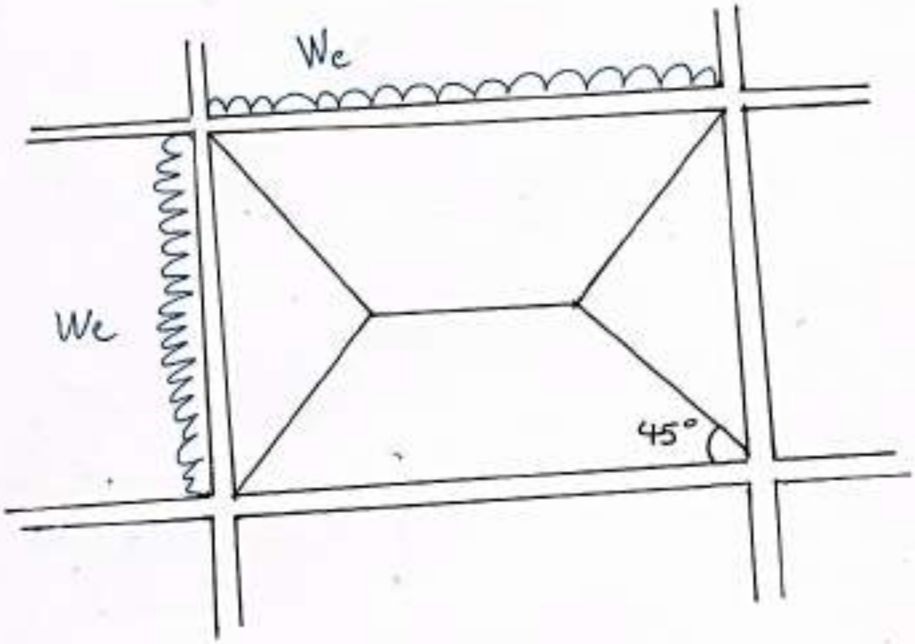

6 # 8 ϕ U SHAPED BARS IN EACH LAYER
230
lx/5 = 930
4500
480
BOTTOM REINFORCEMENT PLAN
10ϕ @ 25
10ϕ @ 20
BRICK WALL
10 ϕ250 c/c
10 ϕ200 c/c
CLEAR COVER
20mm
SECTION BB

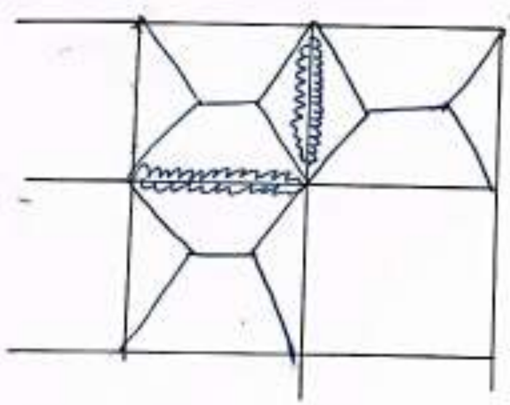

Torsion Reinforcements-
L/5

W equivelant

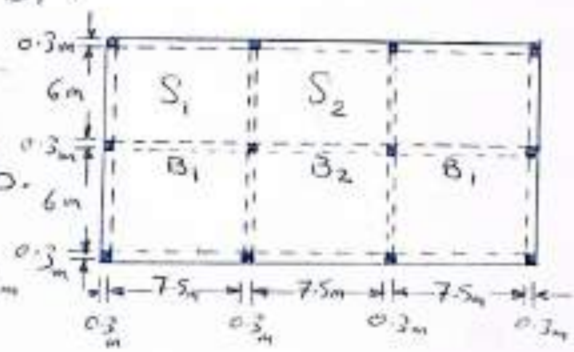
$$We \text{ (for short beams)} = \frac{Wu\,S}{3}$$

$$We \text{ (for Long beams)} = \frac{Wu\,S}{3}\left(\frac{3-m^2}{2}\right)$$





Ex.: Design the slabs of the building showing below. L.L = 3 kN/m², The additive dead load (finshing & Tiling) equal to 2 kN/m². $f'_c = 30$ MPa, $f_y = 400$ MPa. Find the magnitude of loads which applied from the slabs on the beam B_1.



Solution:-

1- Thickness of the slab.

$$h \geq \begin{cases} \frac{P}{180} = \frac{2(6000+7500)}{180} = 150\,mm \\ 90\,mm \end{cases}$$

$\therefore$ Use $h = 150\,mm$

2- Calculate the design load:-

$D.L = 0.15 \times 1 \times 1 \times 24 + 2 = 5.6\ kN/m^2$

$W_u = 1.2(5.6) + 1.6(3) = 11.52\ kN/m^2$

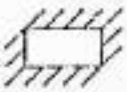
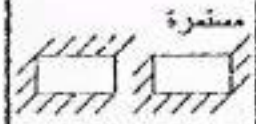
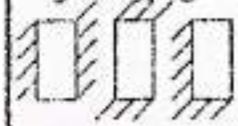
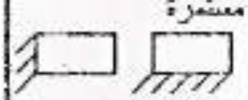
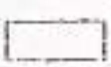
3- Cheack the thickness of slab according to shear requirements.

$d = 150 - 20 - 6 = 124\,mm$ (cover, $d_b/2$)

$V_{ud} = 11.52\left(\frac{6}{2} - 0.124\right) = 33.13\ kN$

$\phi V_c = \frac{0.75}{6}\sqrt{30} \times 1000 \times 124 \times 10^{-3} = 84.9\ kN$

$\because V_{ud} < \phi V_c \Longrightarrow \therefore$ the thickness is adiqute for shear

نوع البلاطة	العزوم	الاتجاه القصير						الاتجاه الطويل
		نسبة العرض الى الطول (m)						لجميع قيم (m)
		1.0	0.9	0.8	0.7	0.6	0.5	
بلاطة داخلية 	$M_{\bar{u}cont}$	0.033	0.040	0.048	0.055	0.063	0.083	0.033
	$M_{\bar{u}disc}$	—	—	—	—	—	—	—
	M_u^+	0.025	0.030	0.036	0.041	0.047	0.062	0.025
أحد الحافات غير مستمرة 	$M_{\bar{u}cont}$	0.041	0.048	0.055	0.062	0.069	0.085	0.041
	$M_{\bar{u}disc}$	0.021	0.024	0.027	0.031	0.035	0.042	0.021
	M_u^+	0.031	0.036	0.041	0.047	0.052	0.064	0.031
حافتان غير مستمرة 	$M_{\bar{u}cont}$	0.049	0.057	0.064	0.071	0.078	0.09	0.049
	$M_{\bar{u}disc}$	0.025	0.028	0.032	0.036	0.039	0.045	0.025
	M_u^+	0.037	0.043	0.048	0.054	0.059	0.068	0.037
ثلاث حافات غير مستمرة 	$M_{\bar{u}cont}$	0.058	0.066	0.074	0.082	0.090	0.098	0.058
	$M_{\bar{u}disc}$	0.029	0.033	0.037	0.041	0.045	0.049	0.029
	M_u^+	0.044	0.050	0.056	0.062	0.068	0.074	0.044
جميع الحافات غير مستمرة 	$M_{\bar{u}cont}$	—	—	—	—	—	—	—
	$M_{\bar{u}disc}$	0.033	0.038	0.043	0.047	0.053	0.055	0.033
	M_u^+	0.050	0.057	0.064	0.072	0.080	0.083	0.050

ملاحظات

1- النهاية الوثرة يقصد بها مستمرة

2- الرموز $M_{\bar{u}cont}$ = العزم السالب للنهاية المستمرة .

$M_{\bar{u}disc}$ = العزم السالب للنهاية غير المستمرة

M_u^+ = العزم الموجب .

4- Max. & Min. ratios of Steel Reinforcement:

$\rho_{max} = (0.85)^2 * \frac{30}{400} * \frac{0.003}{0.003+0.004}$, $\varepsilon_t = 0.004$ $= 0.02322$

$A_{s\,min} = 0.0018bh = 0.0018 * 1000 * 150 = 270\ mm^2/m$

5- Calculating of BM_s.

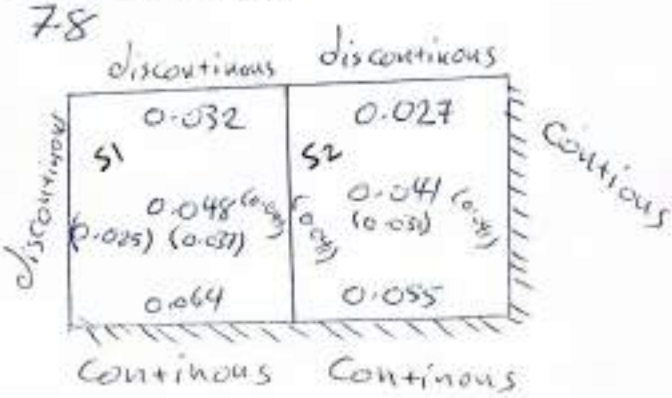
$S \leqslant \begin{cases} c/c \text{ of short span length} = 6 + 0.3 = 6.3m \\ \text{clear length of short span} + 2h = 6 + 2*0.15 = 6.3m \end{cases}$

take the smallest value $\therefore S = 6.3m$

$L \leqslant \begin{cases} 7.5 + 0.3 = 7.8\ m \\ 7.5 + 2 \times 0.15 = 7.8\ m \end{cases}$

$\therefore L = 7.8m$

$m = \frac{6.3}{7.8} = 0.808$



* Bending Moments in short direction

- Slab S1

$M_{\bar{u}\,disc.} = 0.032 * 11.52 * 6.3^2 = 0.032 * 457.23 = 14.63$ kN.m/m

$M_u^+ = 0.048 * 457.23 = 21.95$ kN.m/m

$M_{\bar{u}\,cont.} = 0.064 * 457.23 = 29.26$ kN.m/m

- Slab S2

$M_{\bar{u}\,disc} = 0.027 * 457.23 = 12.35$ kN.m/m

$M_u^+ = 0.041 * 457.23 = 18.75$ kN.m/m

$M_{\bar{u}\,Con} = 0.055 * 457.23 = 25.15$ kN.m/m

* Bending Moments in long direction.

- Slab S1

$M_{\bar{u}\,disc} = 0.025 * 457.23 = 11.43$ kN.m/m

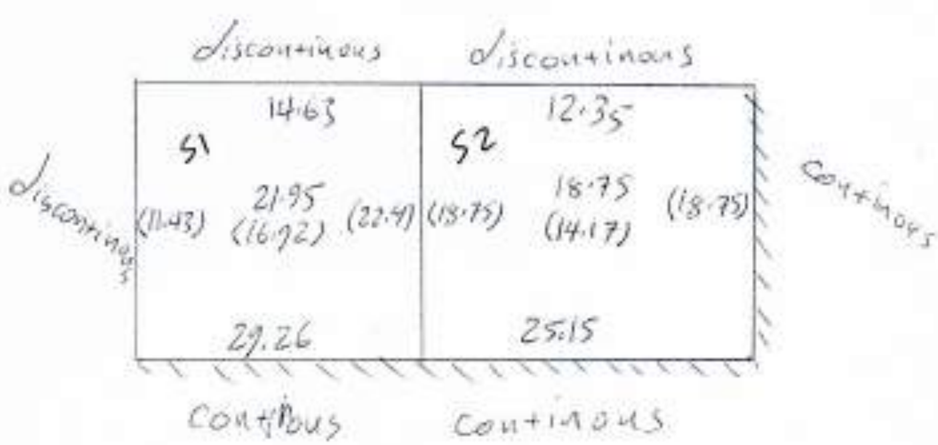
$M_u^+ = 0.037 * 457.23 = 16.92$ kN.m/m

$M_{\bar{u}\,cont.} = 0.049 * 457.23 = 22.4$ kN.m/m

- Slab S2

$M_{\bar{u}\,cont.} = 0.041 * 457.23 = 18.75$ kN.m/m

$M_u^+ = 0.031 * 457.23 = 14.17$ kN.m/m



Steel Reinforcement

a- Short Direction:-

$k = \frac{M_u}{f'_c b d^2}$, $\omega = \rho \frac{f_y}{f'_c}$, $\rho =$ from Table (p4)

$k = \frac{M_u}{\phi f'_c b d^2}$

Reinforcement for middle strip in short direction (S1)

Moment	K	ω	ρ	$A_s = \rho b d$	A_s Provided	A_s added
$M_u^+ = 21.95$	0.053	0.055	0.0041	512	ϕ10/150 (526)	——
$M_{u\,disc}^- = 14.63$	0.035	0.036	0.0027	335	ϕ10/300 (263)	ϕ 8/300 (167)
$M_{u\,cont}^- = 29.26$	0.070	0.074	0.0056	695	ϕ 10/150 (526)	ϕ 10/300 (263)

$\rho_{max} = 0.0232$, $\rho_t = 0.0203$, $A_{s\,min} = 0.002bh$

$A_{s\,min} = 0.00180 * 1000 * 150 = 270.0\ mm^2/m$

* All ρ value < $\rho_{max} = 0.0252$ ∴ o.k.
* All ρ value < $\rho_t = 0.0203$ ⟹ $\phi = 0.9$
* All $A_s > A_{s\,min}$ =

$S = \frac{1000}{A_s/A_b} = \frac{1000 * 79}{512} = 154\ mm$

Use $S = 150\ mm$ c/c

50% of bars will be bend X then (A_s provided) is found

$A_s = \frac{1000}{S} A_b$

Reinforcement for middle strip in short direction (S_2)

Moment	K	ω	ρ	$A_s = \rho b d$ mm^2	A_s provided mm^2	A_s add mm^2
$M_u^+ = 18.75$	0.045	0.047	0.0035	434	ϕ10/180 (435)	—
$M_{u\,disc}^- = 12.35$	0.030	0.031	0.0023	286	ϕ10/360 (219)	ϕ8/360 (139)
$M_{u\,con}^- = 25.15$	0.060	0.063	0.0047	583	ϕ10/180 (438)	ϕ10/360 (219)

All value of ρ & A_s is ok for ρ_{max}, ρ_t & $A_{s\,min}$.

- for vertical strip the steel reinforcement $= \frac{2}{3}$ of steel reinforcement for middle strip.

* Spacing of vertical strip $= 1.5 * S$ of middle strip
* S must not be more than $(2h)$.
* A_s for vertical strip $\geq A_{s\,min}$.
* In practical case $A_{s\,vertical\,strip} = A_{s\,middle\,strip}$ but in that case there are lost in steel reinforcement.

- Steel Reinforcement in Long Direction:

$d = h - (1.5 d_b + 20) = 150 - (1.5 * 12 + 20) = 112\ mm$

This Reinforcement is putted on the steel of short direction.

Reinforcement of Long Direction.

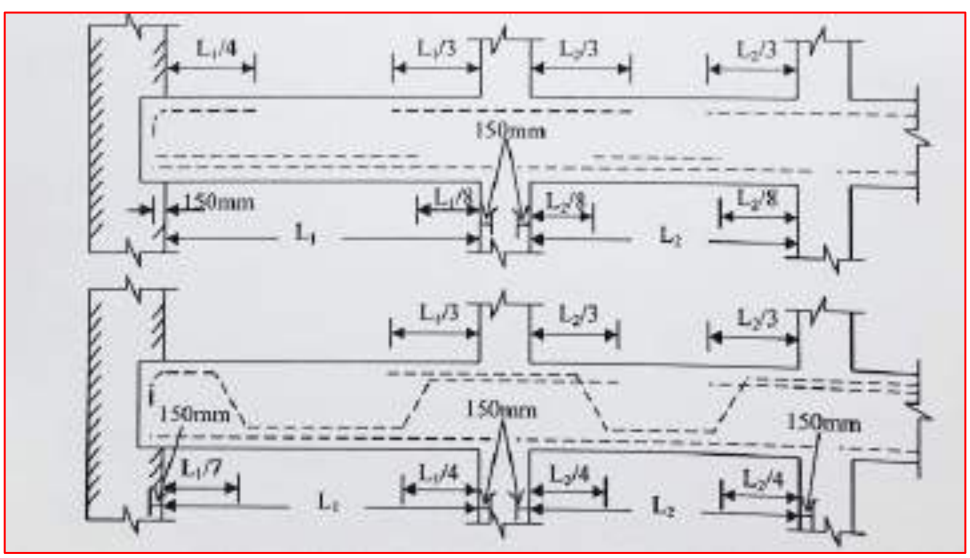
Moment kN.m	k	ω	ρ	$A_s=\rho bd$	A_s provided	A_s add.
$M_u^+ = 16.92$	0.05	0.052	0.0039	437	∅10/180 (438)	—
$M^-_{u\,disc.} = 11.9$	0.039	0.055	0.0026	292	∅10/360 (219)	∅8/360 (139)
$M^-_{u\,cont.} = 22.4$	0.066	0.069	0.0052	583	∅10/180 (438)	∅10/360 (219)

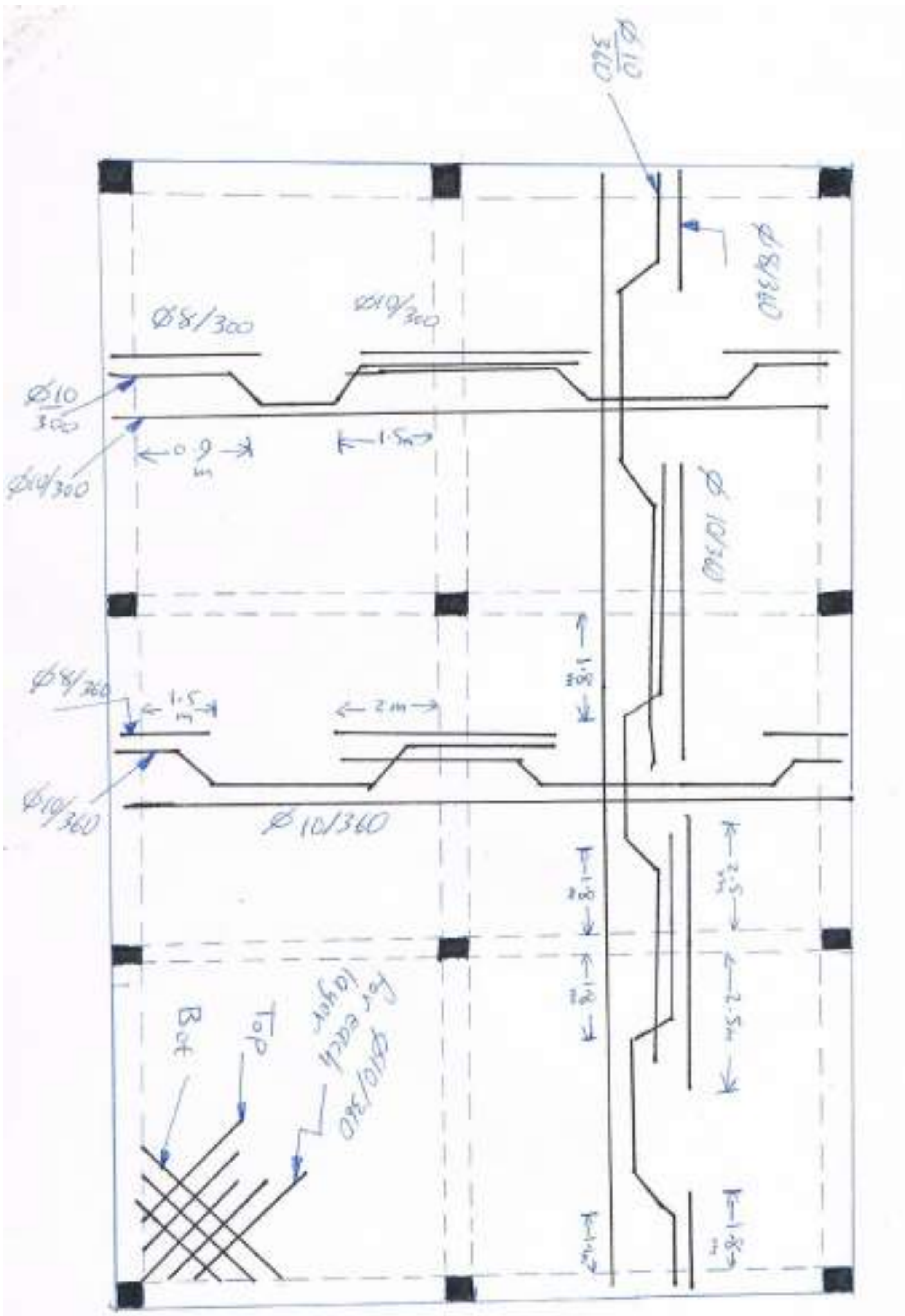
* For Torsion Reinforcement the same diameters & spacing of Posotive Reinforcement in short direction can be used.

- The Load which applied on beam (B_1) equal to:-

$$W_e = \frac{W_s}{3}\,\frac{(3-m^2)}{2} = \frac{11.52 * 6.3}{3}\,\frac{(3-0.8^2)}{2} * 2 = 57\ kN/m$$

* Torsion Reinforcement Must put for every Corner.




Ø10/300
Ø8/300
Ø10/300
Ø8/360
Ø10
300
Ø10/300
0.9 m
1.5m
Ø10/360
Ø8/360
1.5 m
2m
Ø10/360
Ø10/360
1.8
2.5m
Bot
Top
for each layer
Ø10/360

العلاقة بين المقاومة الاسمية للانحناء و نسبة التسليح

ω	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
	$k = M_n / f'_c bd^2 = M_u / \phi f'_c bd^2$									
0	0	0.0010	0.0020	0.0030	0.0040	0.0050	0.0060	0.0070	0.0080	0.0090
0.01	0.0099	0.0109	0.0119	0.0129	.0139	0.0149	0.0159	0.0168	0.0178	0.0188
0.02	0.0197	0.0207	0.0217	0.0226	0.0236	0.0246	0.0256	0.0266	0.0275	0.0285
0.03	0.0295	0.0304	0.0314	0.0324	0.0333	0.0343	0.0352	0.0362	0.0372	0.0381
0.04	0.0391	0.0400	0.0410	0.0420	0.0429	0.0438	0.0448	0.0457	0.0467	0.0476
0.05	0.0485	0.0495	0.0504	0.0513	0.0523	0.0532	0.0541	0.0551	0.0560	0.0569
0.06	0.0579	0.0588	0.0597	0.0607	0.0616	0.0625	0.0634	0.0643	0.0653	0.0662
0.07	0.0671	0.0680	0.0689	0.0699	0.0708	0.0717	0.0726	0.0735	0.0744	0.0753
0.08	0.0762	0.0771	0.0780	0.0789	0.0798	0.0807	0.0816	0.0825	0.0834	0.0843
0.09	0.0852	0.0861	0.0870	0.0879	0.0888	0.0897	0.0906	0.0915	0.0923	0.0932
0.10	0.0941	0.0950	0.0959	0.0967	0.0976	0.0985	0.0994	0.1002	0.1011	0.1020
0.11	0.1029	0.1037	0.1046	0.1055	0.1063	0.1072	0.1081	0.1089	0.1098	0.1106
0.12	0.1115	0.1124	0.1133	0.1141	0.1149	0.1158	0.1166	0.1175	0.1183	0.1192
0.13	0.1200	0.1209	0.1217	0.1226	0.1234	0.1243	0.1251	0.1259	0.1268	0.1276
0.14	0.1284	0.1293	0.1301	0.1309	0.1318	0.1326	0.1334	0.1342	0.1351	0.1359
0.15	0.1367	0.1375	0.1384	0.1392	0.1400	0.1408	0.1416	0.1425	0.1433	0.1441
0.16	0.1449	0.1457	0.1465	0.1473	0.1481	0.1489	0.1497	0.1506	0.1514	0.1522
0.17	0.1529	0.1537	0.1545	0.1553	0.1561	0.1569	0.1577	0.1585	0.1593	0.1601
0.18	0.1609	0.1617	0.1624	0.1632	0.1640	0.1648	0.1656	0.1664	0.1671	0.1679
0.19	0.1687	0.1695	0.1703	0.1710	0.1718	0.1726	0.1733	0.1741	0.1749	0.1756
0.20	0.1764	0.1772	0.1779	0.1787	0.1794	0.1802	0.1810	0.1817	0.1825	0.1832
0.21	0.1840	0.1847	0.1855	0.1862	0.1870	0.1877	0.1885	0.1892	0.1900	0.1907
0.22	0.1914	0.1922	0.1929	0.1937	0.1944	0.1951	0.1959	0.1966	0.1973	0.1981
0.23	0.1988	0.1995	0.2002	0.2010	0.2017	0.2024	0.2031	0.2039	0.2046	0.2053
0.24	0.2060	0.2067	0.2075	0.2082	0.2089	0.2094	0.2103	0.2110	0.2117	0.2124
0.25	0.2131	0.2138	0.2145	0.2152	0.2159	0.2166	0.2173	0.2180	0.2187	0.2194
0.26	0.2201	0.2208	0.2215	0.2222	0.2229	0.2236	0.2243	0.2249	0.2256	0.2263
0.27	0.2270	0.2277	0.2284	0.2290	0.2297	0.2304	0.2311	0.2317	0.2324	0.2331
0.28	0.2337	0.2344	0.2351	0.2357	0.2364	0.2371	0.2377	0.2384	0.2391	0.2397
0.29	0.2404	0.2410	0.2417	0.2423	0.2430	0.2437	0.2443	0.2450	0.2456	0.2463
0.30	0.2469	0.2475	0.2482	0.2488	0.2495	0.2501	0.2508	0.2514	0.2520	0.2527
0.31	0.2533	0.2539	0.2546	0.2552	0.2558	0.2565	0.2571	0.2577	0.2583	0.2590
0.32	0.2596	0.2602	0.2608	0.2614	0.2621	0.2627	0.2633	0.2639	0.2645	0.2651
0.33	0.2657	0.2664	0.2670	0.2676	0.2682	0.2688	0.2694	0.2700	0.2706	0.2712
0.34	0.2718	0.2724	0.2730	0.2736	0.2742	0.2748	0.2754	0.2760	0.2766	0.2771
0.35	0.2777	0.2783	0.2789	0.2795	0.2801	0.2807	0.2812	0.2818	0.2824	0.2830
0.36	0.2835	0.2841	0.2847	0.2853	0.2858	0.2864	0.2870	0.2875	0.2881	0.2887
0.37	0.2892	0.2898	0.2904	0.2909	0.2915	0.2920	0.2926	0.2931	0.2937	0.2943
0.38	0.2948	0.2954	0.2959	0.2965	0.2970	0.2975	0.2981	0.2986	0.2992	0.2997
0.39	0.3003	0.3008	0.3013	0.3019	0.3024	0.3029	0.3035	0.3040	0.3045	0.3051
0.40	0.3056	0.3061	0.3066	0.3072	0.3077	0.3082	0.3087	0.3093	0.3098	0.3103