HOLLOW BLOCK SLABS

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LAYOUT

- General Idea
- Types of Hollow Block Slabs
- Code Requirements and Concrete Dimensions
- Design of One Way Hollow Block Slabs
    - Examples
- Design of Two Way Hollow Block Slabs
    - Example
- Design of Beams Supporting Hollow Block Slabs

GENERAL IDEA

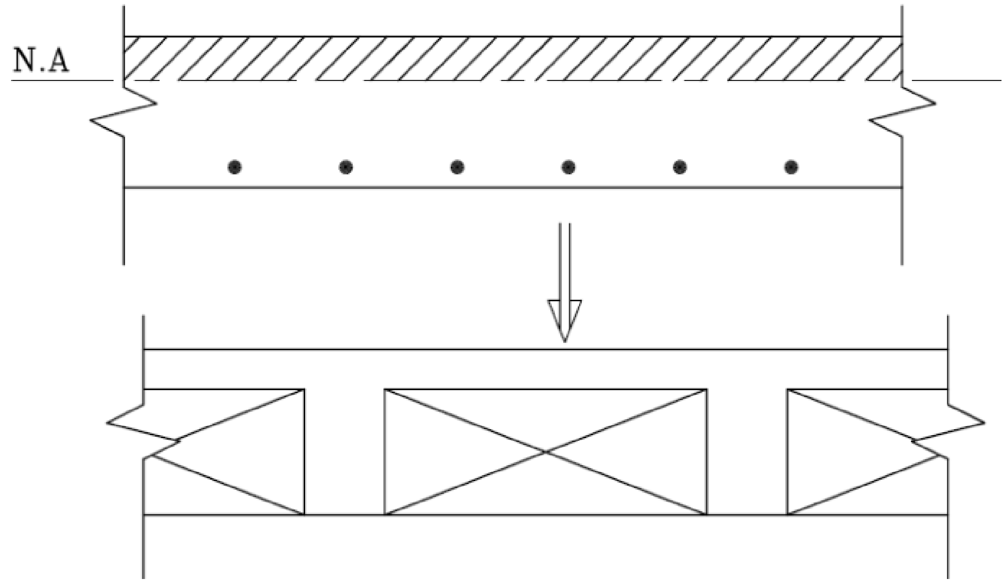
- At t_s = 12 cm

Slab o.w. = 45% from total weight

- At t_s = 20 cm

Slab o.w. = 70% from total weight

- Concrete **is not** effective below N.A.
- For large t_s, it is better to remove un-needed concrete.



Ribbed and Waffle slabs

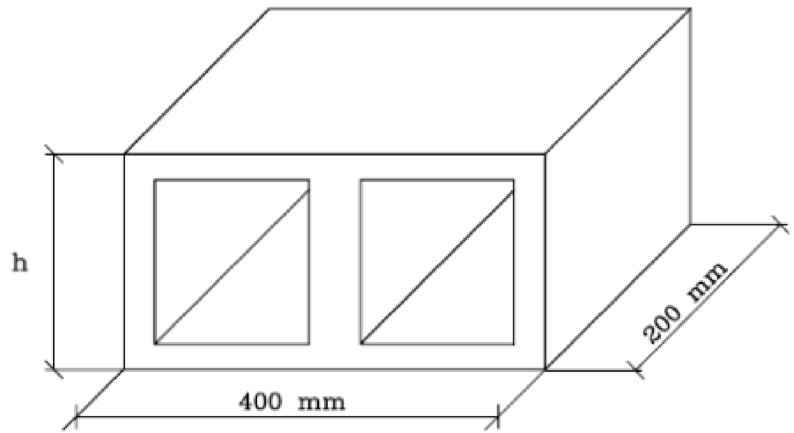
Hollow Core Slabs

HOLLOW BLOCK SLABS

- Hollow block slabs are made using hollow cement blocks or foam blocks

Blocks

h	weight
150 mm	0.10 kN
200 mm	0.15 kN
250 mm	0.20 kN



- Foam blocks are made to the client required dimensions

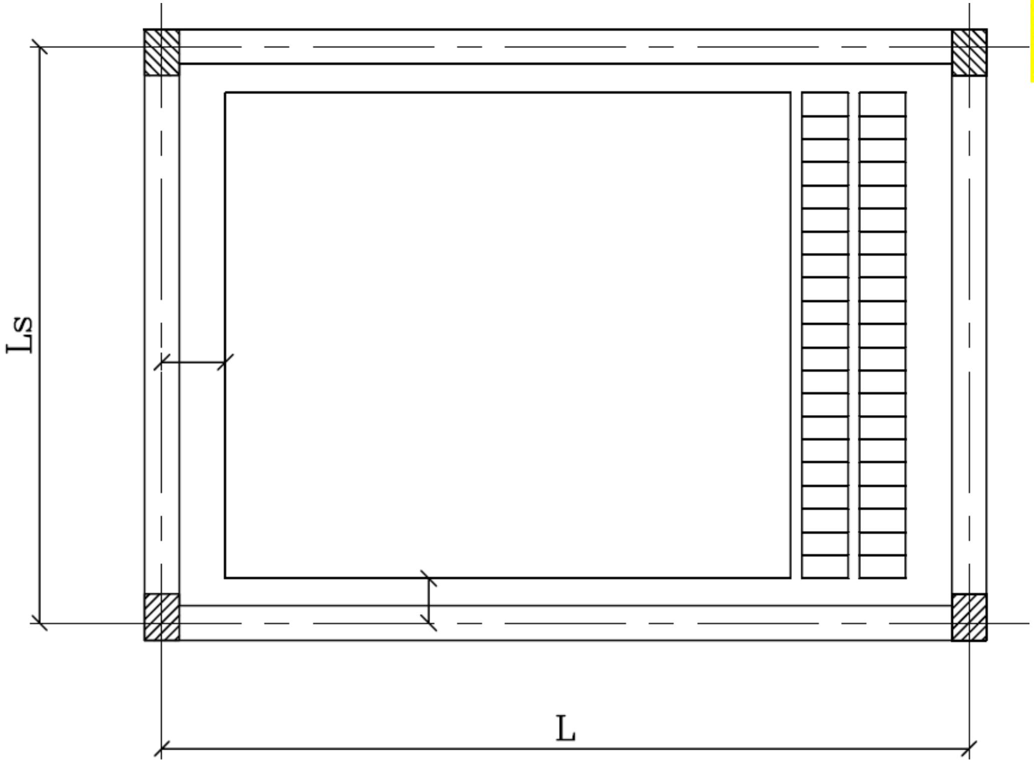
SITE Photos

CEMENT BLOCKS

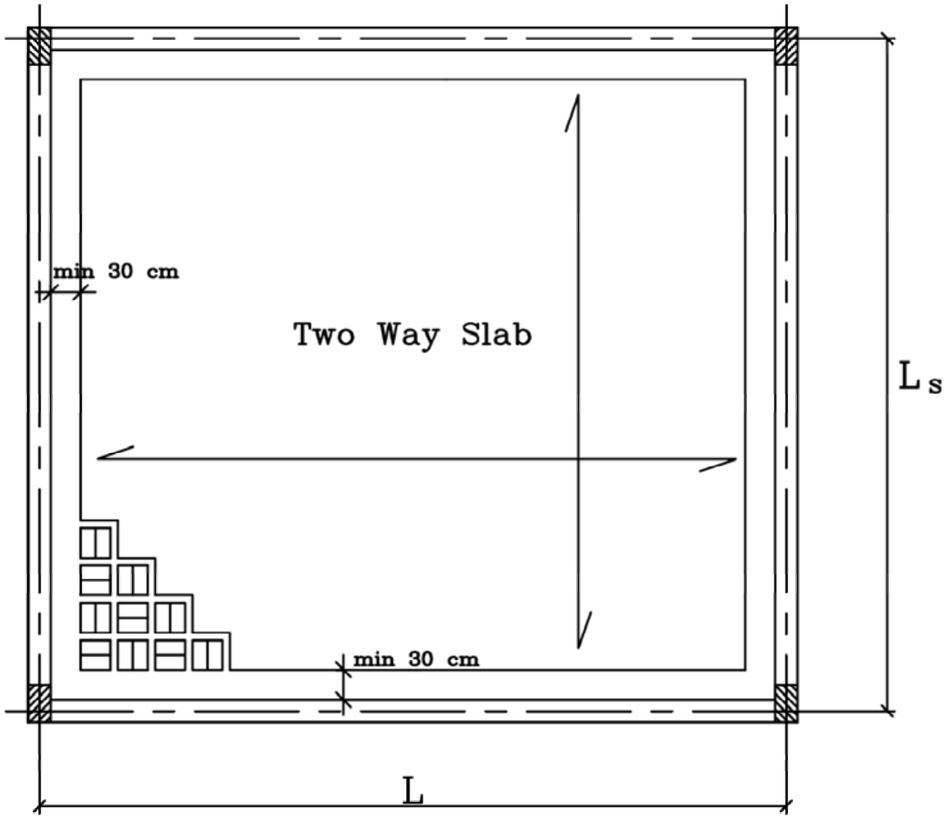
FOAM BLOCKS

SITE PHOTOS

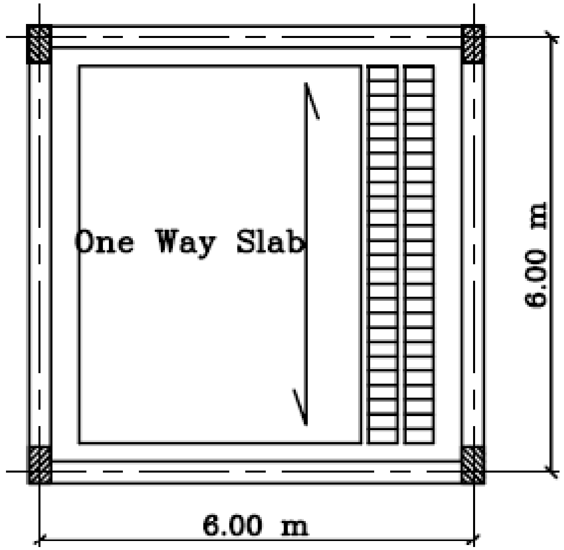
One way and two way slabs

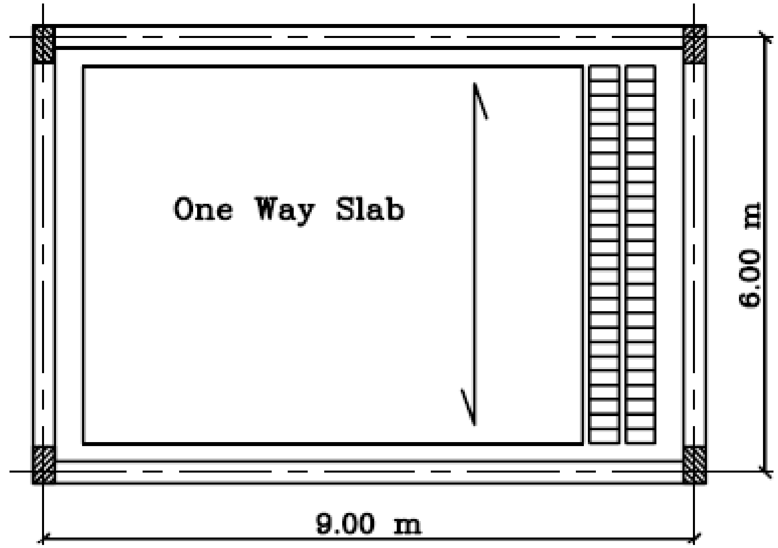


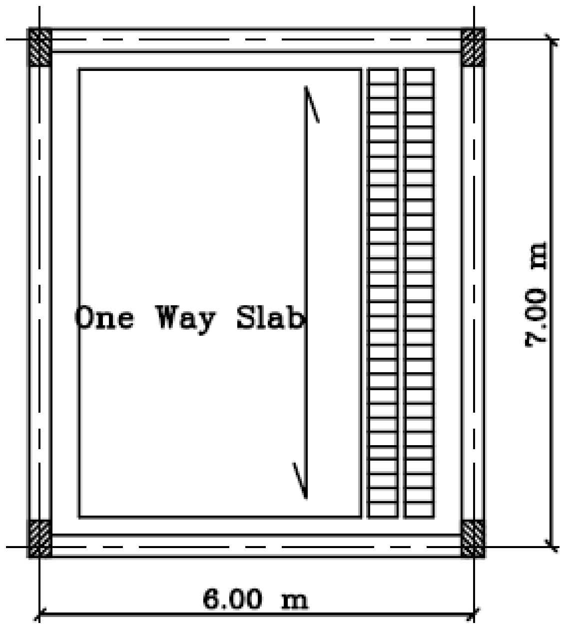
One way and two way slabs



One way and Two way



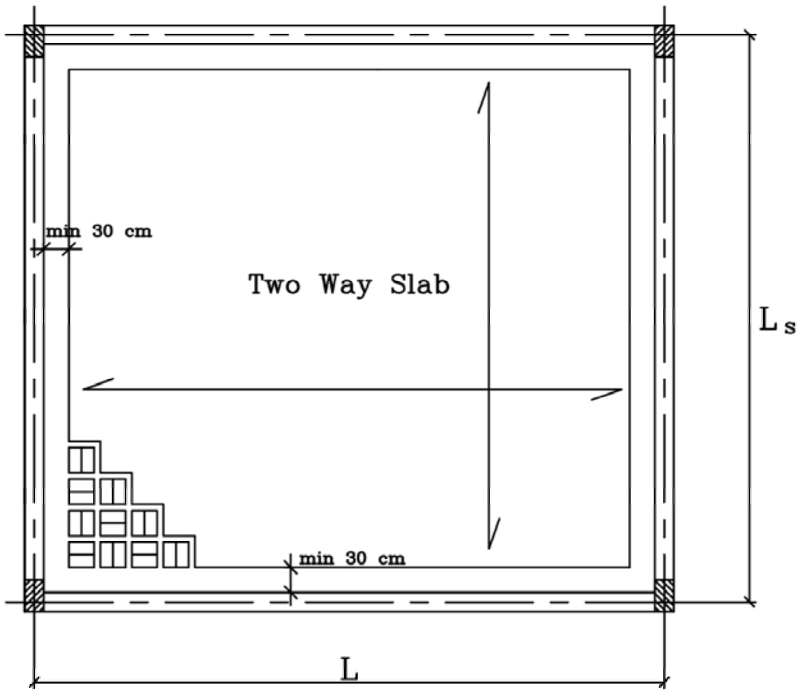




- The arrangement of blocks control the type of slab (regardless of slab dimensions)
- In general, one way if loaded direction less than 7-8 meters

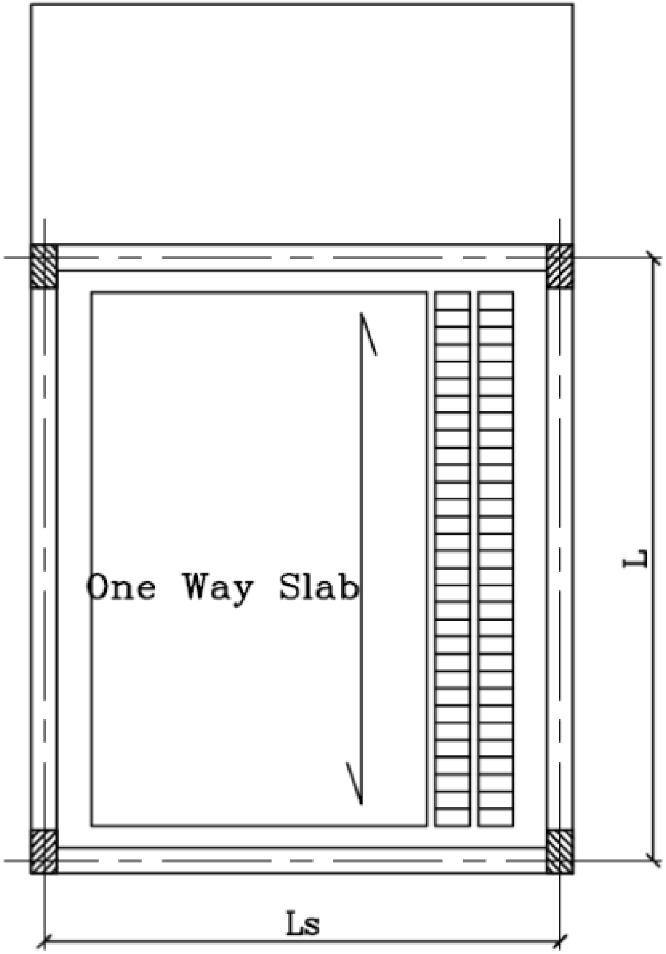
One way and Two way

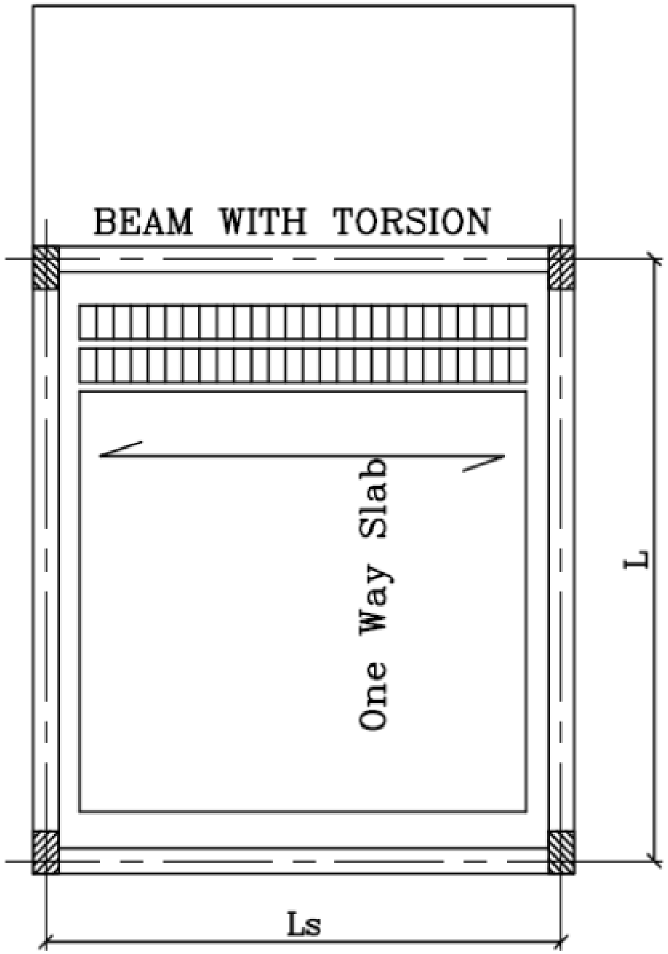
- In general, two way if short direction is more than 7-8 meters
- Condition L/Ls<1.50
- Two way slab is not recommended when L/Ls>4/3



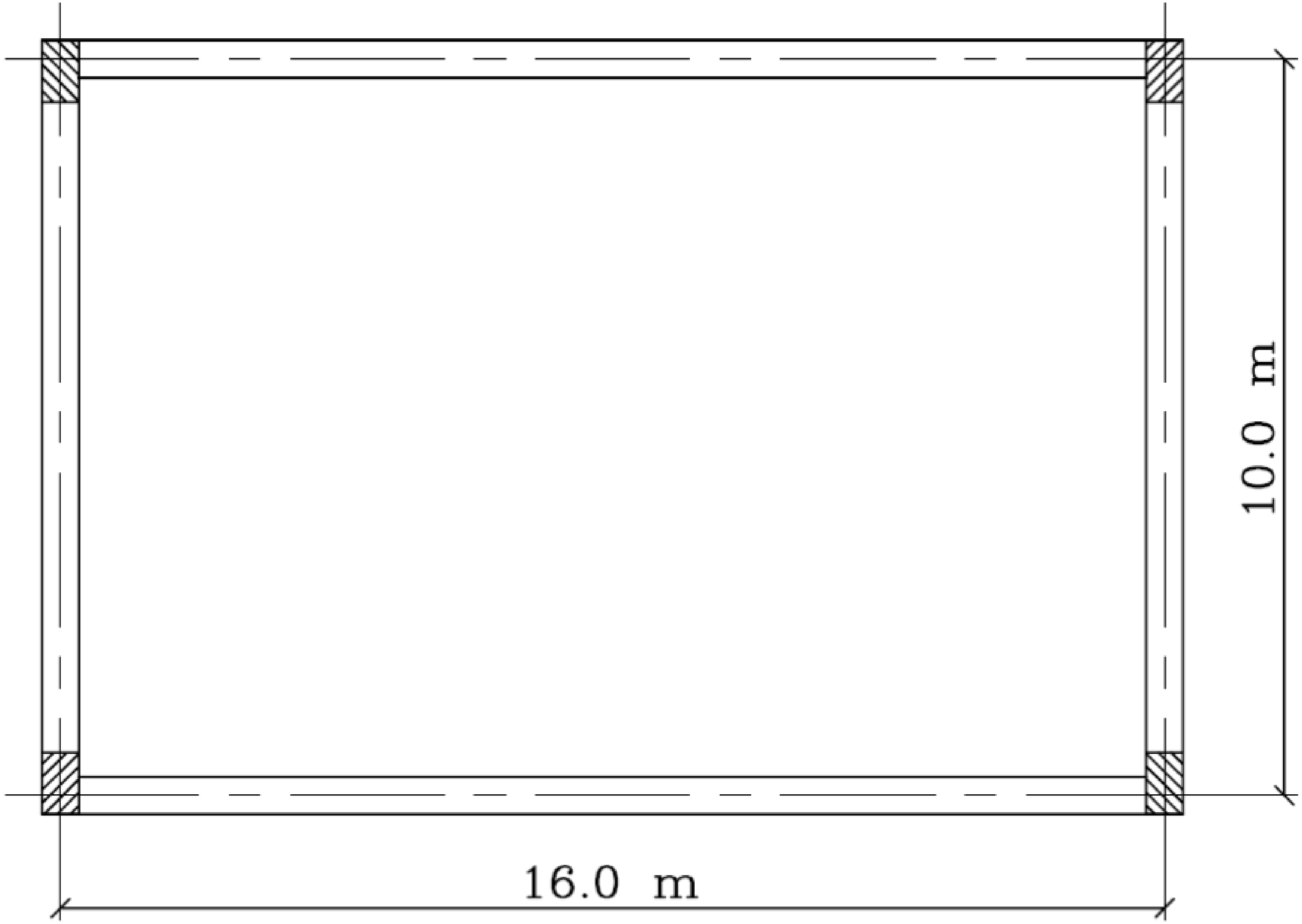
ملحوظة مهمة: لا يوجد ما يمنع عمل بلاطة في اتجاهين مع بحور أصغر من ٧ متر.

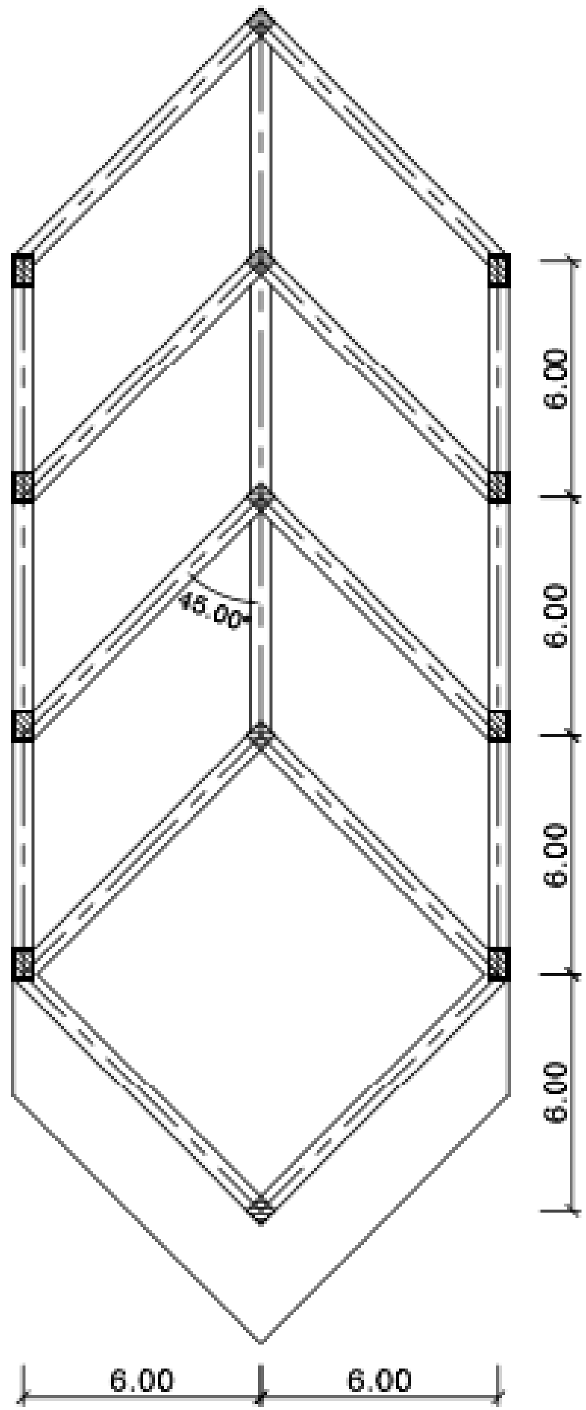
One way and Two way

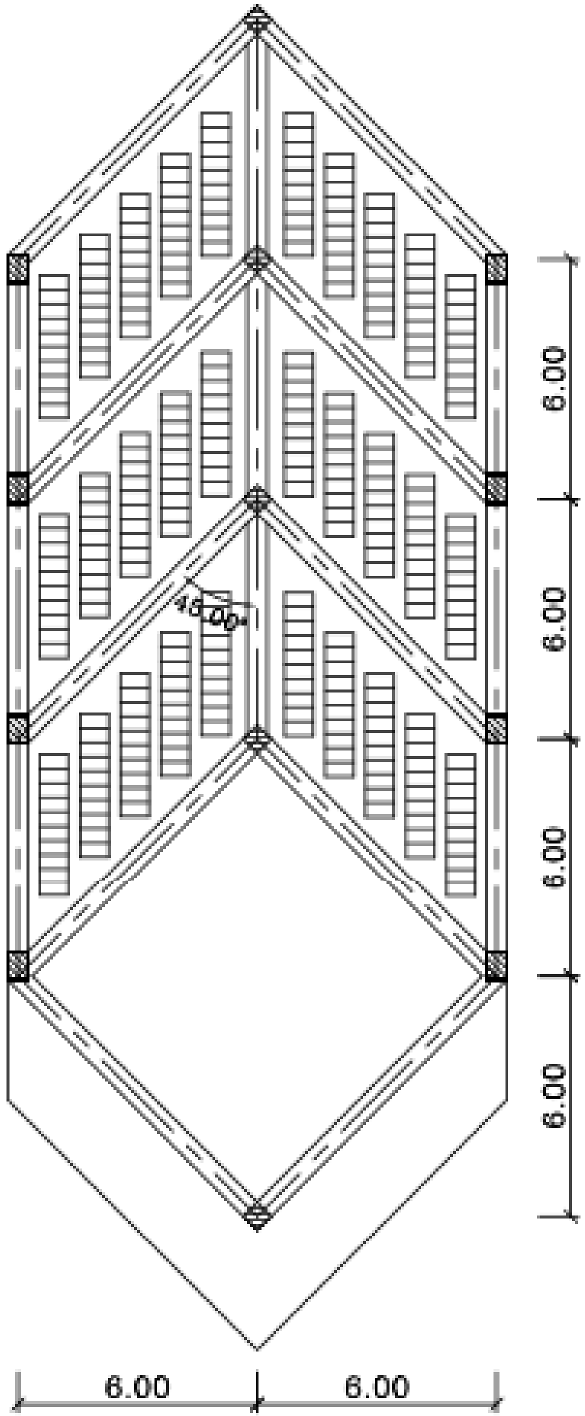




One way and Two way

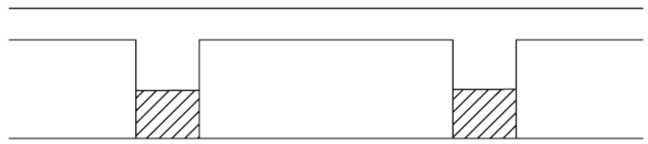



6.00
6.00
6.00
6.00
45.00°
6.00
6.00


6.00
6.00
6.00
6.00
45.00°
6.00
6.00

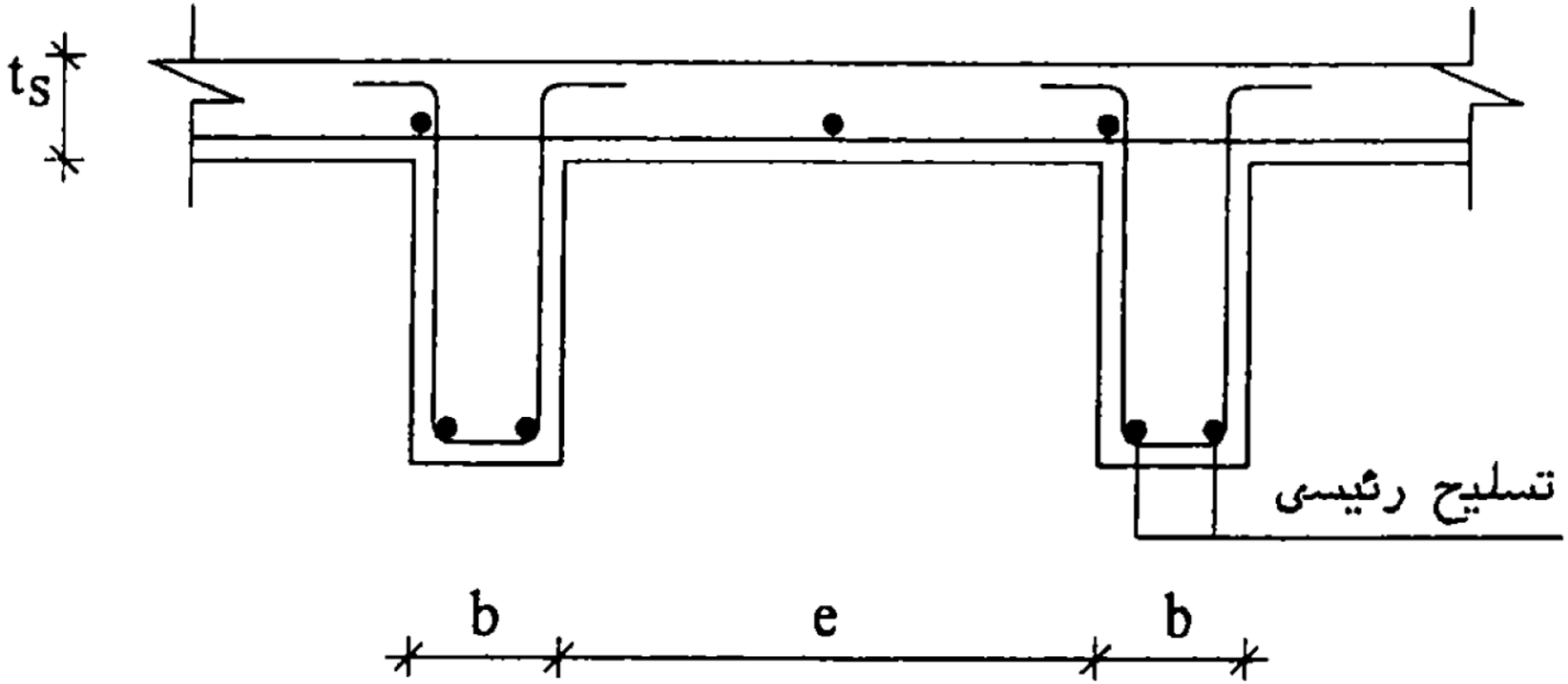
When not to use HB Slabs

- Slabs are not most suitable for negative moment regions
  - Do not use in cantilevers



- Do not use in bath rooms
- Do not use in dynamic loads
  - Bridges
  - Factories

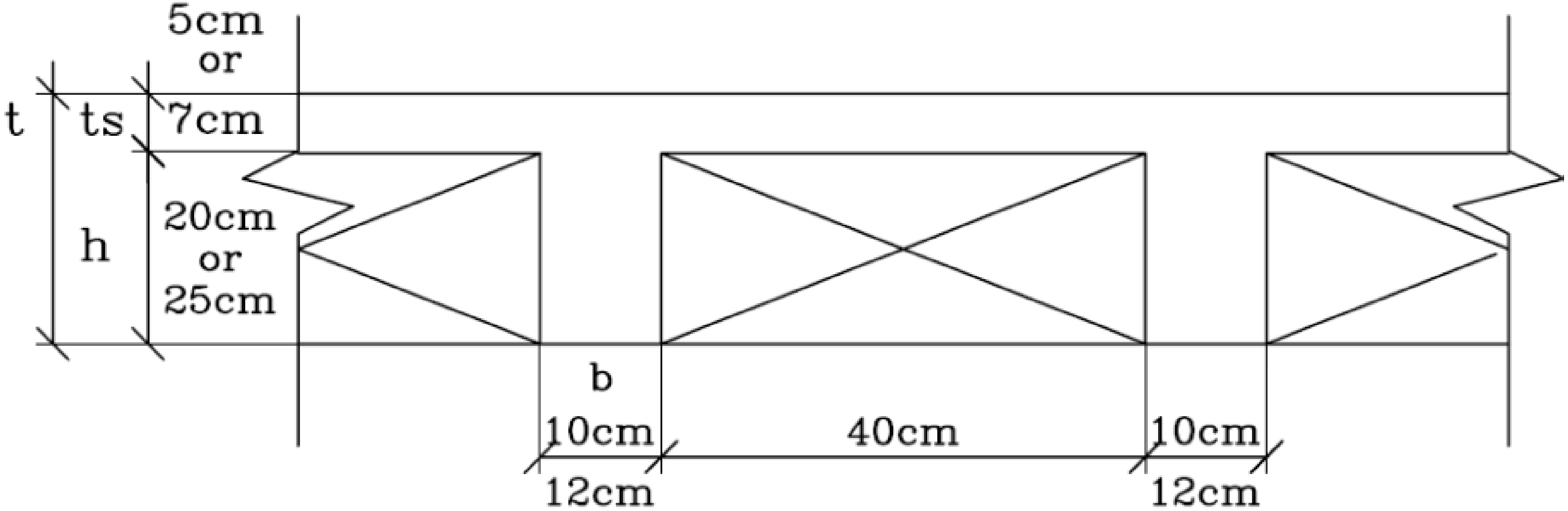
CODE REQUIREMENTS



Code Page 6-16

e	بحد أقصى ٧٠٠ مم
b	١٠٠ مم أو $t/3$ أيهما أكبر
t_s	٥٠ مم أو $e/10$ أيهما أكبر

POPULAR DIMENSIONS IN EGYPT

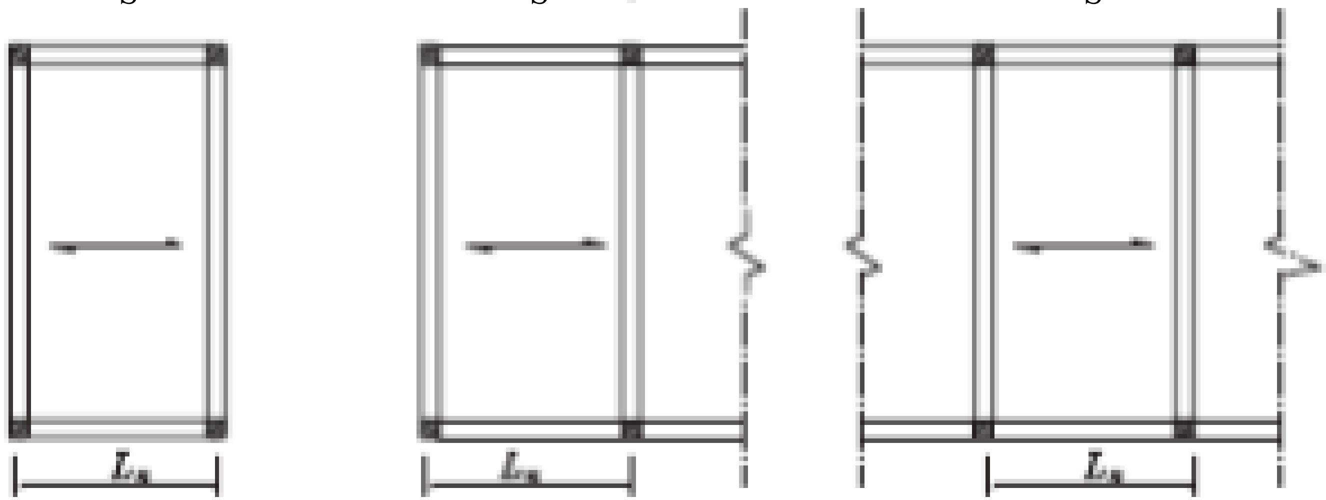


DESIGN OF ONE WAY H.B. SLABS

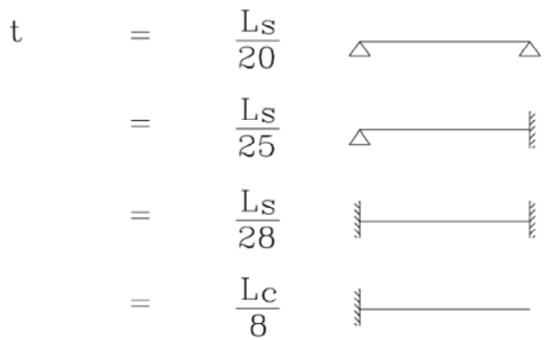
- **Slab thickness**

  Minimum slab thickness as per ECP is:

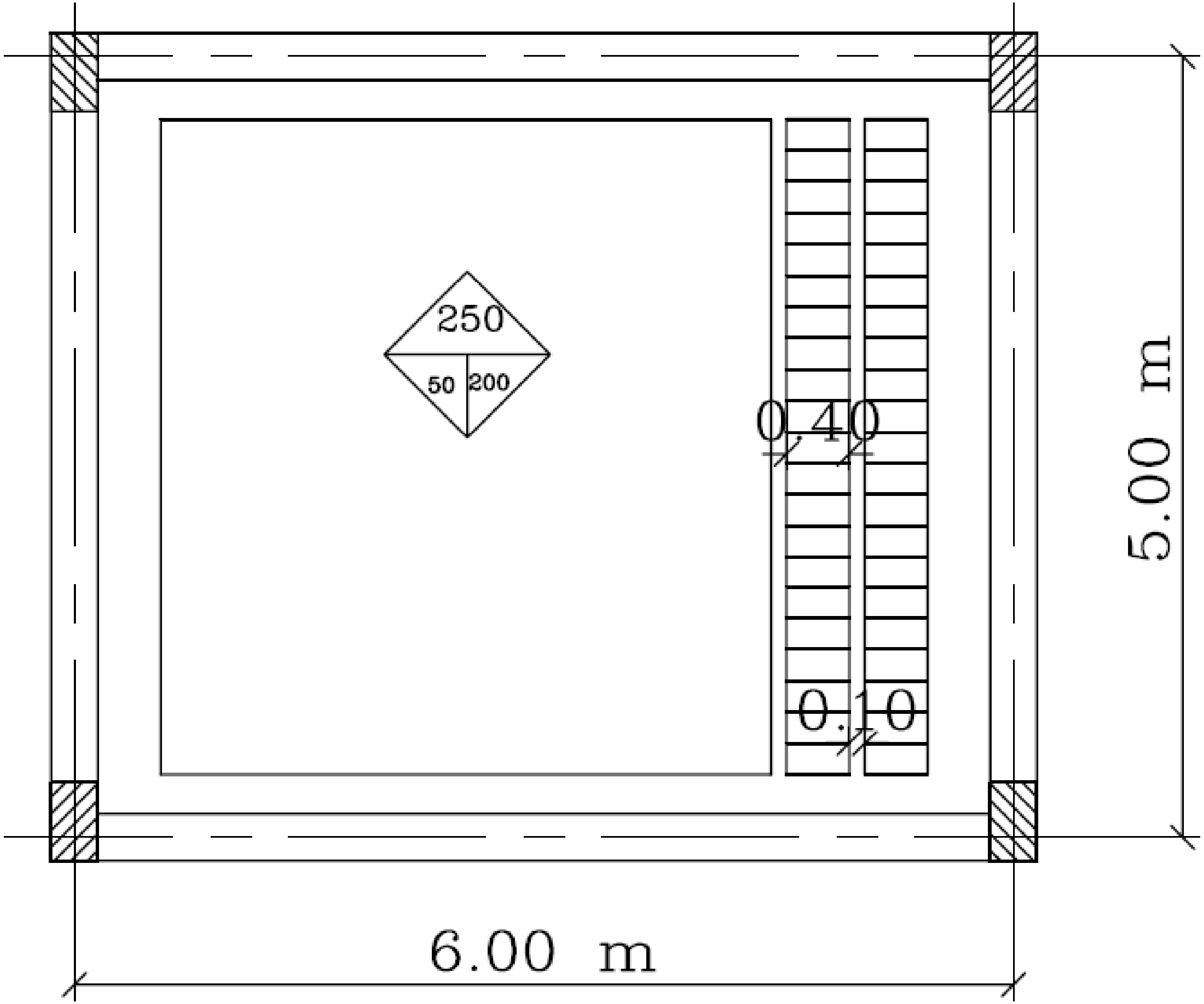
$t \geq L_S/20$ $t \geq L_S/25$ $t \geq L_S/28$



For Cantilevers $t \geq L_c/8$



EXAMPLE



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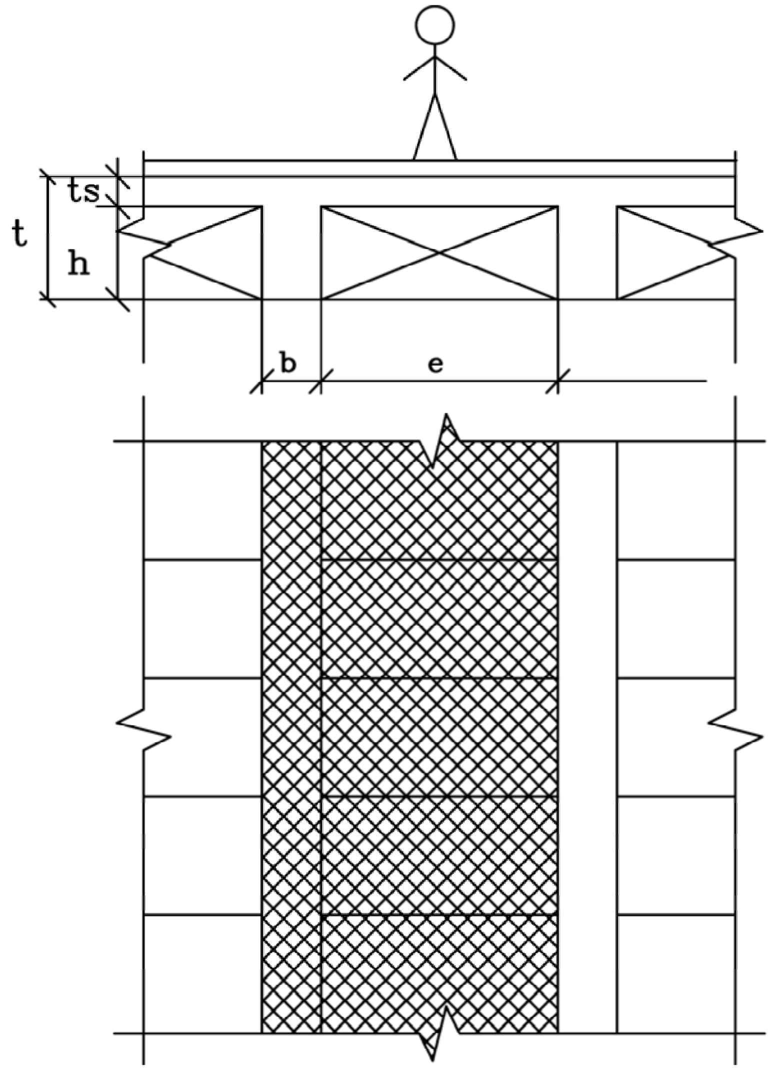
DESIGN OF ONE WAY H.B. SLABS

- **Calculation of load**

Consider an area of (e+b) x 1.00 meter

In case of block width=0.20 meter



$$o.w.^{*} = t_s \gamma_c (1.0)(e+b) + b(t-t_s)\gamma_c + 5\text{weight of blocks}$$

$$o.w.(kN/m^2) = \frac{o.w.^{*}}{(e+b)}$$

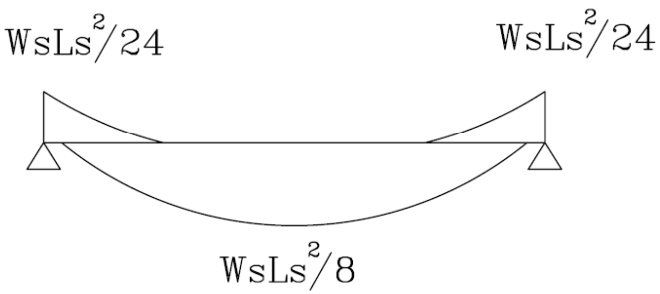
$$w_{su} = 1.4(o.w. + F.C) + 1.6(L.L.)$$

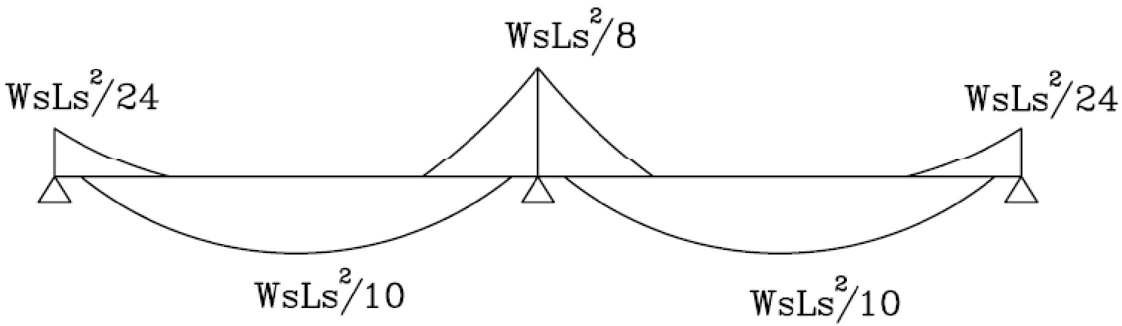
OR

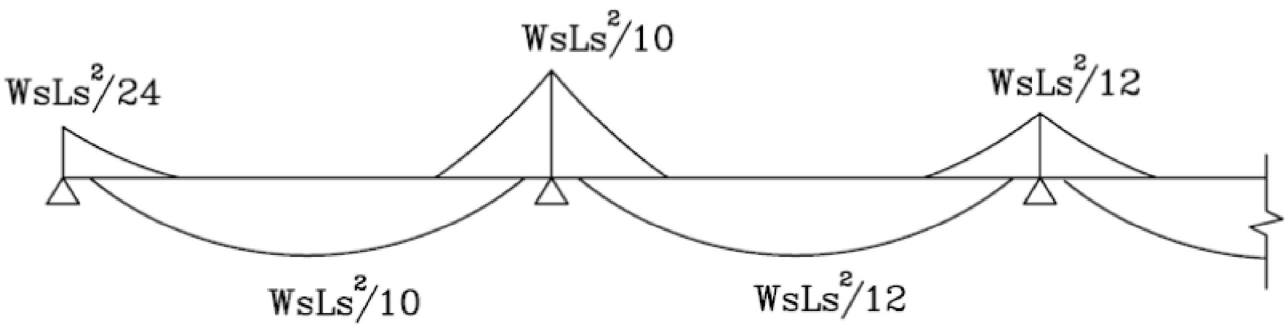
$$w_{su} = 1.5(o.w. + F.C + L.L.)$$

DESIGN OF ONE WAY HOLLOW BLOCK SLABS

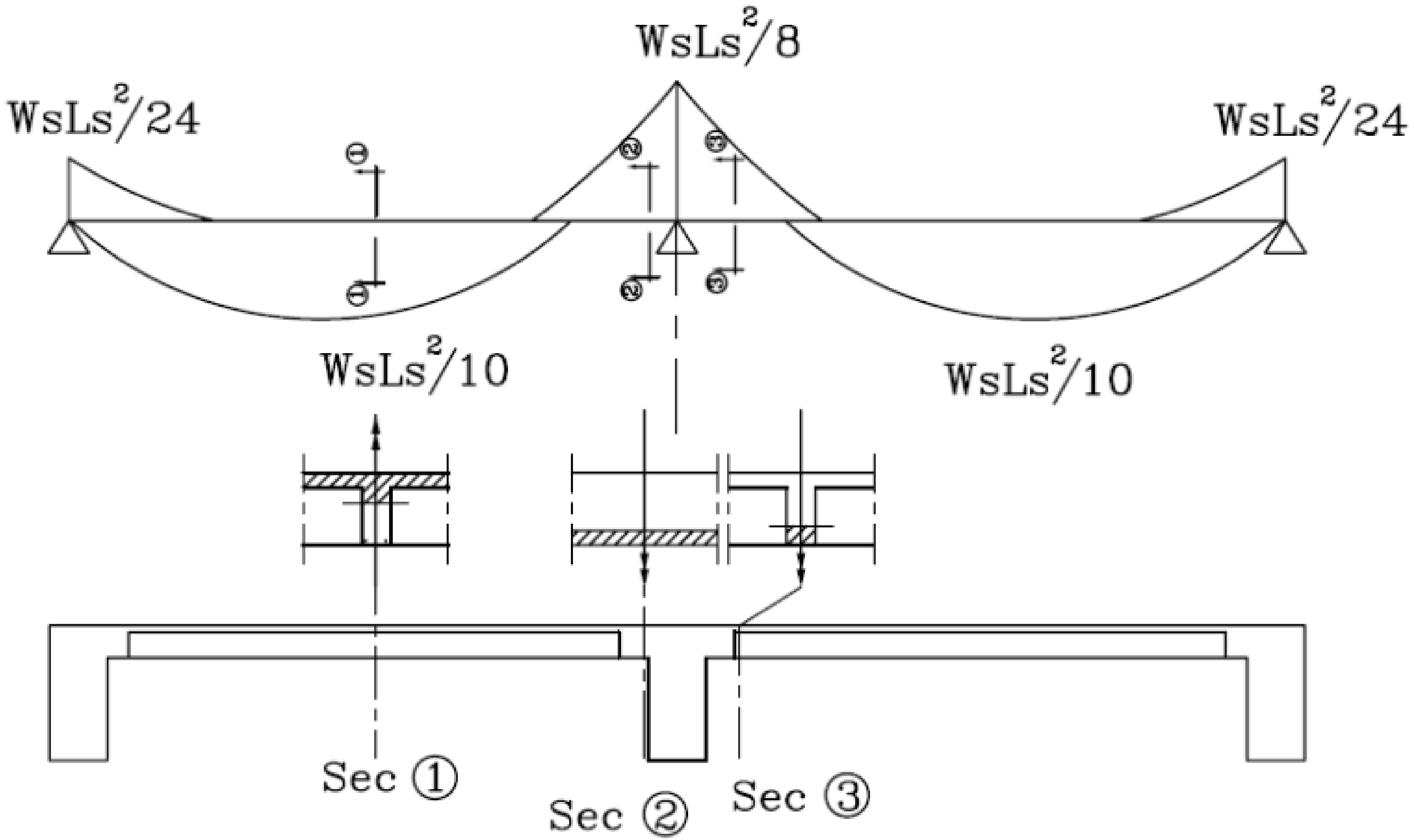
- Take 1 meter strip width
- Get straining actions (moment and shear)
- Design for moment
- Check shear
- Draw rft







DESIGN OF ONE WAY H.B. SLABS



DESIGN OF ONE WAY H.B. SLABS

- **Design of critical sections**
  - *Positive moments* ***(At Mid-Span)***

Sec. (1)

$$M / rib = M / m' * (e + b)$$

$$B = e + b \quad mm$$

$$d = t - 35 \quad mm$$

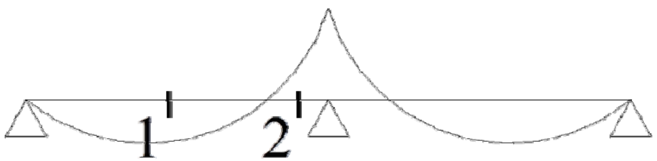
$$d = c_1 \sqrt{\frac{M}{fcu * B}}$$

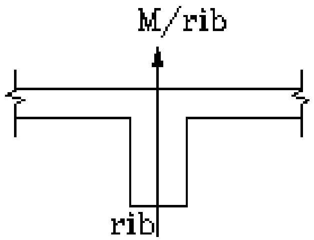
$$c_1 = \ldots\ldots \qquad j = \ldots\ldots\ldots$$

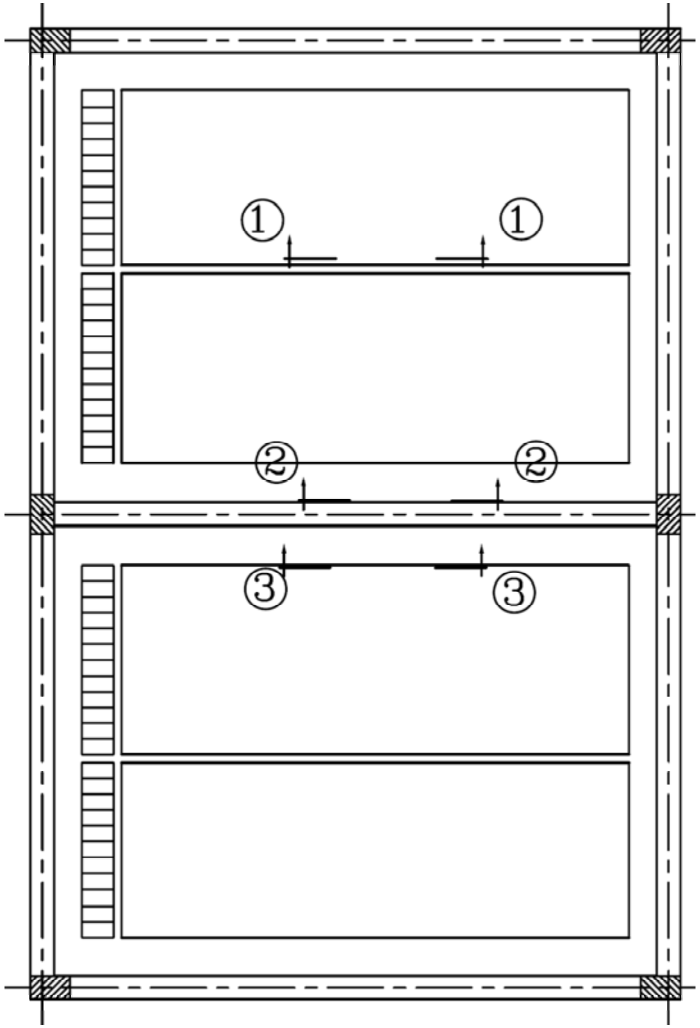
$$A_s = \frac{M}{fy\ j\ d} = 2\Phi\ldots\ldots / rib$$

Min diameter=10 mm

Max diameter=22 mm







DESIGN OF ONE WAY H.B. SLABS

- **Design of critical sections**
  - *Negative moments* ***(At Support)***

Sec. (2)

$$M / rib = M / m' * (e + b)$$

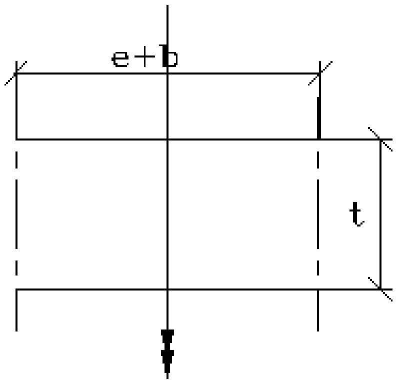
$$B = e + b \quad mm$$

$$d = t - 35 \quad mm$$

$$d = c_1 \sqrt{\frac{M}{fcu * B}}$$

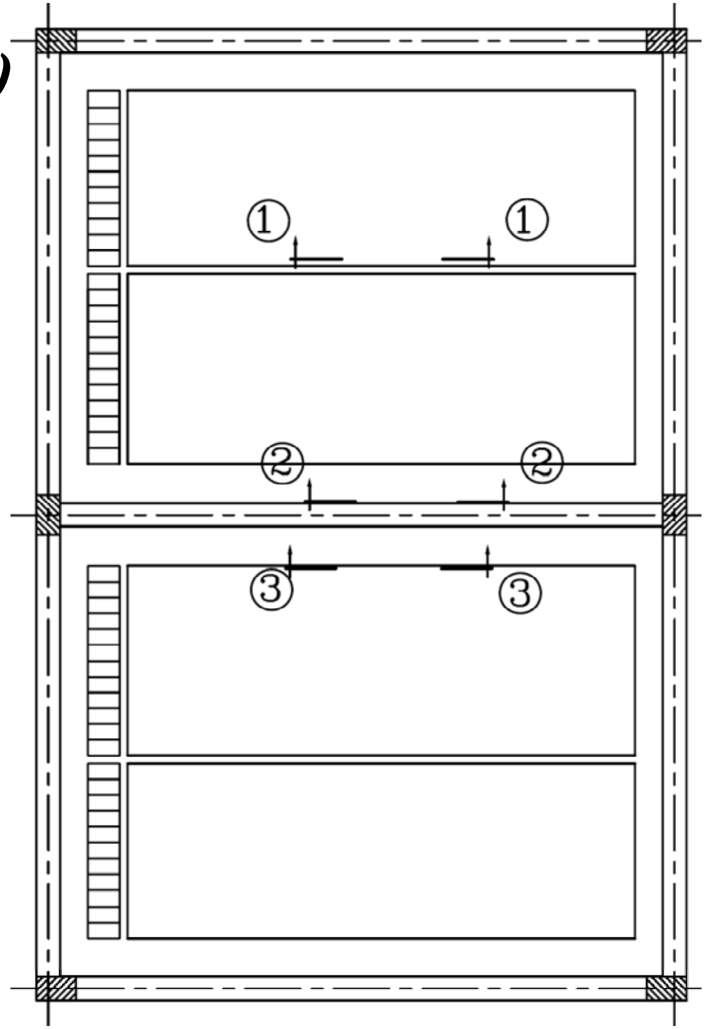
c_1 = ... j=........

$$A_s = \frac{M}{fy\ j\ d} = 2\Phi....../rib$$



Min diameter=10 mm

Max diameter=22 mm



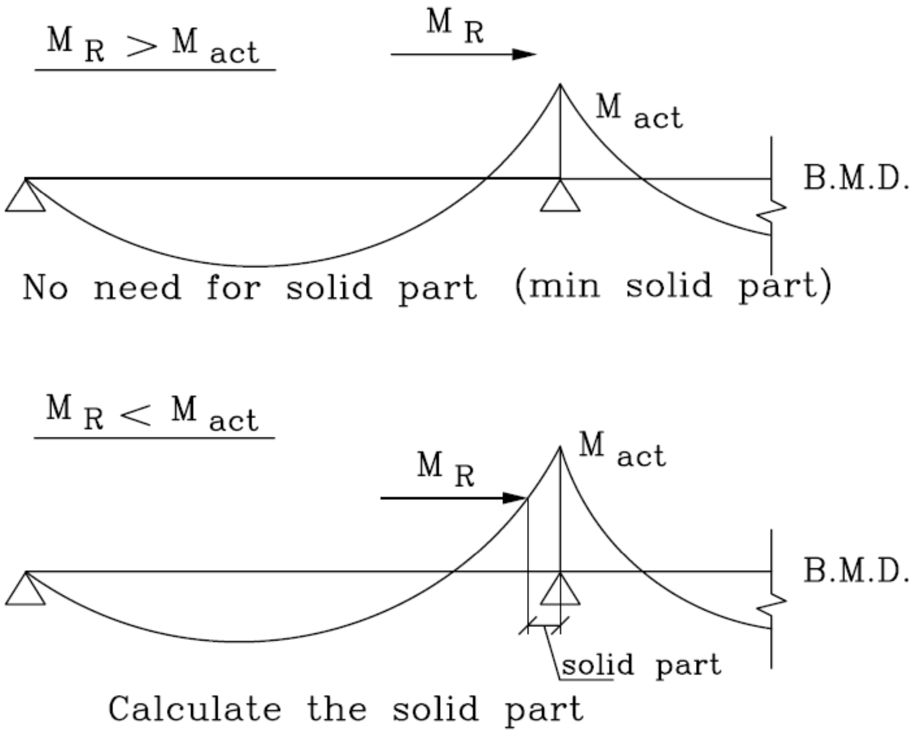
CHECKS

- **Check of solid part**

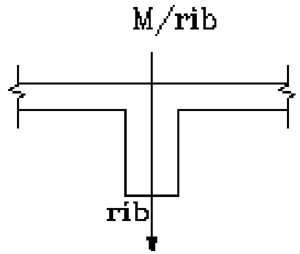
$$M_R = R_{max} \frac{fcu}{\gamma_c} b d^2$$

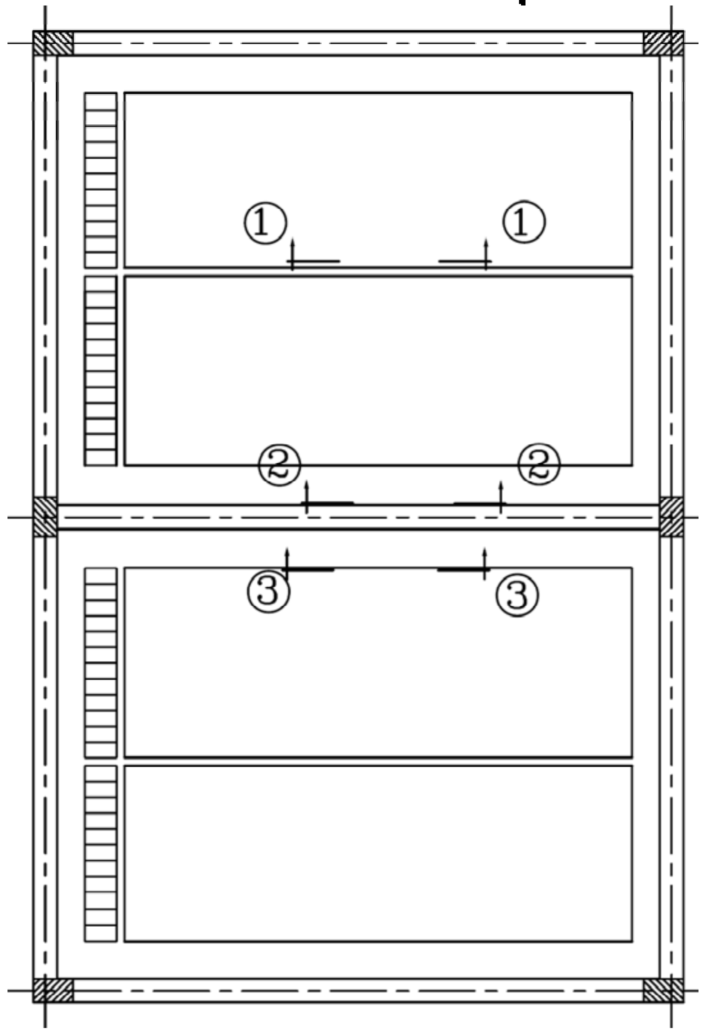
If M_R > M/rib, use minimum solid part

If M_R < M/rib, increase solid part



Sec. (3)





Check Shear

$$q = \frac{Q}{bd} \le q_c = 0.16\sqrt{\frac{fcu}{1.5}}$$

If $q > q_c$ increase b or d

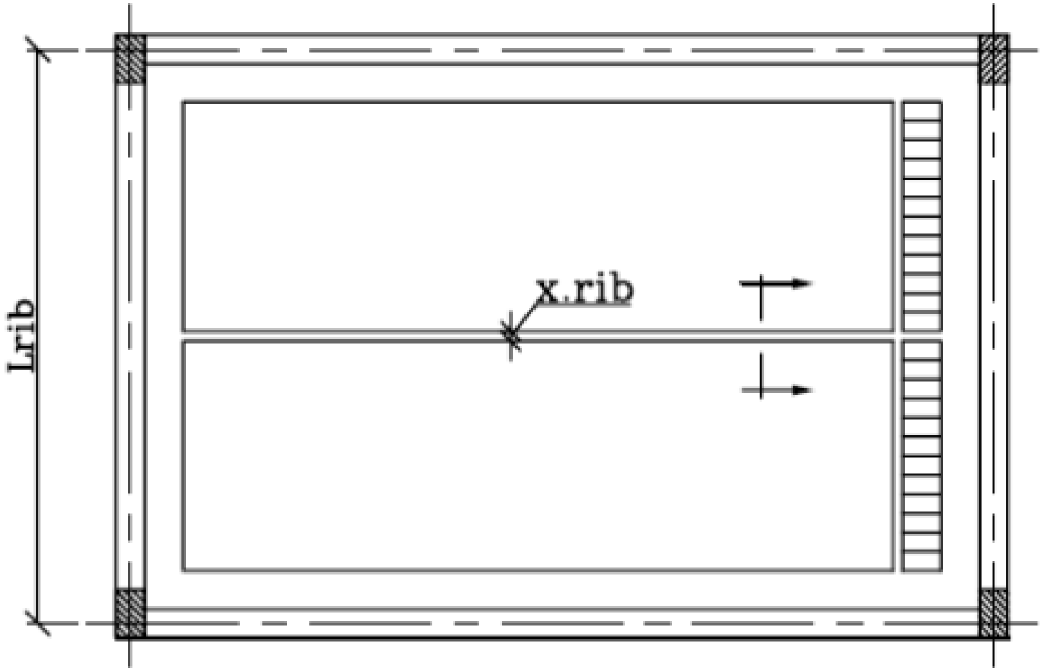
Cross Ribs

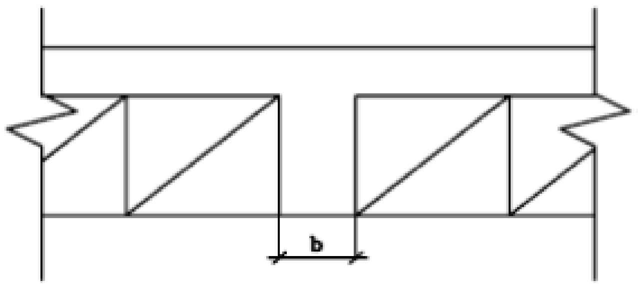
- Distribute loads

1) $L_{rib} > 5.0$ m when L.L $\leqslant$ 3 KN/m^2 (one cross rib)

2) $L_{rib} = (4.0 - 7.0)$ m when L.L > 3 KN/m^2 (one cross rib)

3) $L_{rib} \geqslant 7.0$ m (three cross ribs)





sec of X-rib

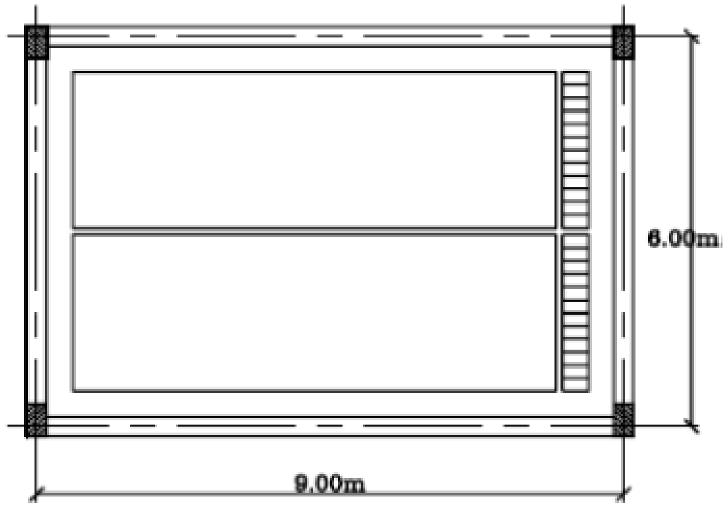
Example

F.C. = 1.5 kN/m^2

L.L = 2 kN/m^2

Fcu = 25 N/mm^2

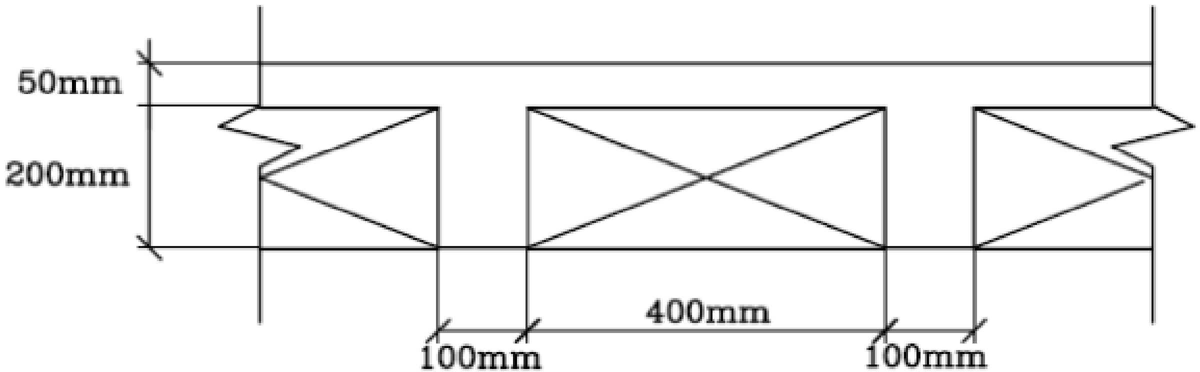
steel 400/600



$$t = \frac{6000}{20} = 300 \quad mm$$

$\Longrightarrow$ Take t = 250 mm and check deflection

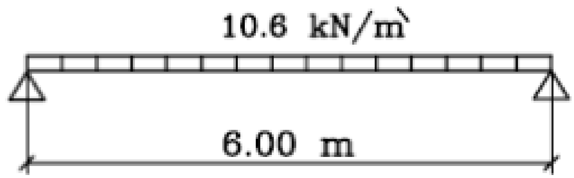
(wt. of one block 0.15 kN)



Example

$$ws = 1.4 * (\overbrace{0.05 * 25}^{s.s} + \overbrace{1.5}^{f.c} + \overbrace{2 * 0.1 * 0.2 * 25}^{ribs} + \overbrace{10 * \frac{15}{100}}^{blocks}) + 1.6 * \overbrace{2}^{L.L}$$

$$= 10.6 \ kN/m^2$$

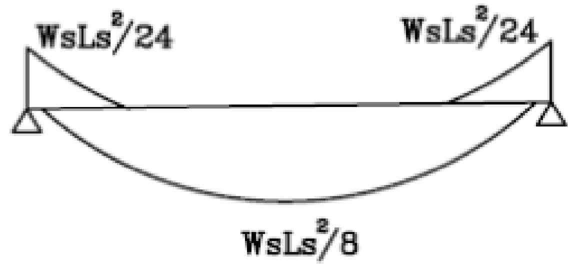


Strip 1.0m

$$B.M = \frac{10.6 * 6^2}{8} = 47.7 \ kN.m/m`$$

$$M/rib = \frac{47.7}{2} = 23.9 \ KN.m/rib$$

$$d = 250 - 35 = 215 \ mm$$

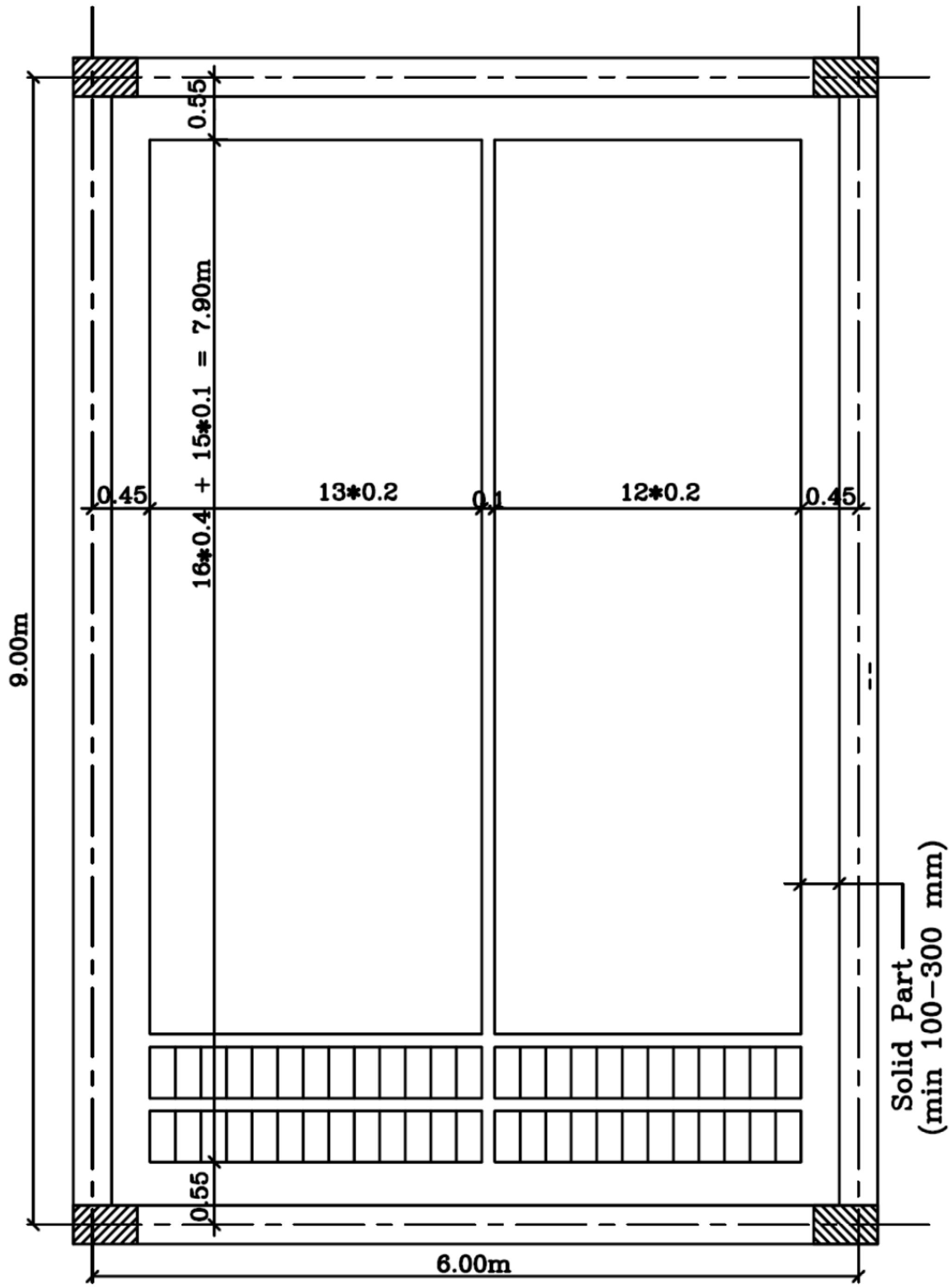


$$215 = c_1 \sqrt{\frac{23.9 * 10^6}{25 * 500}} \qquad c_1 = 5.03 \qquad j = 0.826$$

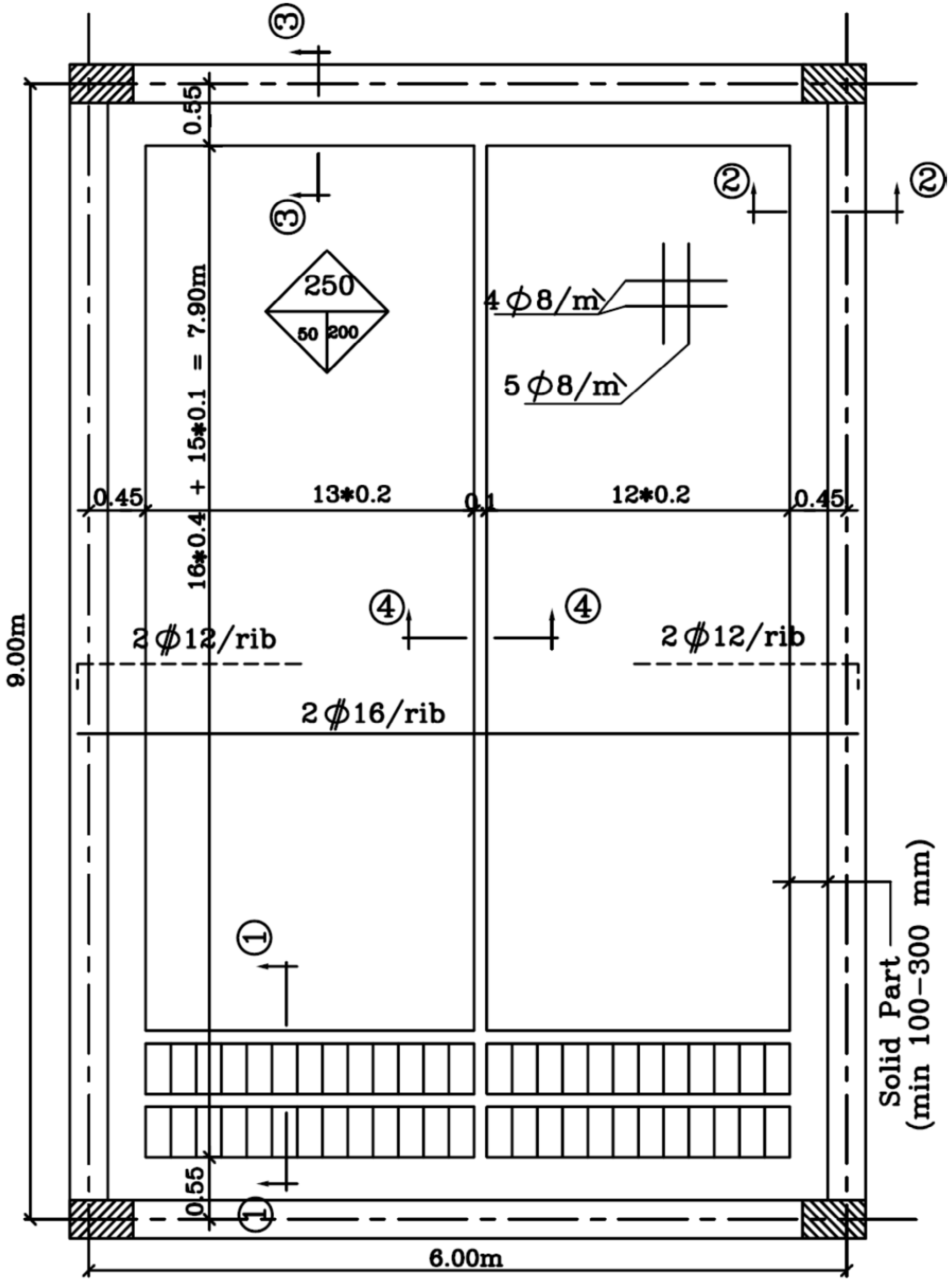
$$As = \frac{23.9 * 10^6}{0.826 * 400 * 215} = 340 \ mm^2 = 2\phi 16/rib$$

Concrete Dimensions

- Note the hollow block arrangement

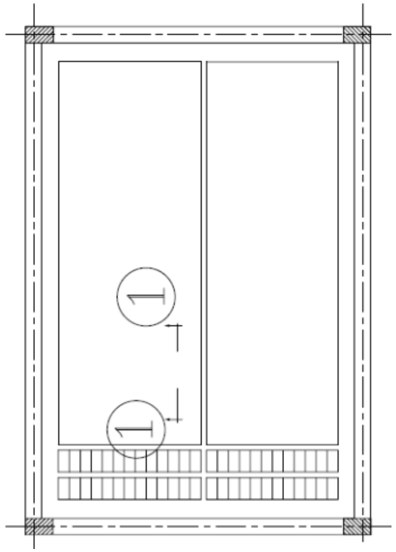


RFT

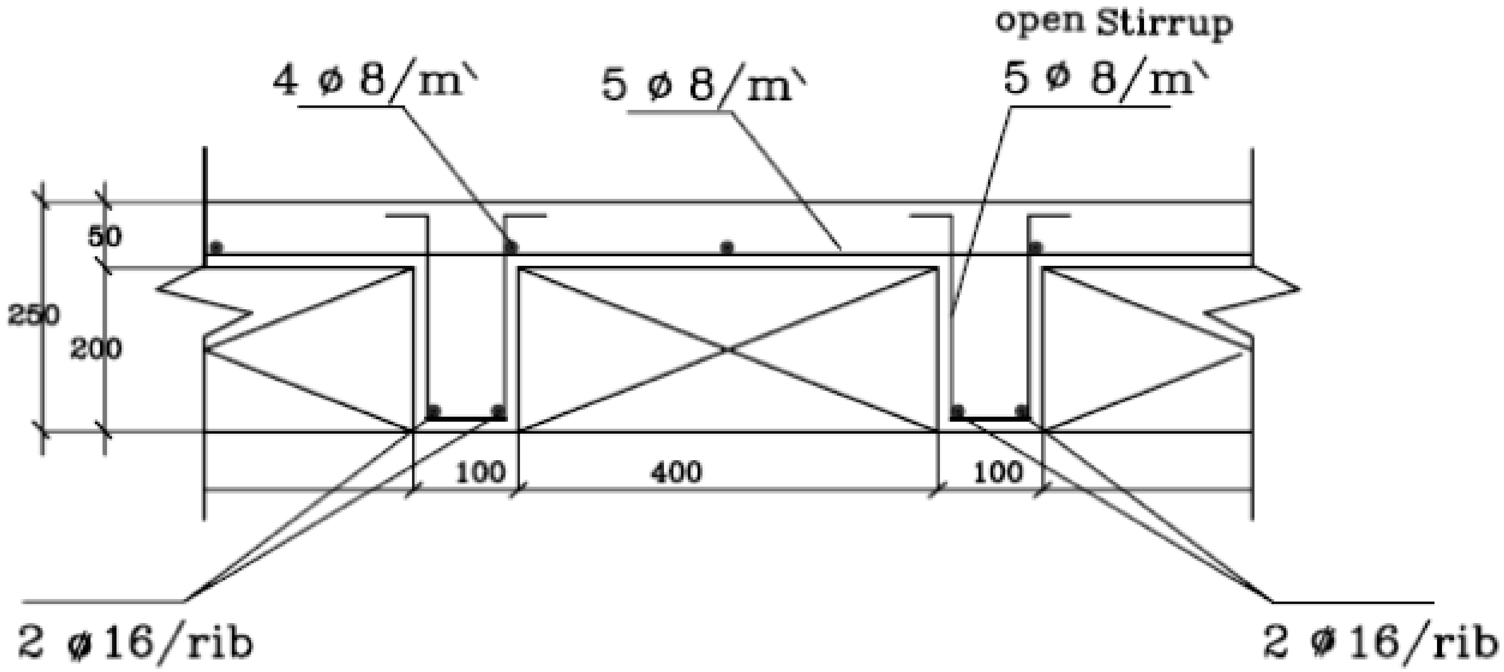


250
50
200
4 ϕ8/m
5 ϕ8/m
0.55
16*0.4 + 15*0.1 = 7.90m
0.45
13*0.2
0.1
12*0.2
0.45
2 ϕ12/rib
2 ϕ12/rib
2 ϕ16/rib
9.00m
6.00m
0.55
Solid Part
(min 100–300 mm)

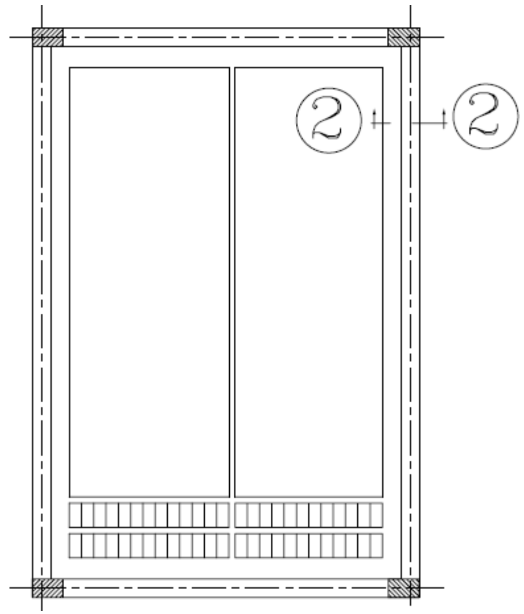
Details

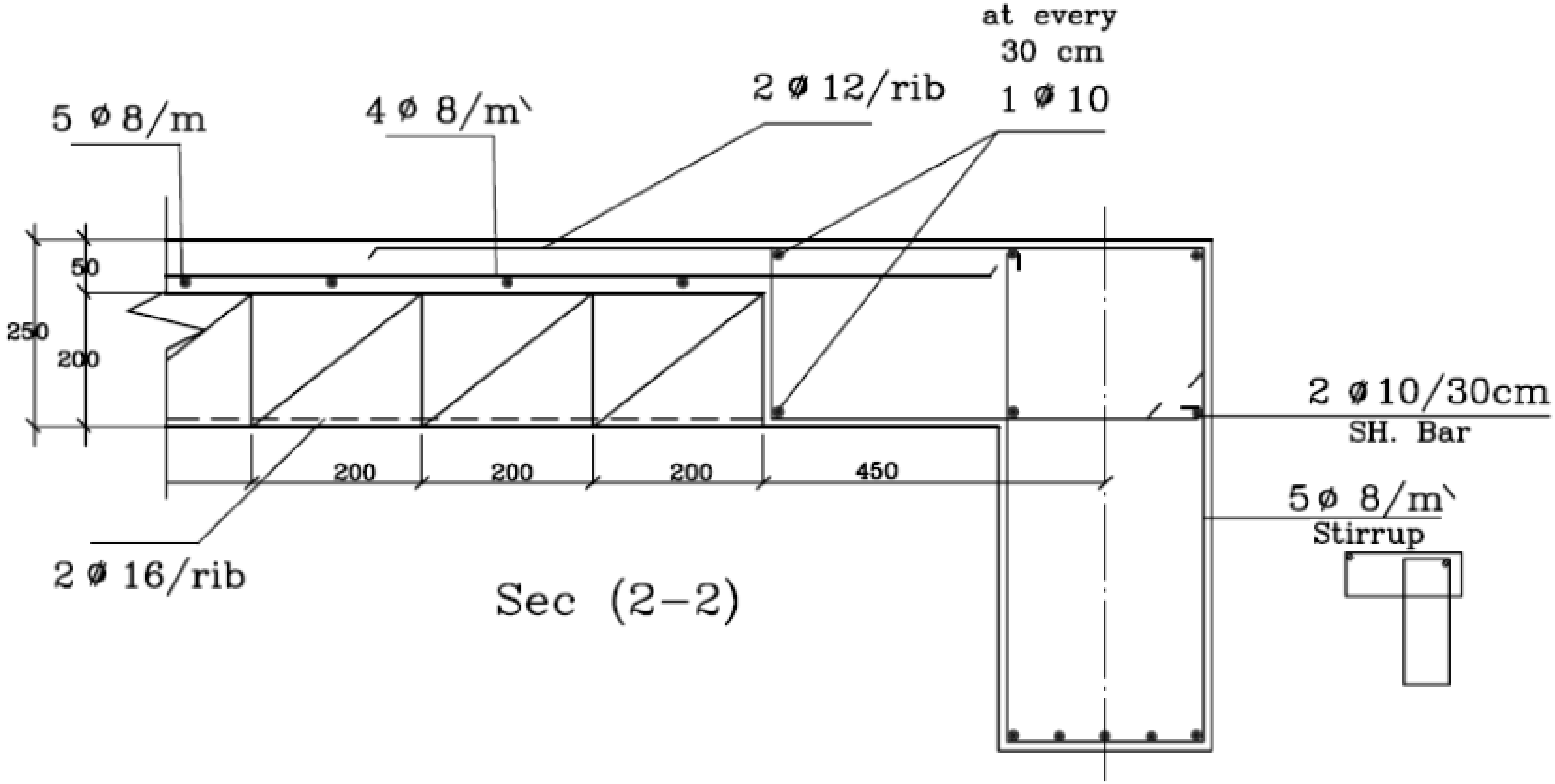


Sec (1–1)



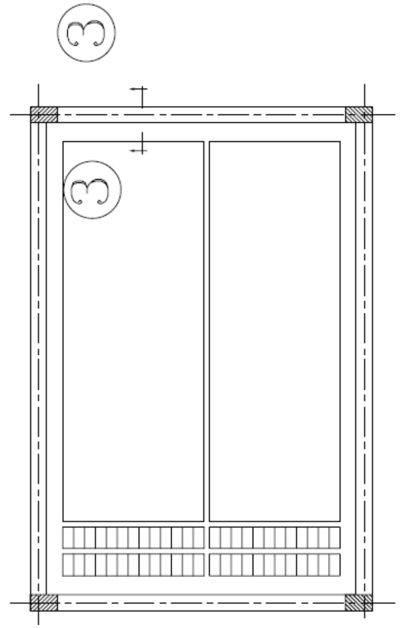
Details

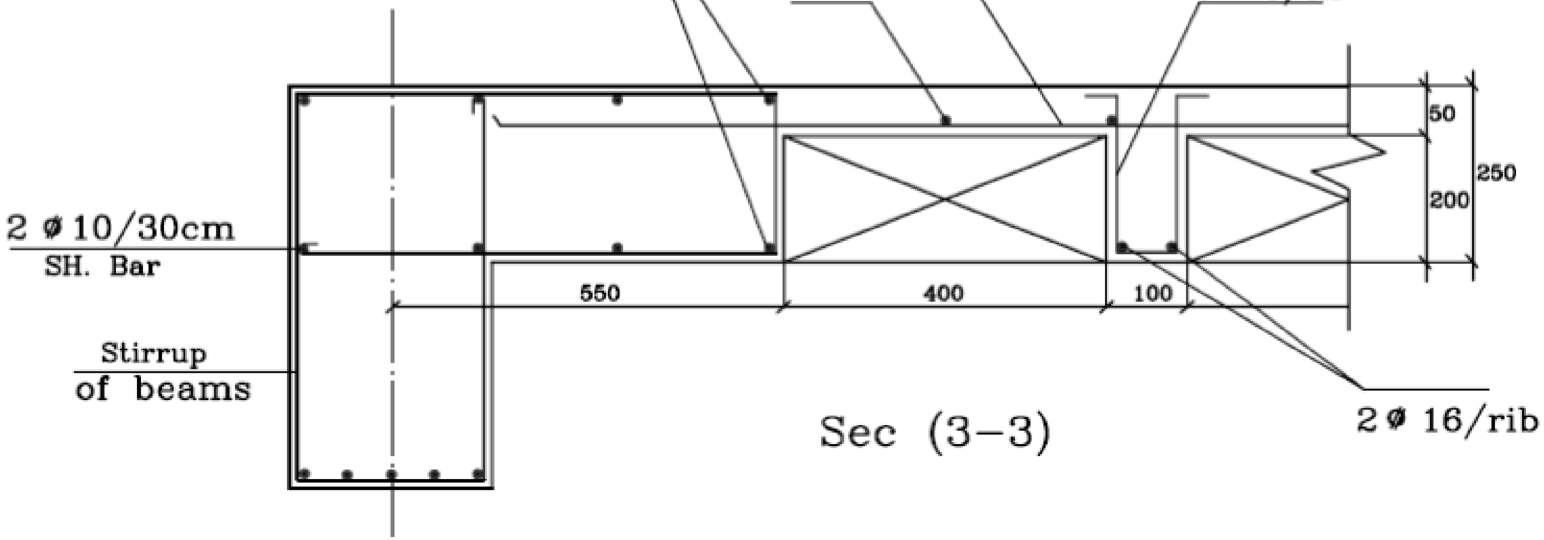




Sec (2-2)

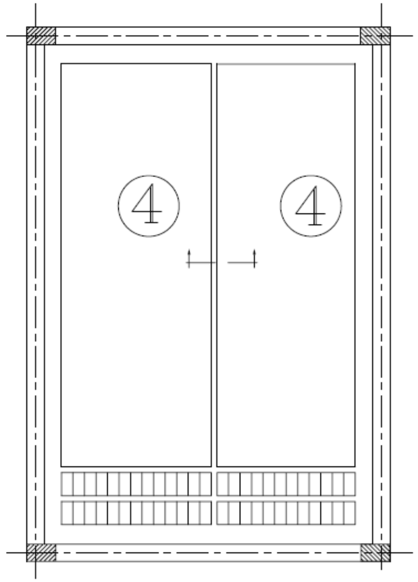
Details

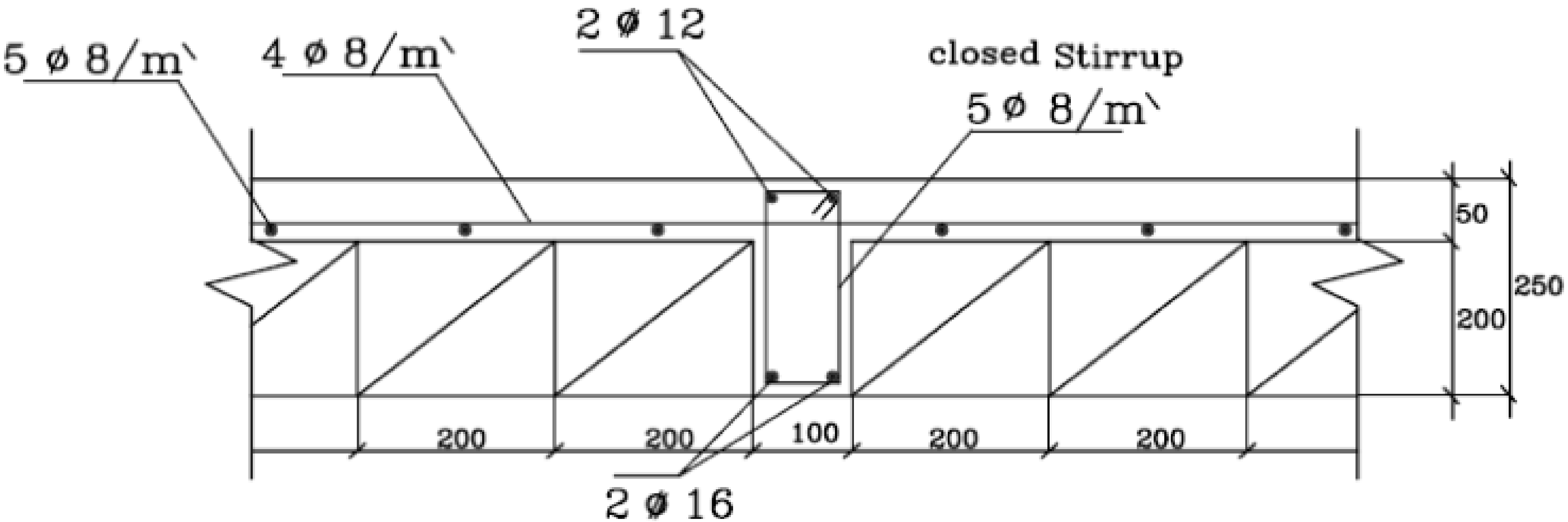




Sec (3–3)

Details





Sec (4-4)

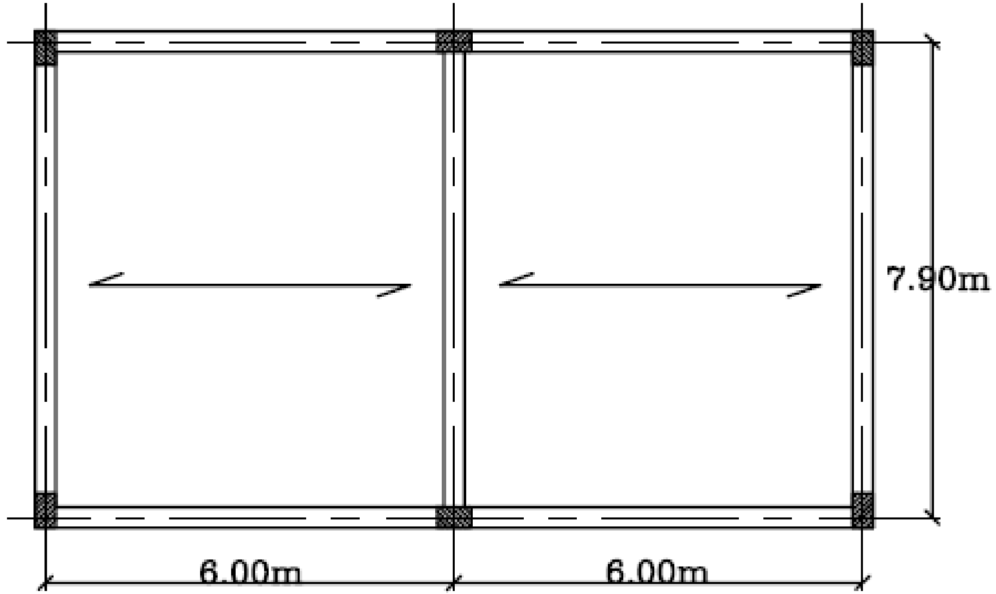
EXAMPLE

F.C. = 1.5 kN/m^2

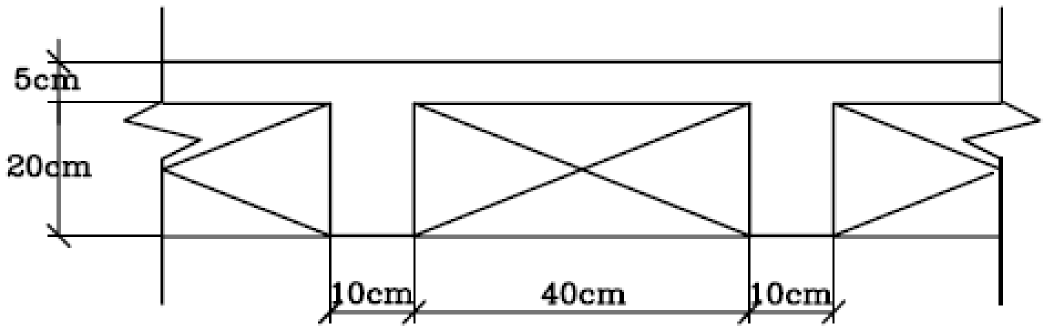
L.L = 2 kN/m^2

Fcu = 20 N/mm^2

steel 360/520



$$t = \frac{6000}{25} = 240 \text{ mm}$$

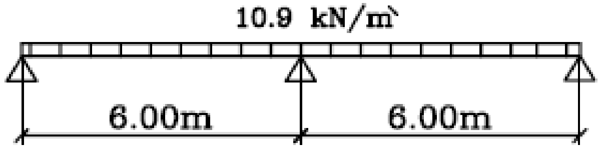


Example

$$ws = 1.5*(\underbrace{0.05*25}_{s.s} + \underbrace{1.5}_{f.c} + \underbrace{2*0.1*0.2*25.}_{ribs} + \underbrace{10*\frac{15}{100}}_{blocks} + \underbrace{2}_{L.L})$$

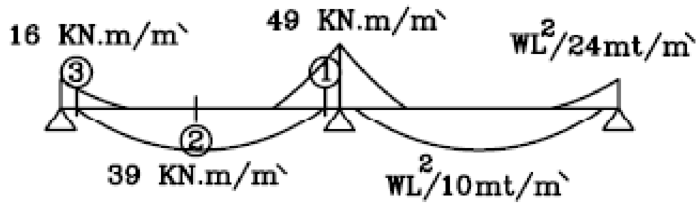
$$= 10.9 \quad kN/m^2$$

Strip 1.0m



Sec. ①

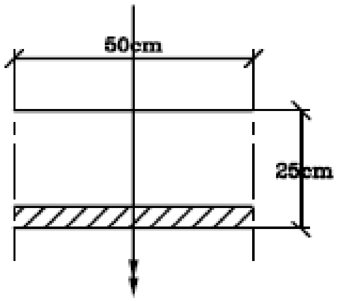
B.M.D



$$M/rib = \frac{49}{2} = 24.5 \ KN.m/rib$$

$$d = 250 - 35 = 215 \ mm$$

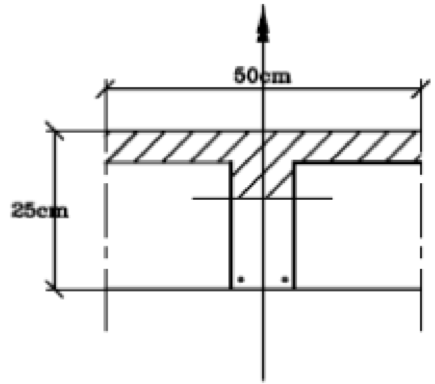
$$215 = c_1\sqrt{\frac{24.5*10^6}{20*500}} \qquad c_1 = 4.44 \qquad j = 0.826$$



$$As = \frac{24.5*10^6}{0.826*360*215} = 380 \ mm^2 = 2\phi\,16/0.5 \ m$$

Example

Sec. ②



$$M/rib = \frac{39}{2} = 19.5 \text{ KN.m/rib}$$

$$d = 250 - 35 = 215 \text{ mm}$$

$$215 = c_1 \sqrt{\frac{19.5 * 10^6}{20 * 500}} \qquad c_1 = 5.00 \qquad j = 0.826$$

$$As = \frac{19.5 * 10^6}{0.826 * 360 * 220} = 296 \text{ mm}^2 = 1 \phi 16 + 1 \phi 12 \text{ /rib}$$

Sec. ③

$$As = \frac{16}{49} * 375 = 122 \text{ mm}^2 = 2 \phi 10 / \text{ rib}$$

Example

Check Moment of Resistance of rib : (M_R)

$$M_R = R_{max} * \frac{Fcu}{\gamma_c} * b * d^2$$

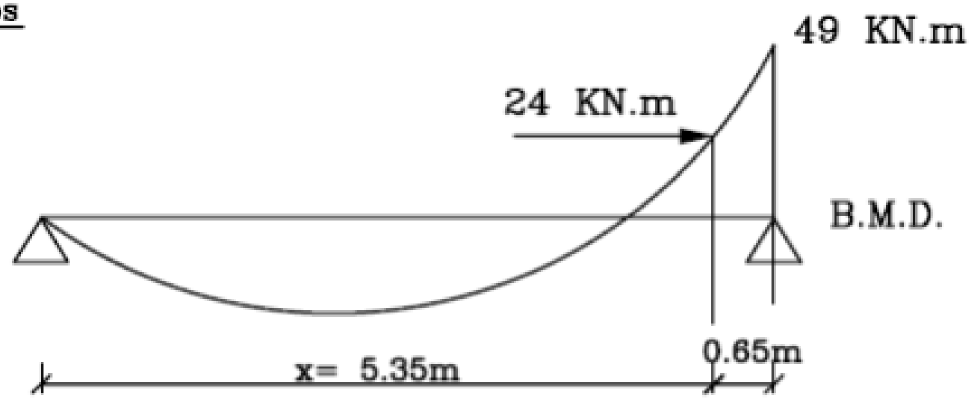
(in case of maximum -ve moment at the rib)

$$M_R = 0.194 * \frac{20}{1.5} * 100 * 215^2 = 11956866 \text{ N.mm/rib}$$

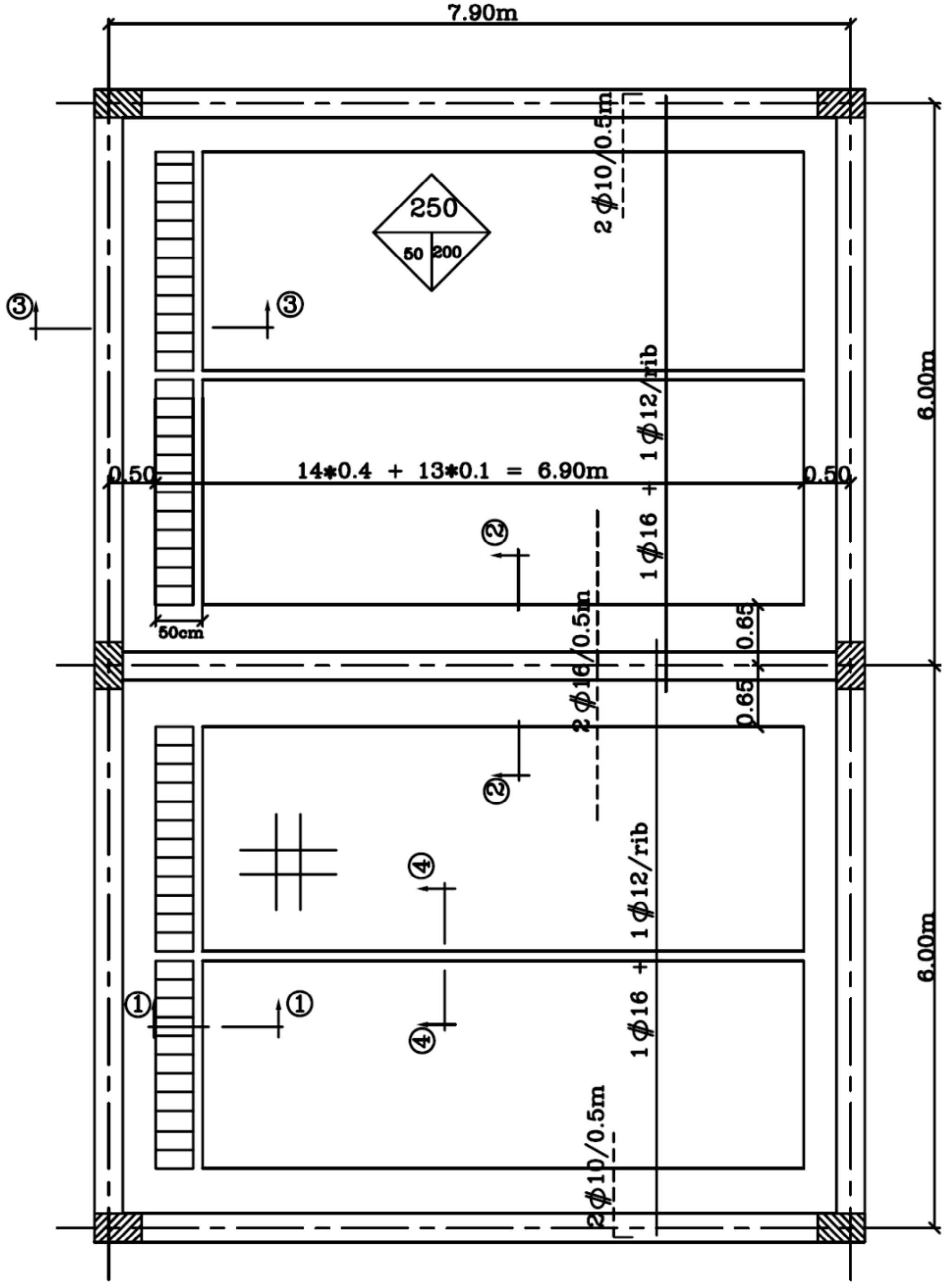
$$= 12.0 \text{ KN.m/rib}$$

$$M_R/m` = 12.0 * 2 = 24.0 \text{ KN.m/m`}$$

(2 = no. of ribs)

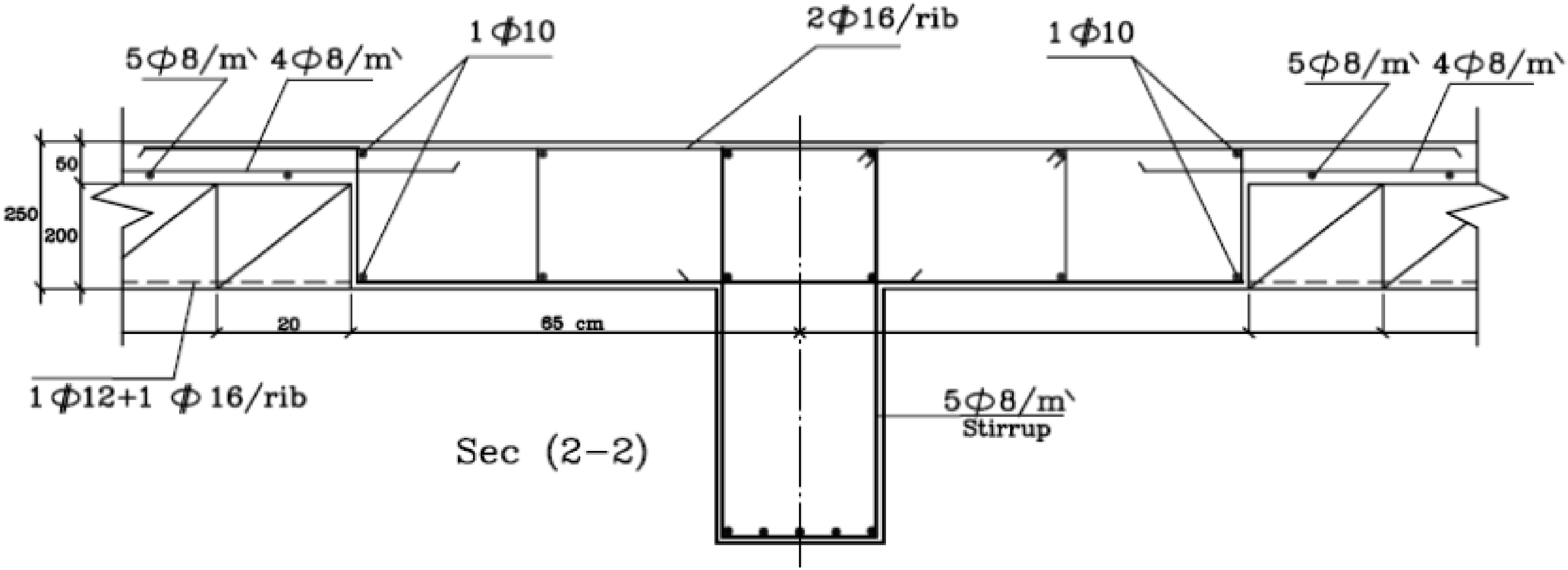


Example

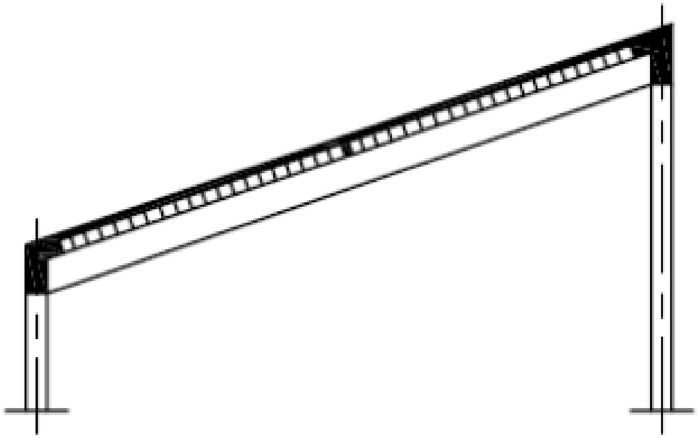


7.90m
250
50
200
2 φ10/0.5m
1 φ16 + 1 φ12/rib
14*0.4 + 13*0.1 = 6.90m
0.50
0.50
50cm
2 φ16/0.5m
0.65
0.65
6.00m
6.00m
2φ10/0.5m

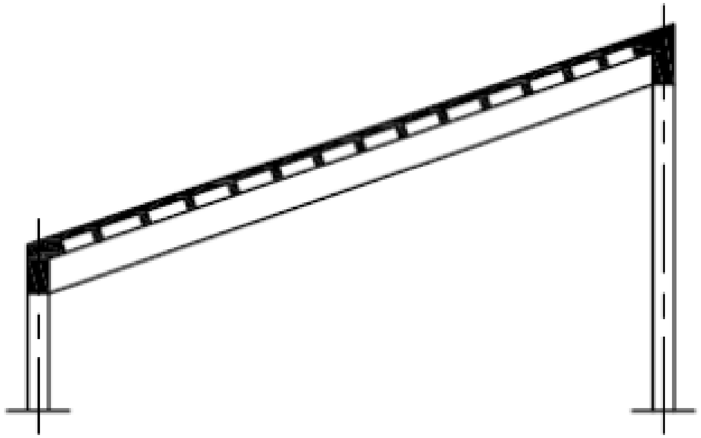
Details of RFT



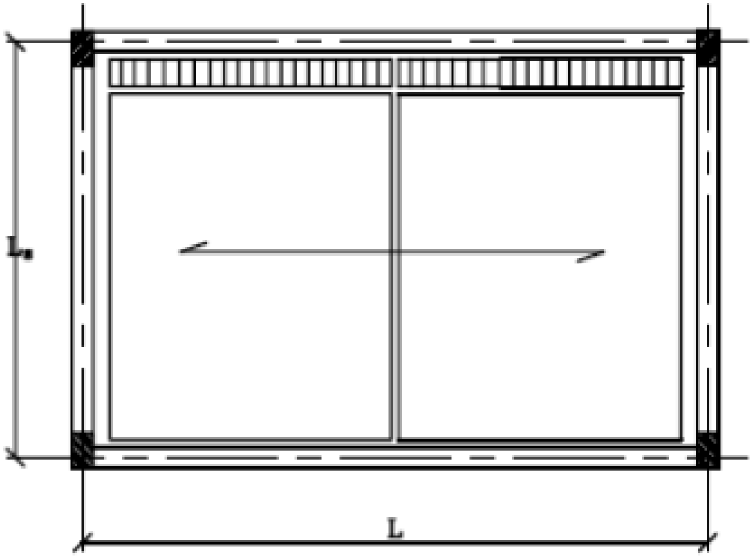
Inclined Slabs

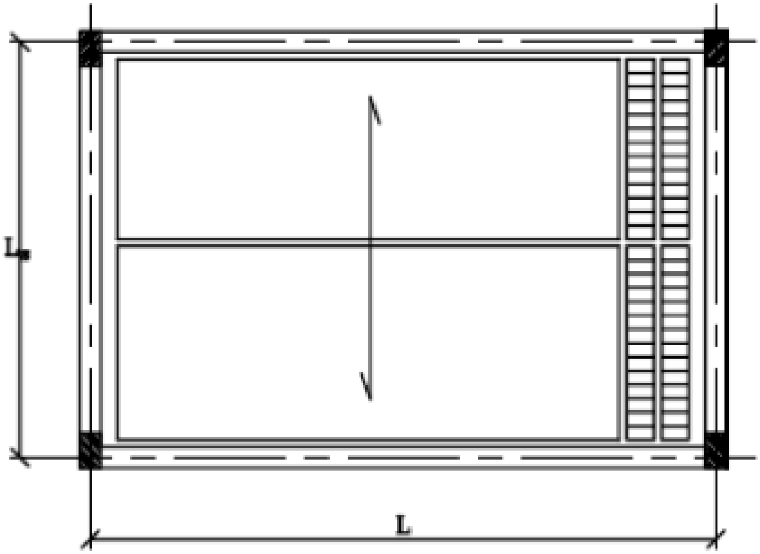


Easier to construct

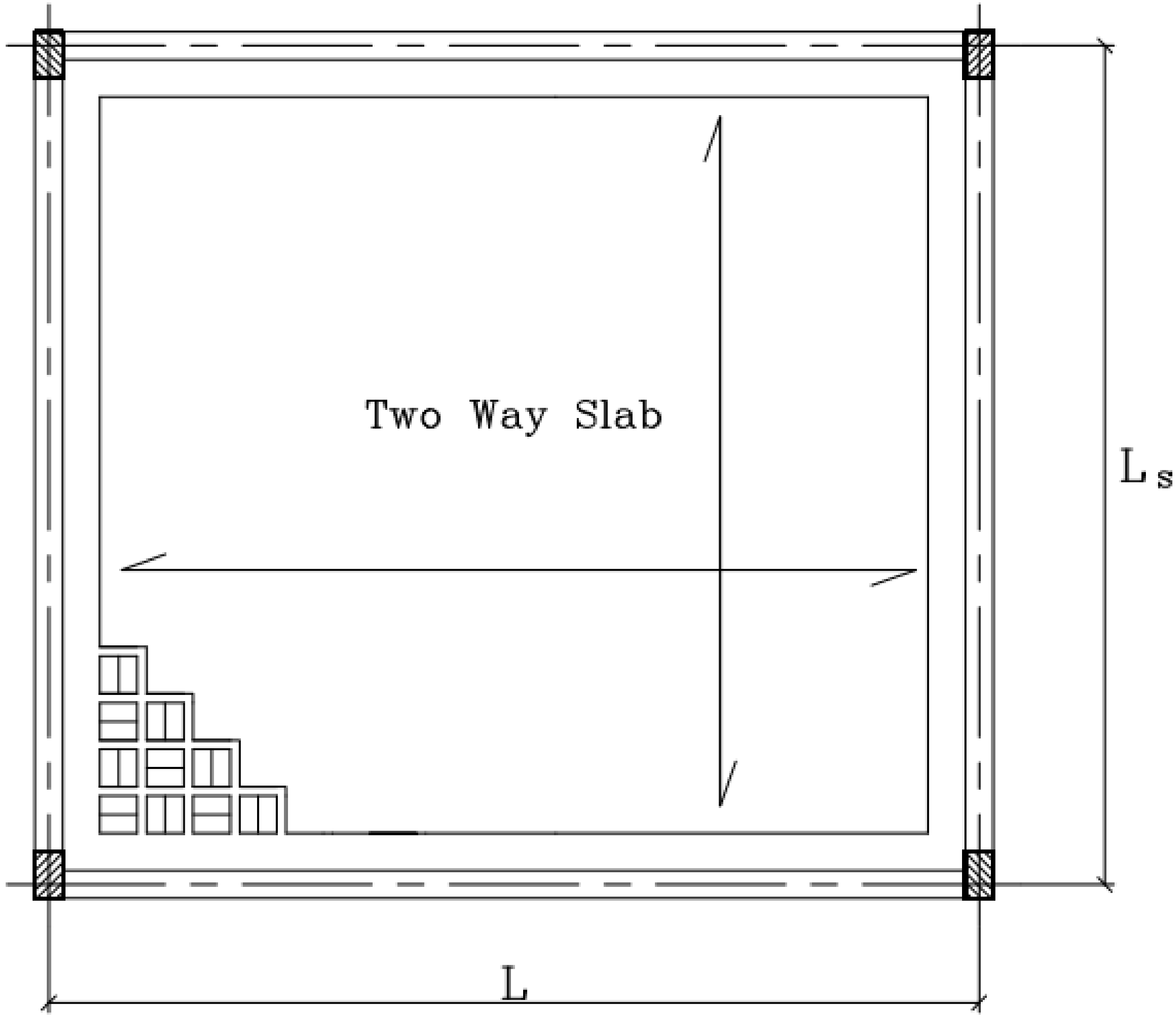


We must hold every block





TWO WAY HB SLABS

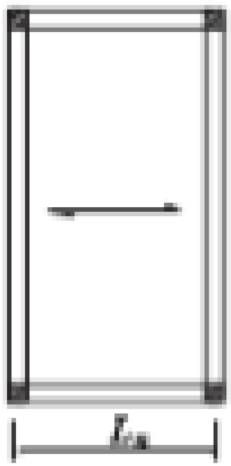


DESIGN OF TWO WAY H.B. SLABS

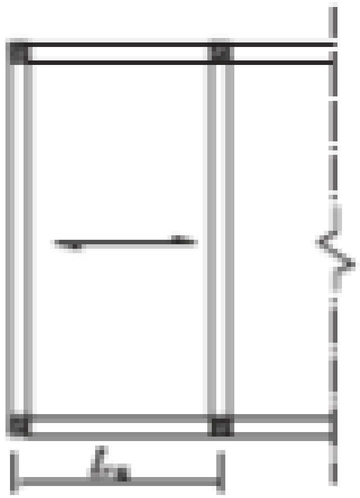
- **Slab thickness**

  Slab thicknesses can be estimated such as:

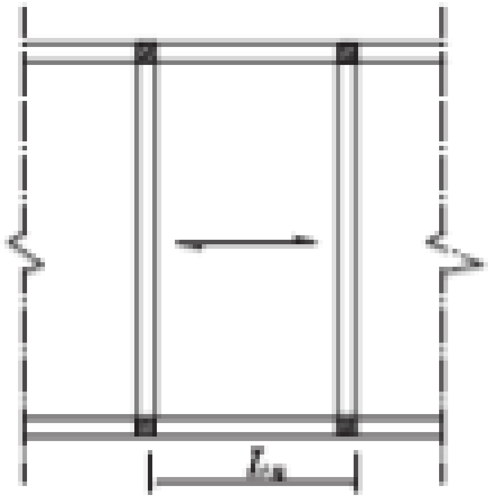
$t_s \geq L_S/35$



$t_s \geq L_S/40$



$t_s \geq L_S/45$



Deflection must be checked

Design of 2 Way HB Slab

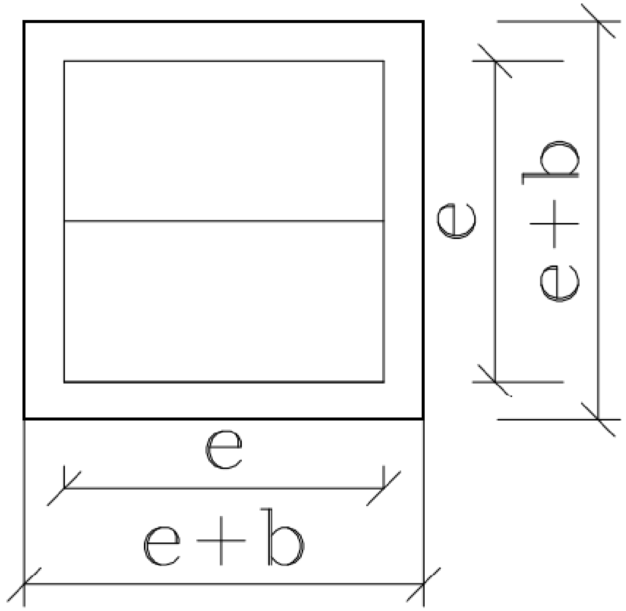
- Calculate Ws
- Compute α,β
- Strips 1 meter width in both directions
- Moments and Shears
- Rft
- Details of rft

DESIGN OF TWO WAY H.B. SLABS

- **Weight Calculation**

Consider an area of (e+b) x (e+b)

$$o.w.^{*} = t_s \gamma_c (e+b)(e+b)$$
$$+ b(t - t_s)\gamma_c \left[(e+b) + e\right]$$
$$+ 2 \text{weight of blocks}$$

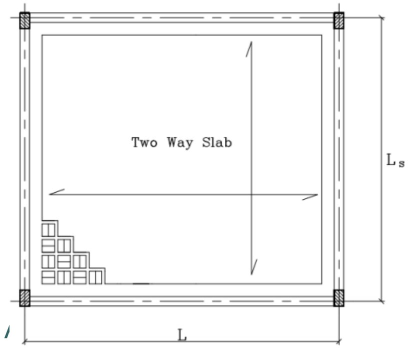


$$o.w.(kN/m^2) = \frac{o.w.^{*}}{(e+b)(e+b)}$$

$$w_u = 1.4(o.w. + F.C) + 1.6(L.L.)$$

OR

$$w_u = 1.5(o.w. + F.C + L.L.)$$



Dr. /

DESIGN OF TWO WAY H.B. SLABS

- **Calculation of load factors**

$$r = \frac{mL}{m' L_s}$$

Strip			
m or m′	1.00	0.87	0.76

- LL<5 kN/m^2

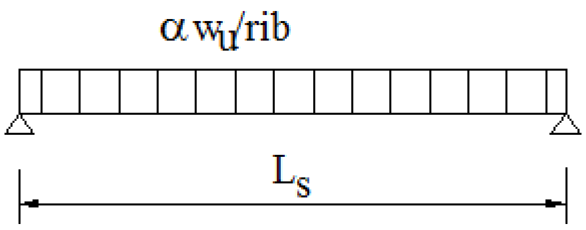
r	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
α	0.396	0.473	0.543	0.606	0.660	0.706	0.746	0.778	0.806	0.830	0.849
β	0.396	0.333	0.262	0.212	0.172	0.140	0.113	0.093	0.077	0.063	0.053

- LL≥5kN/m^2

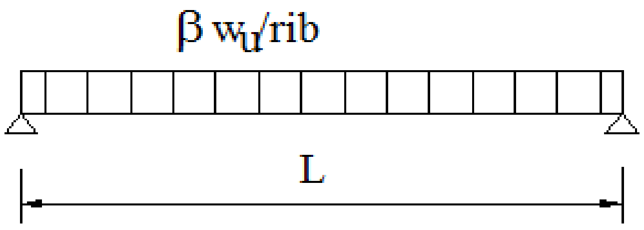
$$\alpha = \frac{r^4}{1+r^4} \text{ and } \beta = \frac{1}{1+r^4}$$

DESIGN OF TWO WAY H.B. SLABS

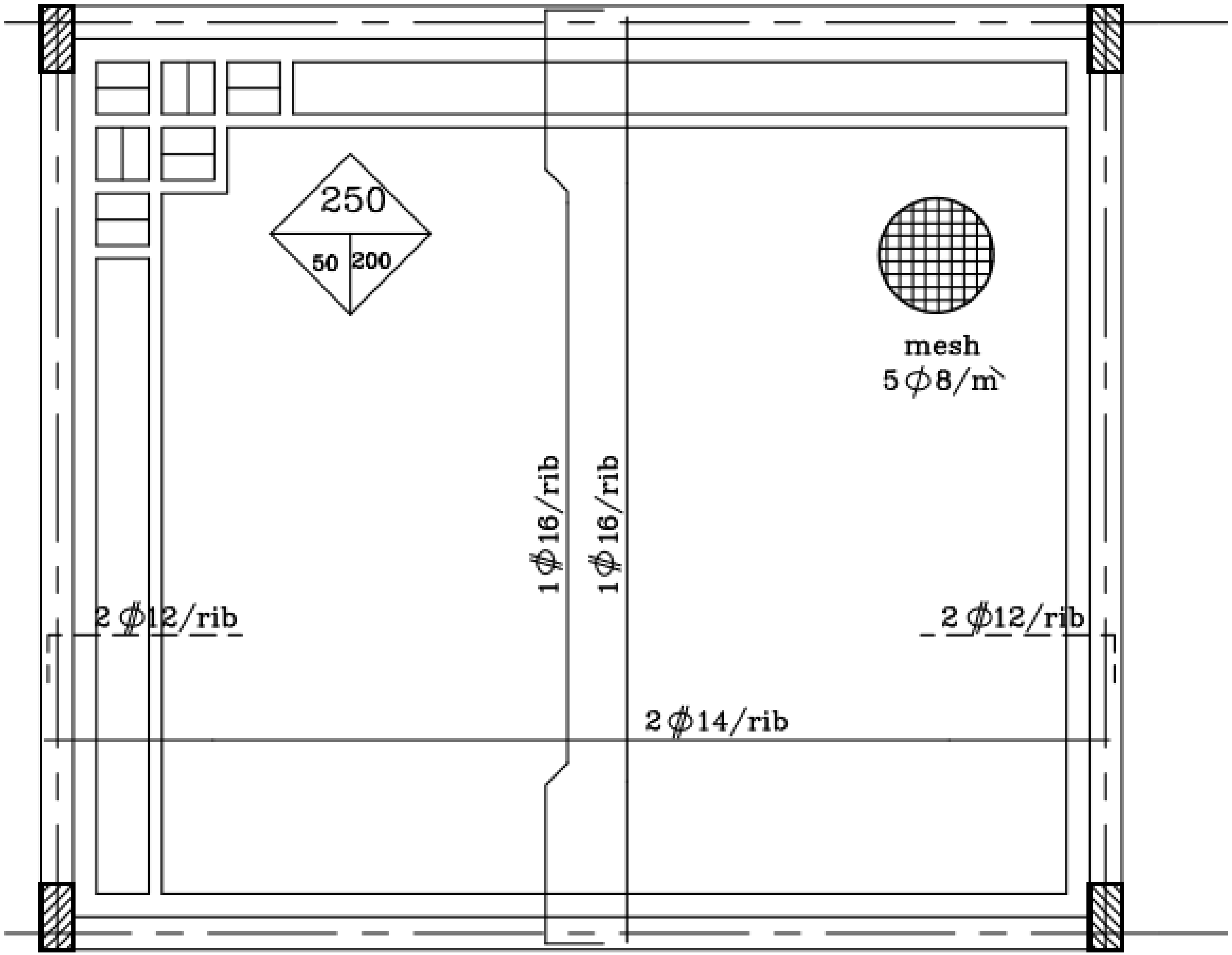
- **Strips in both directions**
  - For strip in the short direction



  - For strips in the long direction



DESIGN OF TWO WAY H.B. SLABS



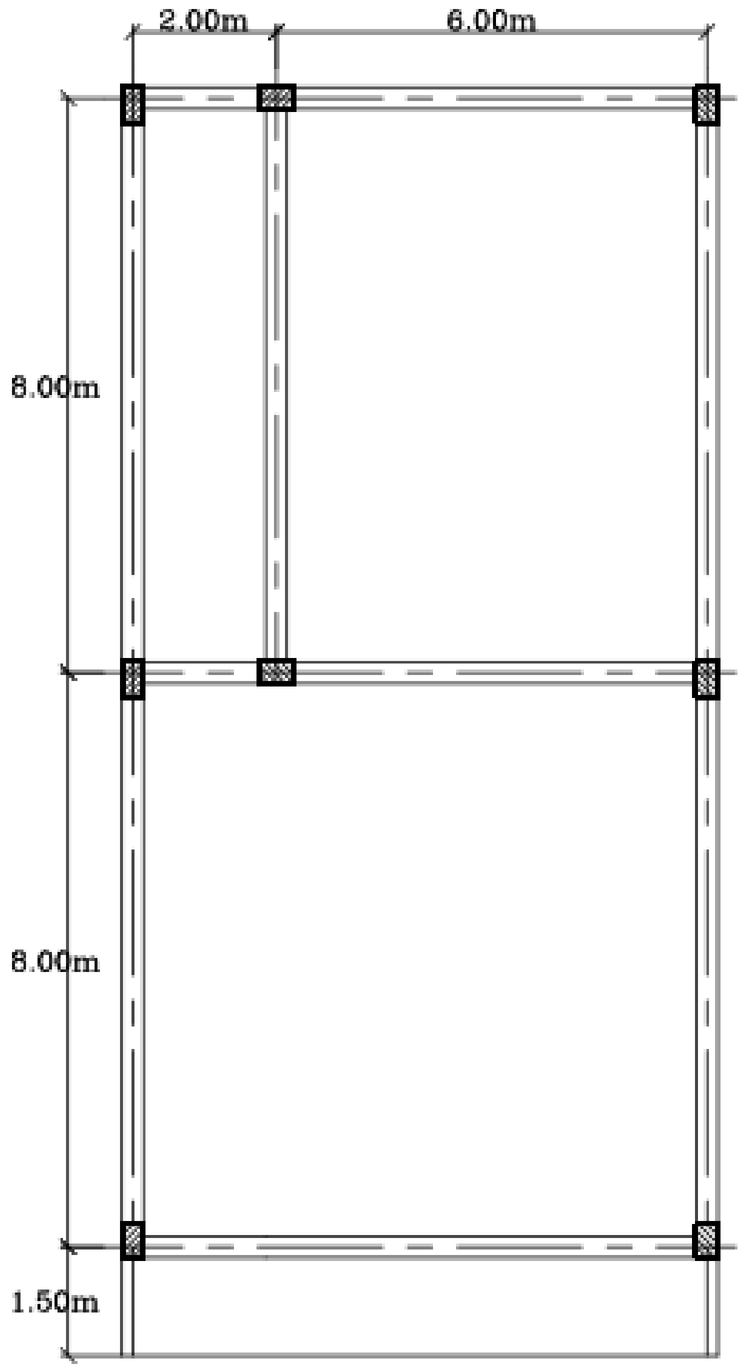
Example

$L.L = 3.0\ kN/m^2$

$F.C. = 1.5\ kN/m^2$

$Fcu = 25\ N/mm^2$

steel 360/520



SOLUTION

S1

Ls = 6.0 m $\Rightarrow$ One Way H.B.

assume $t = \frac{L_s}{25} = \frac{6000}{25} = 240$ mm

$\Rightarrow$ Take t = 250 mm

S2

Solid Slab

assume ts = 140 mm

S3

Two Way H.B.

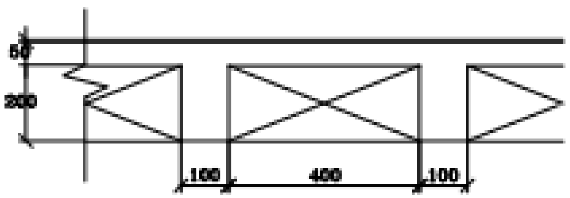
$t = \frac{L_s}{40} = \frac{8000}{40} = 200$ mm $\Rightarrow$ Take t = 250 mm

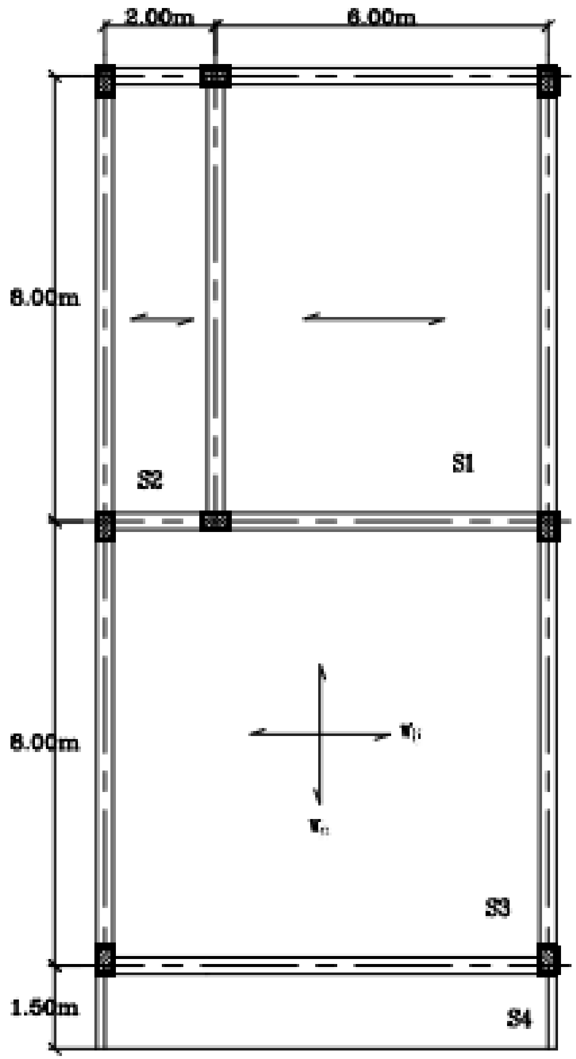
Use block 200 * 200 * 400

S4

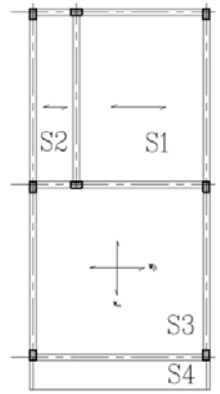
Cantilever Solid Slab

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





SOLUTION



S1

wt. of solid slab = $0.05 * 25 = 1.25\ kN/m^2$

wt. of block = $10 * 0.15_{kN} = 1.5\ kN/m^2$

wt. of ribs = $2 * 0.1 * 0.2 * 25 = 1\ kN/m^2$

$Ws = 1.4 * (1.25 + 1.5 + 1.0 + 1.5) + 1.6 * 3 = 12.1\ kN/m^2$

S2

$Ws = 1.4 * (3.5 + 1.5) + 1.6 * 3.0 = 11.8\ kN/m^2$

S3

wt. of solid slab = $0.05 * 25 = 1.25\ kN/m^2$

wt. of block = $8 * 0.15_{kN} = 1.2\ kN/m^2$

wt. of ribs = $3.60 * 0.1 * 0.2 * 25 = 1.8\ kN/m^2$

$Ws = 1.4 * (1.25 + 1.5 + 1.8 + 1.2) + 1.6 * 3.0 = 12.9\ kN/m^2$

S4

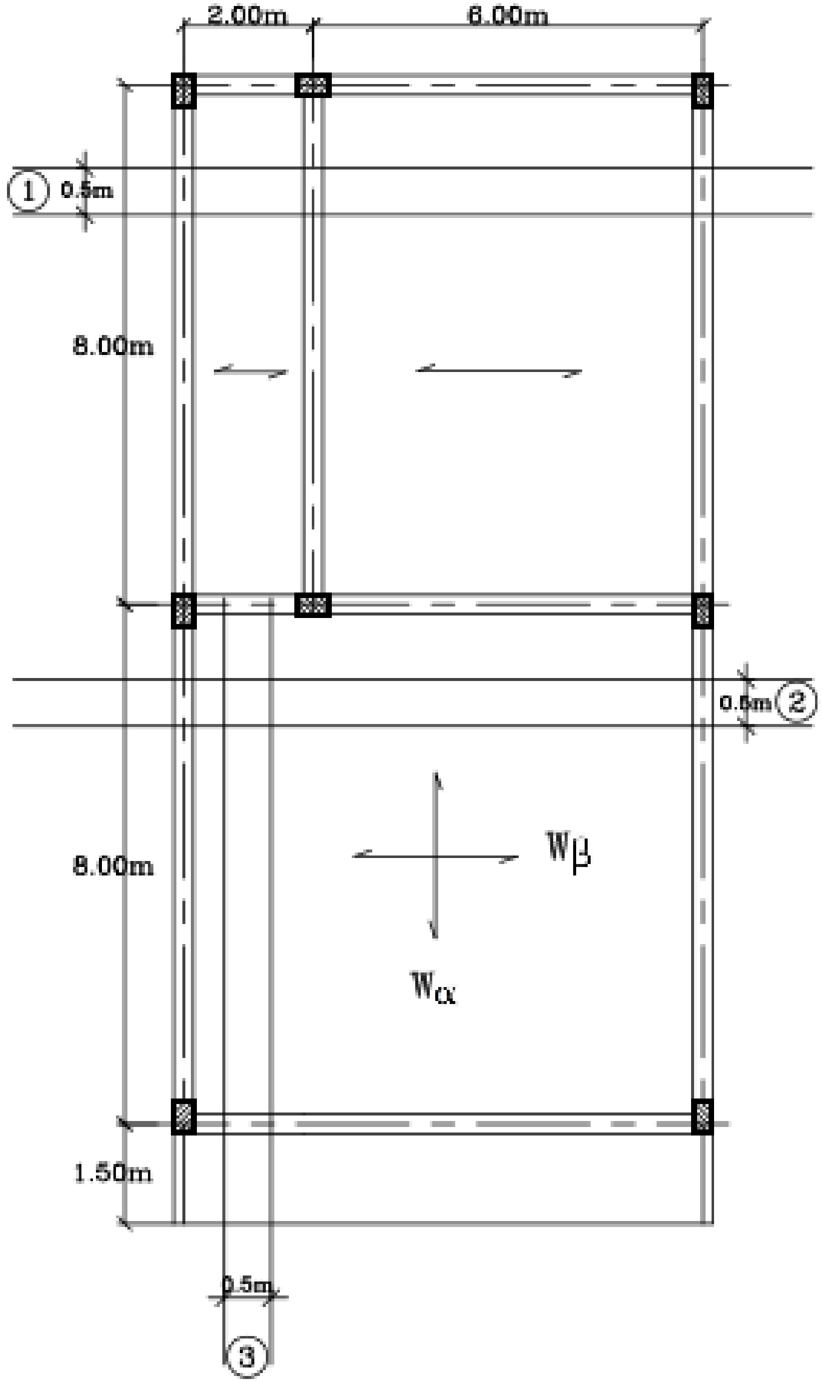
$Ws = 1.4 * (3.75 + 1.5) + 1.6 * 3.0 = 12.15\ kN/m^2$

Solution

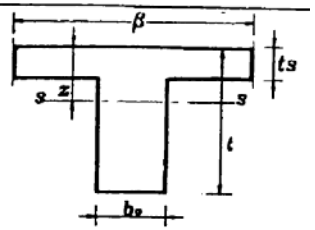
$$r = \frac{1.0 * 8.0}{0.87 * 8.0} = 1.14 \qquad \alpha = 0.5 \quad \beta = 0.3$$

$$W_\alpha = 0.5 * 12.9 = 6.5 \ kN/m^2$$

$$W_\beta = 0.3 * 12.9 = 3.9 \ kN/m^2$$



1.6. Moment of Center of Gravity of T-Section



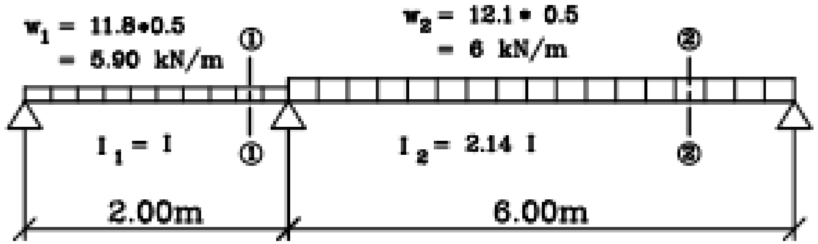
$$I_s = \mu \cdot B\, t^3$$

Table of μ - values x 10^{-4}:

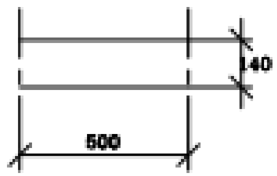
b_0/B	t_s/t										
	.05	.10	.15	.20	.25	.30	.35	.40	.50	.55	.60
.05	97	109	111	111	112	115	122	132	169	196	231
.06	110	125	129	129	129	132	137	147	181	207	241
.07	122	140	145	146	146	148	152	161	193	218	251
.08	133	154	161	162	162	163	167	175	205	229	260
.09	143	167	176	178	178	178	182	189	217	240	270
.10	154	179	190	192	192	193	196	202	228	250	279
.11	164	192	203	206	207	207	209	215	240	260	288
.12	173	204	216	220	221	221	223	227	251	271	298
.13	182	215	229	233	234	234	236	240	262	281	307
.14	191	226	241	246	247	247	248	252	272	290	316
.15	200	236	252	258	260	260	261	264	283	300	324
.16	209	245	263	270	272	272	273	276	293	310	333
.17	217	255	273	282	284	284	285	287	304	319	342
.18	225	265	284	293	296	296	296	298	314	329	350
.19	234	274	295	304	307	308	307	309	324	338	359
0.20	242	283	304	314	318	319	319	320	333	347	367
0.22	258	301	323	334	339	340	340	341	353	365	384
0.24	275	318	342	354	359	360	360	361	371	382	400
0.26	291	334	360	373	378	380	380	381	389	399	417
0.28	306	350	376	390	397	399	399	400	407	416	431
0.30	320	366	392	407	415	417	418	418	424	432	446
0.32	336	380	408	424	432	435	435	435	441	448	461
0.34	352	396	424	440	448	452	452	452	457	464	475
0.36	367	410	438	455	464	468	468	469	473	479	490
0.38	382	426	453	470	480	484	485	485	488	497	504
0.40	397	441	468	485	495	499	500	500	503	508	517
0.42	412	454	482	499	509	514	515	515	518	522	530
0.44	427	468	496	513	523	528	530	530	532	536	544
0.46	441	482	509	527	537	542	544	544	546	549	557
0.48	456	496	523	540	551	556	558	558	560	563	569
0.50	470	509	533	553	564	569	571	572	573	576	582
0.55	505	544	567	585	596	601	604	604	605	607	612
0.60	544	575	599	616	626	631	634	635	636	637	641
0.65	581	609	630	645	655	660	663	664	664	665	668
.70	616	642	660	674	683	688	691	691	692	692	695
.75	652	675	691	702	709	714	717	718	718	718	720
.80	689	706	720	729	736	740	742	743	743	743	744
.90	761	770	779	782	786	788	789	790	790	790	791
1.0	833	833	833	833	833	833	833	833	833	833	833

Solution

Strip (1) :

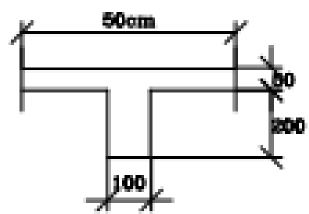


$$I_1 = \frac{500 * (140)^3}{12} = 1.14*10^8 \, mm^4$$



Sec ①

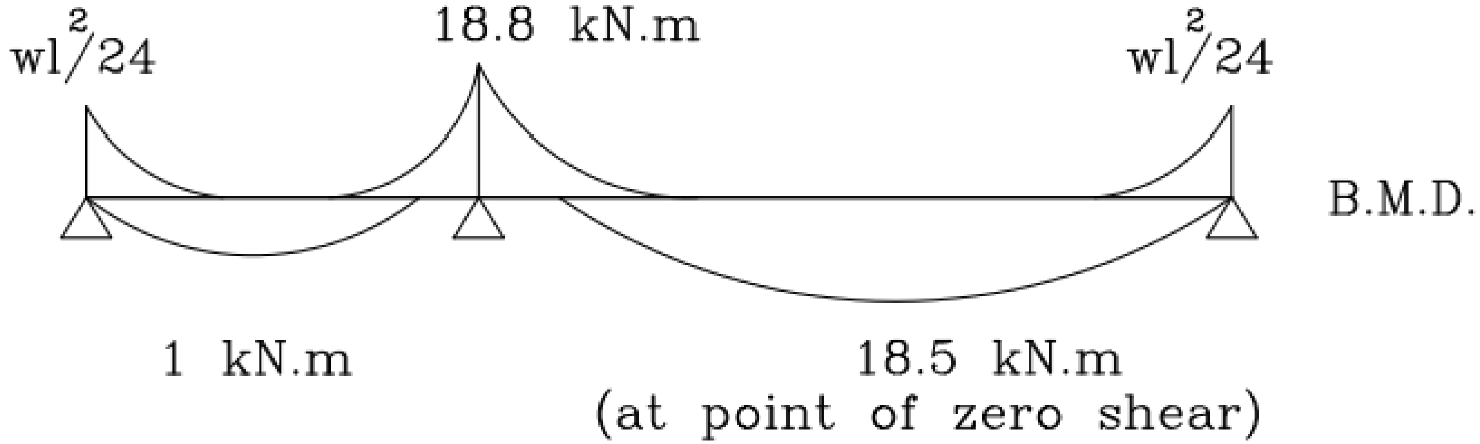
$$\left.\begin{array}{l} \frac{b}{B} = \frac{100}{500} = 0.2 \\ \\ \frac{ts}{t} = \frac{50}{250} = 0.2 \end{array}\right\} \Longrightarrow \mu = 314 * 10^{-4}$$



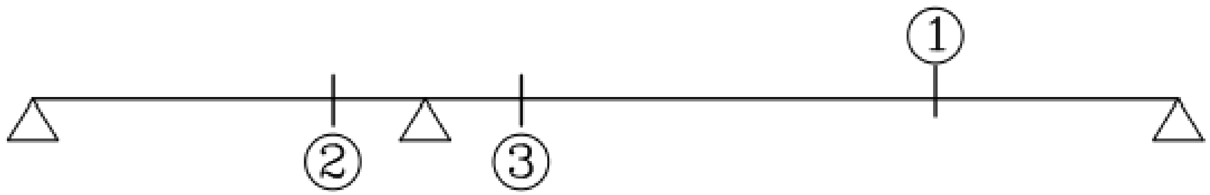
Sec ②

$$I_2 = 314 * 10^{-4} * 500 * (250)^3 = 2.45*10^8 \, mm^4 \Longrightarrow \frac{I_2}{I_1} = 2.14$$

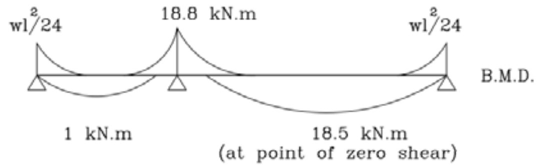
Strip 1



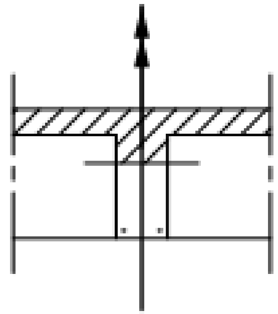
wl²/24
18.8 kN.m
wl²/24
B.M.D.
1 kN.m
18.5 kN.m
(at point of zero shear)



1
2
3



Sec. ①



$M = 18.5$ KN.m $t = 250$ mm T−Sec.

$d = 215$ mm $F_{cu} = 50\ N/mm^2$ $B = 500$ mm

$$215 = c_1 \sqrt{\frac{18.5*10^6}{25*500}} \qquad c_1 = 5.72 \qquad j = 0.826$$

$$As = \frac{18.5*10^6}{0.826*360*215} = 283\ mm^2 = 2\ \phi\ 16\ /rib$$

Sec. ②

$M = 18.8$ KN.m $b = 500$ mm Solid Slab $ts = 140$ mm

$d = 115$ mm $F_{cu} = 25\ N/mm^2$

$$115 = c_1 \sqrt{\frac{18.8*10^6}{25*500}} \qquad c_1 = 2.96 \qquad j = 0.73$$

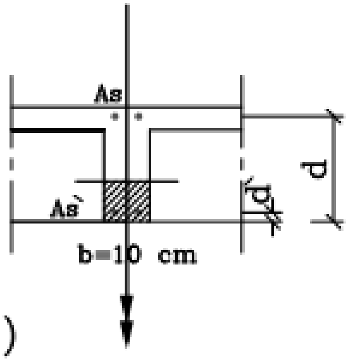
$$As = \frac{18.8*10^6}{0.73*360*115} = 620\ mm^2/0.5\ m = 1240\ mm^2/m = 9\phi 14/m$$

Solid part

Sec. ③

$M_{-ve} = 18.8$ KN.m   Rec. Sec.

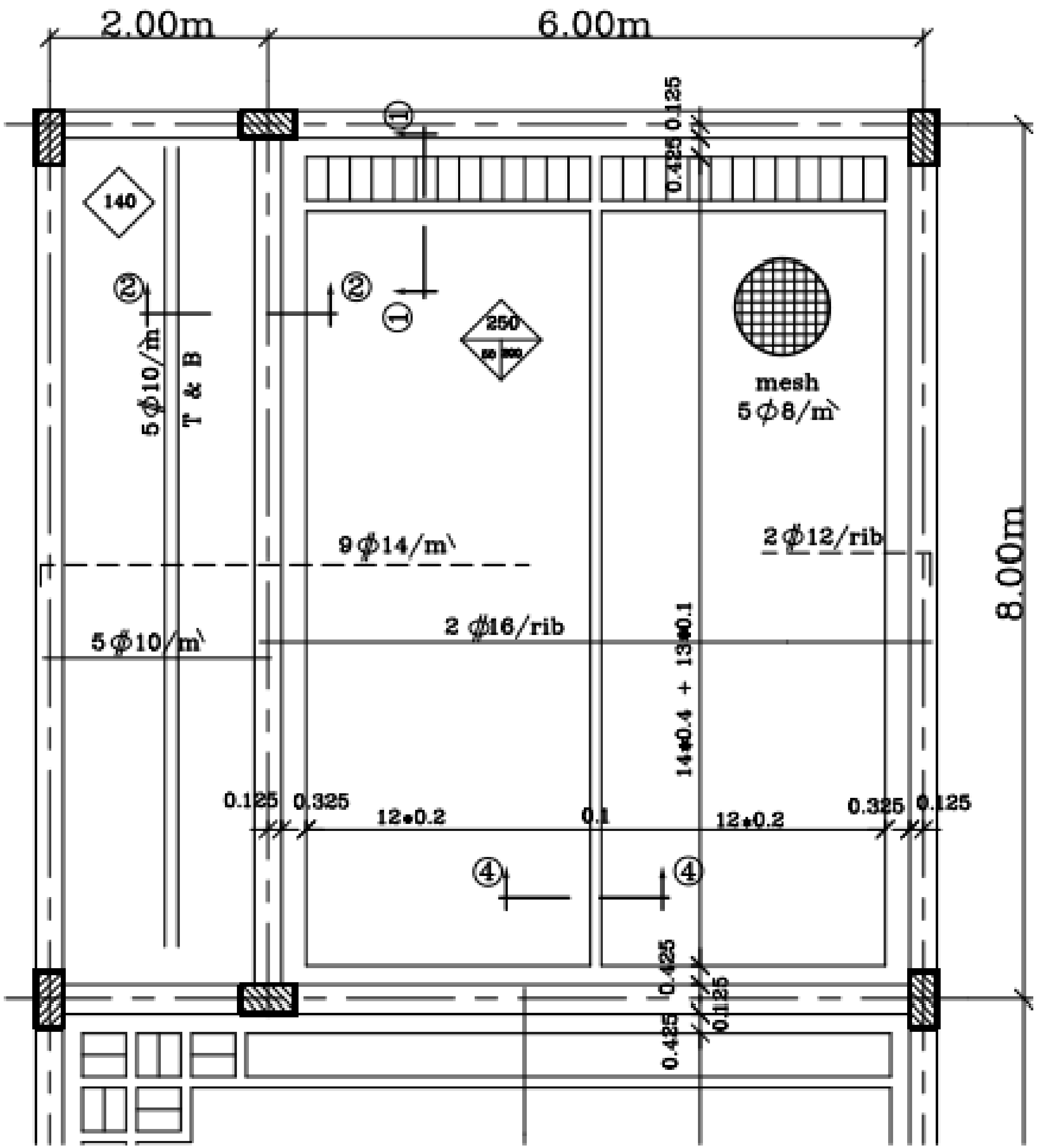
t=250 mm & d=215 mm & As=620 mm^2 & b=100 mm



$$M_R = R_{max} * \frac{Fcu}{\gamma_c} * b * d^2 + A`_s * \frac{Fy}{\gamma_s} * (d - d`)$$

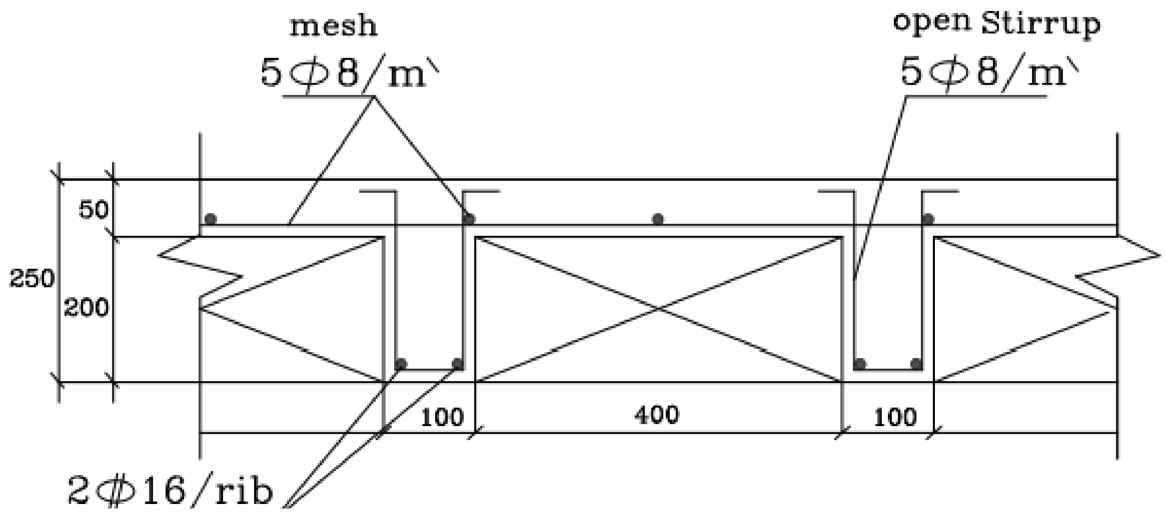
$$M_R = 0.194 * \frac{25}{1.5} * 100 * 215^2 + (0.4 * 662) * \frac{360}{1.15} * (215 - 35)$$

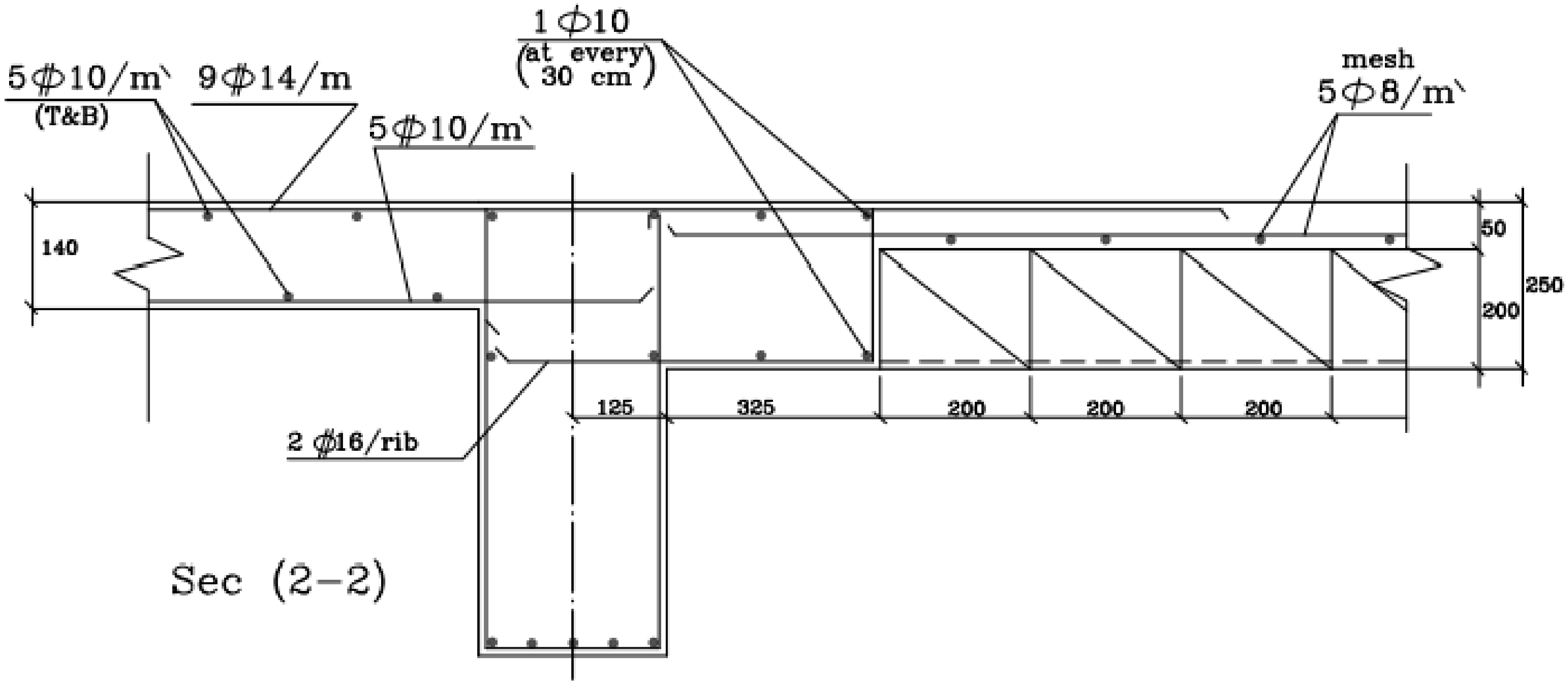
$= 2.95$ KN.m $> M_{-ve} \Longrightarrow$ Use min. solid part.



2.00m
6.00m
8.00m
140
250
5 φ10/m'
T & B
9 φ14/m'
2 φ12/rib
mesh
5 φ8/m'
5 φ10/m'
2 φ16/rib
0.125
0.425
14*0.4 + 13*0.1
0.125
0.325
12*0.2
0.1
12*0.2
0.325
0.125
0.425
0.125
0.425

Sec (1–1)


mesh
5 ϕ 8/m`
open Stirrup
5 ϕ 8/m`
50
250
200
100
400
100
2 ϕ 16/rib

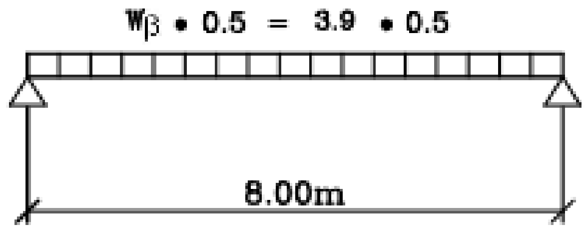

1 ϕ 10
(at every 30 cm)
5 ϕ 10/m`
(T&B)
9 ϕ 14/m
5 ϕ 10/m`
mesh
5 ϕ 8/m`
140
50
250
200
125
325
200
200
200
2 ϕ 16/rib

Sec (2–2)

Solution

<u>Strip (2) :</u>

$$M = \frac{1.95 * (8)^2}{8} = 15.6 \ KN.m$$

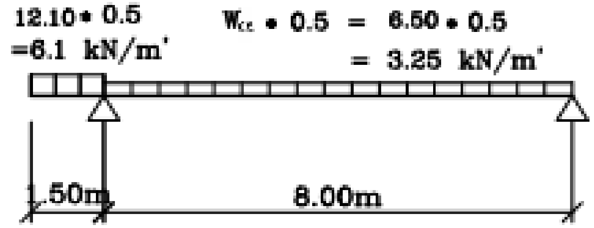


as T−Sec. $B = 500$ mm $d = t - 50 = 200$ mm

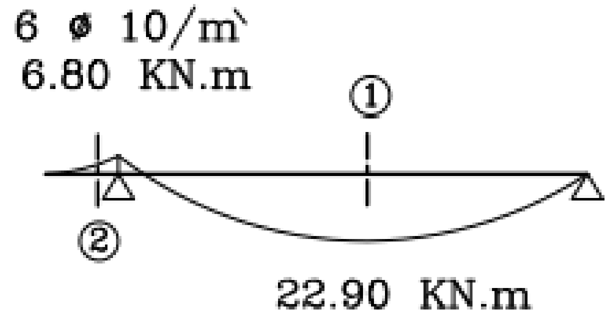
$\Longrightarrow$ $C1 = 6.23$ & $J = 0.826$ $As = 238 \ mm^2 = 2 \ \phi \ 14/rib$

Solution

Strip (3) :

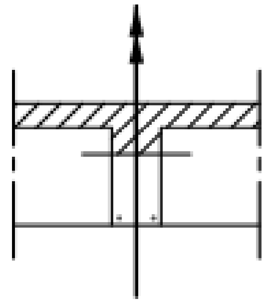


Sec. ①



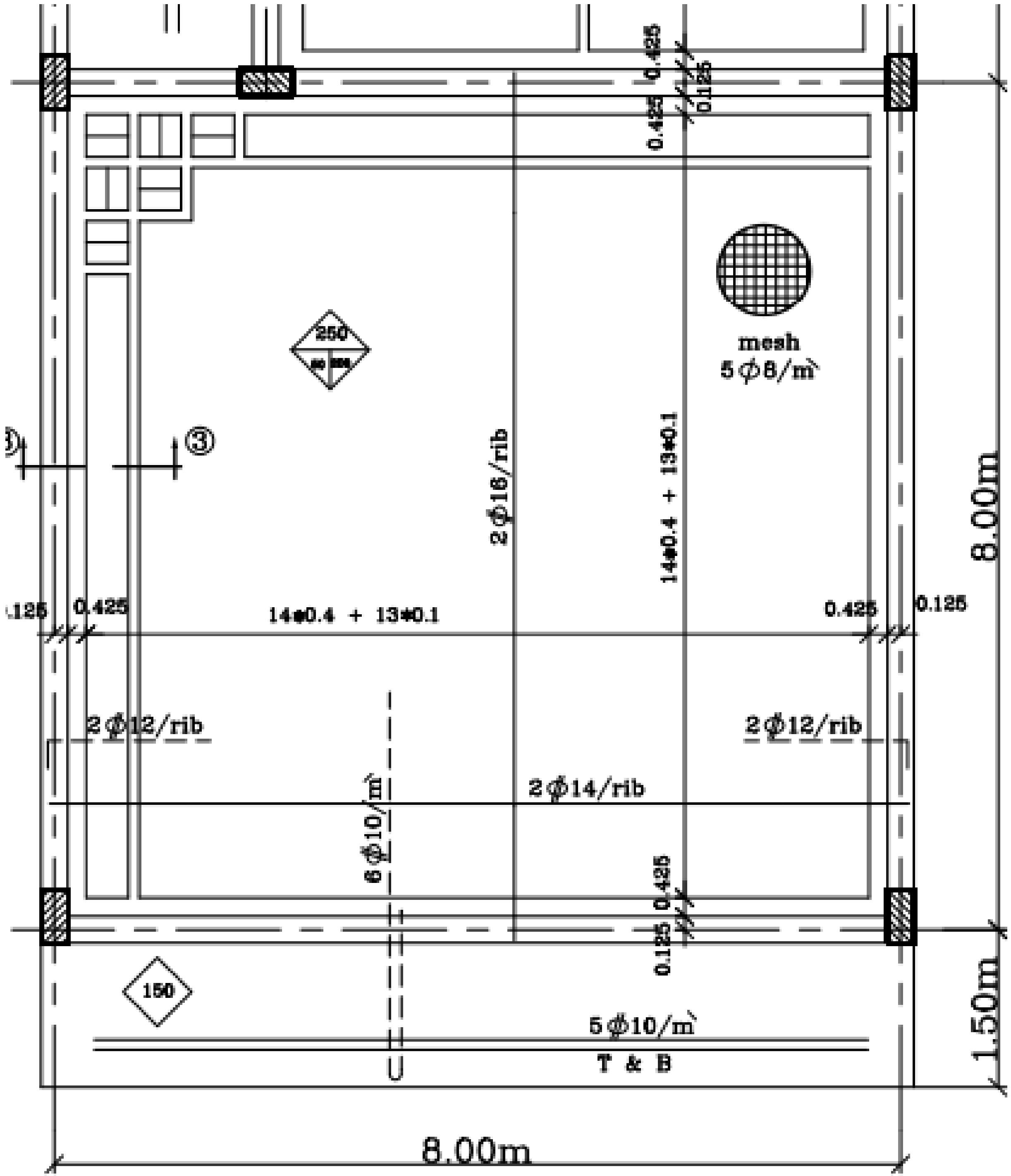
M = 22.9 KN.m   H.B. (+ve) M   T−Sec.

d = 215 mm $F_{cu} = 25\ N/mm^2$ B = 500 mm

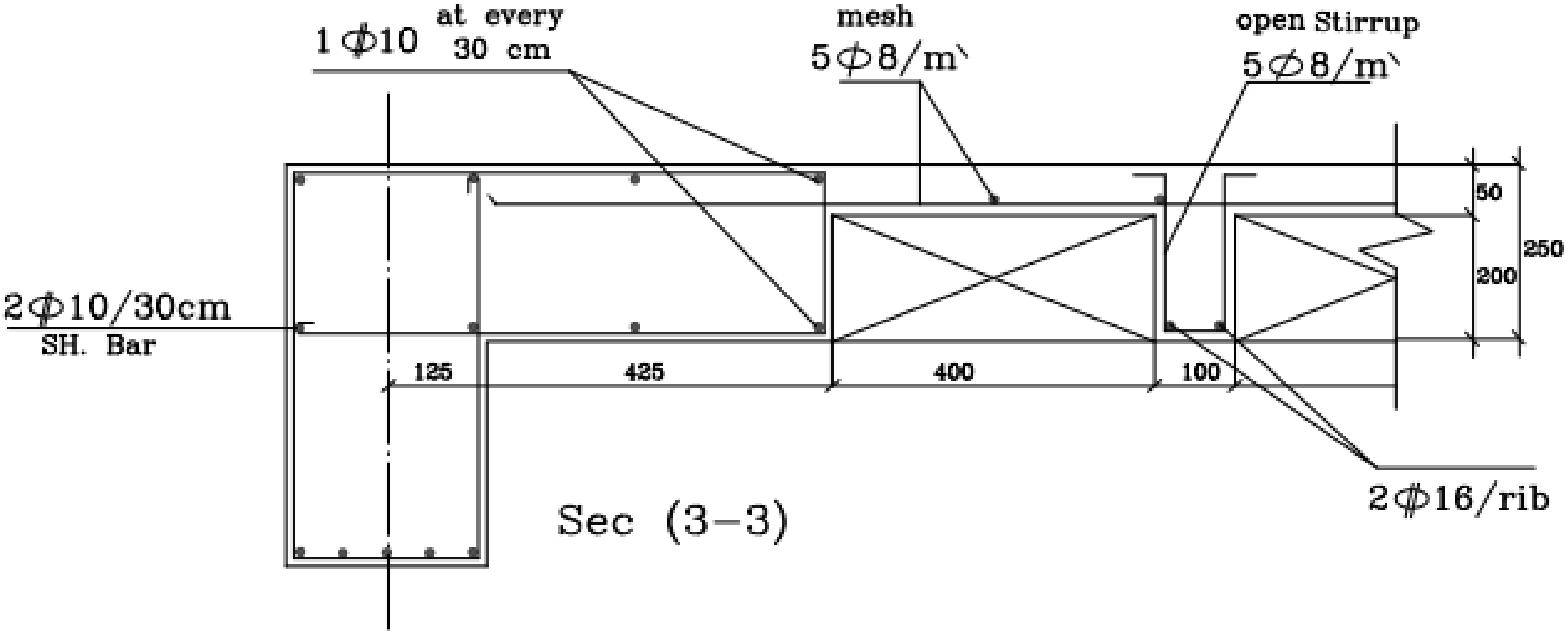


$$215 = c_1 \sqrt{\frac{22.9*10^6}{25*500}} \qquad c_1 = 5.1 \qquad j = 0.826$$

$$As = \frac{22.9*10^6}{0.826*360*215} = 350\ mm^2 = 2\ ø\ 16/rib$$

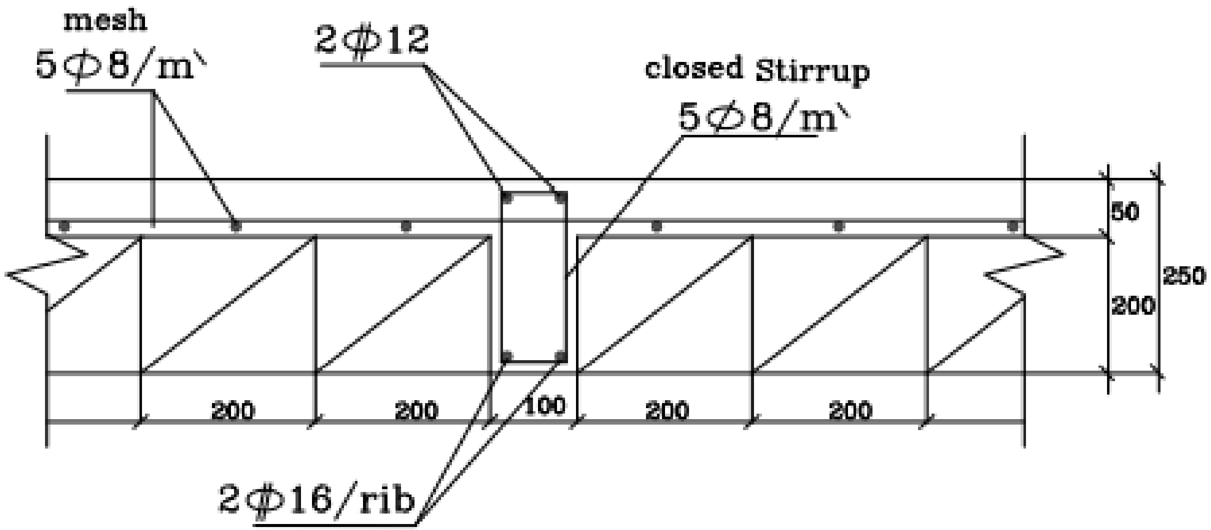


0.425
0.125
0.425
250
mesh
5 ϕ 8/m`
③
2 ϕ 16/rib
14*0.4 + 13*0.1
8.00m
.125
0.425
14*0.4 + 13*0.1
0.425
0.125
2 ϕ 12/rib
2 ϕ 12/rib
6 ϕ 10/m`
2 ϕ 14/rib
0.425
0.125
150
5 ϕ 10/m`
T & B
1.50m
8.00m

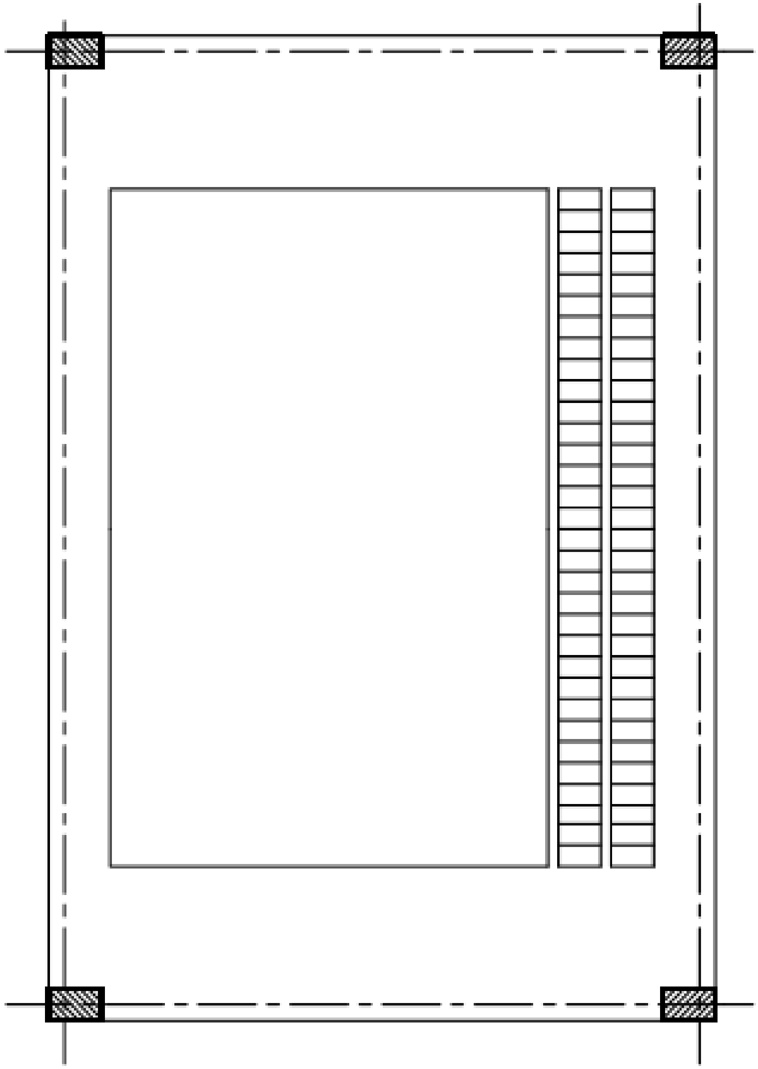

1 Φ10 at every 30 cm
mesh
5 Φ8/m`
open Stirrup
5 Φ8/m`
2Φ10/30cm
SH. Bar
50
200
250
125
425
400
100
2Φ16/rib

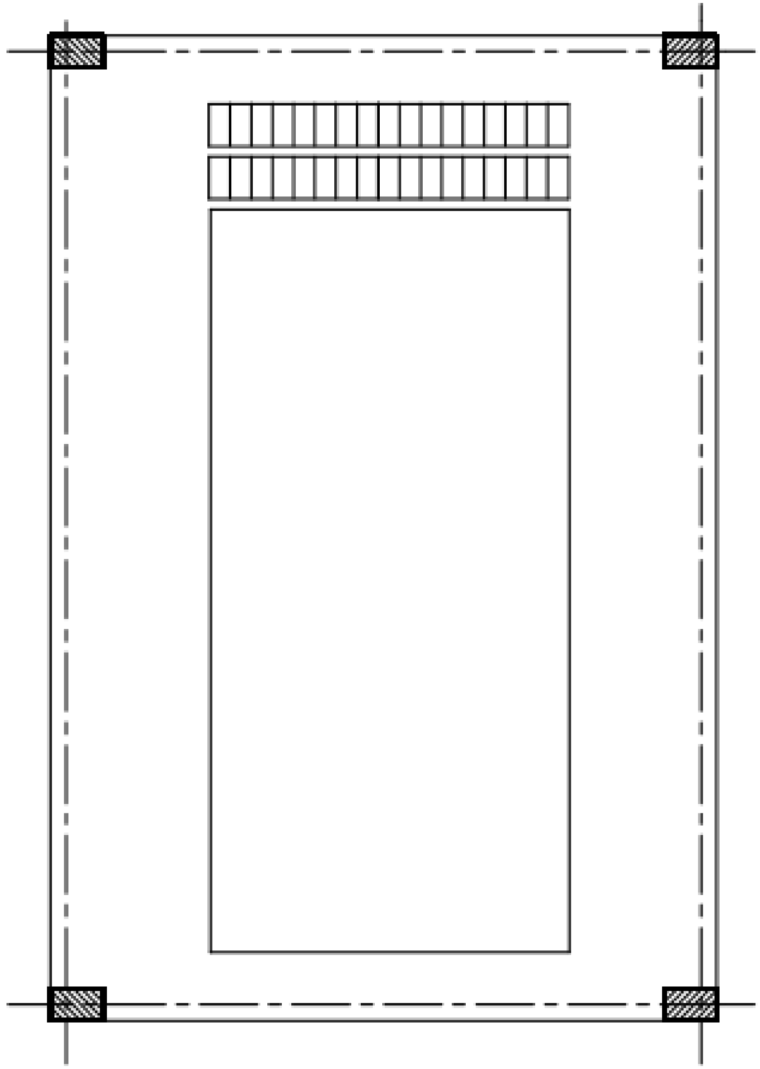
Sec (3–3)

Sec (4–4)


mesh
5Φ8/m`
2Φ12
closed Stirrup
5Φ8/m`
50
200
250
200
200
100
200
200
2Φ16/rib

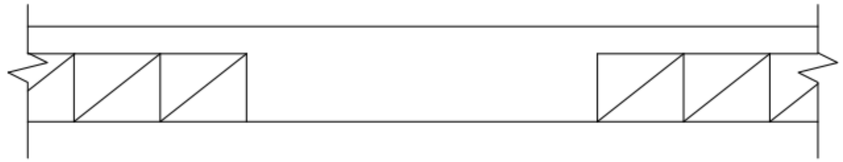
EMBEDDED BEAMS

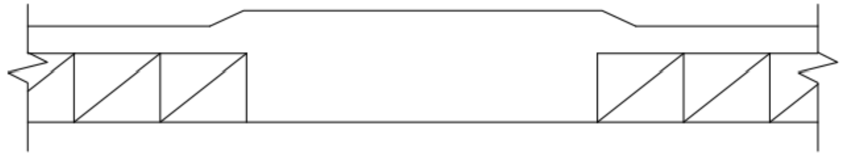




USE OF EMBEDDED BEAMS

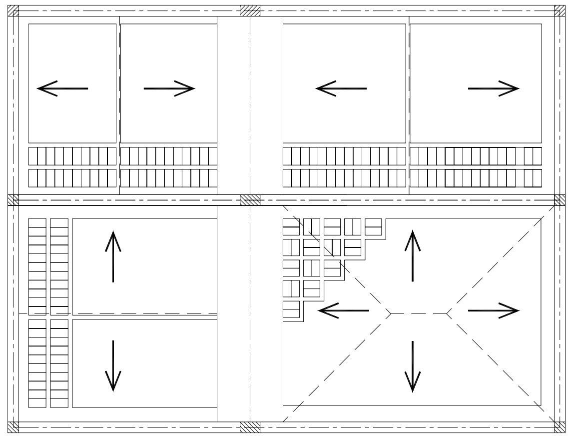
- Hollow Block slabs are supported by either embedded beam or drop beams.
- **Embedded beams**
  - Width > depth
  - Same features as flat slabs
  - Depth can be greater than that of slab by up to 70 mm.



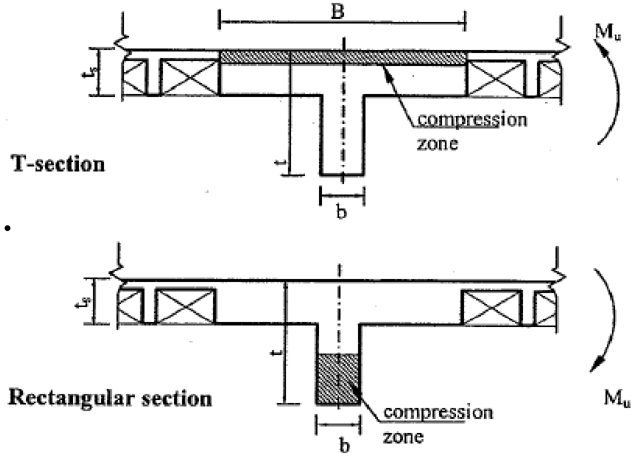


DESIGN OF PROJECTED BEAMS

- Projected Beams are designed to carry the following loads
  - Own weight
  - Wall load (if any)
  - Loads transmitted from slabs

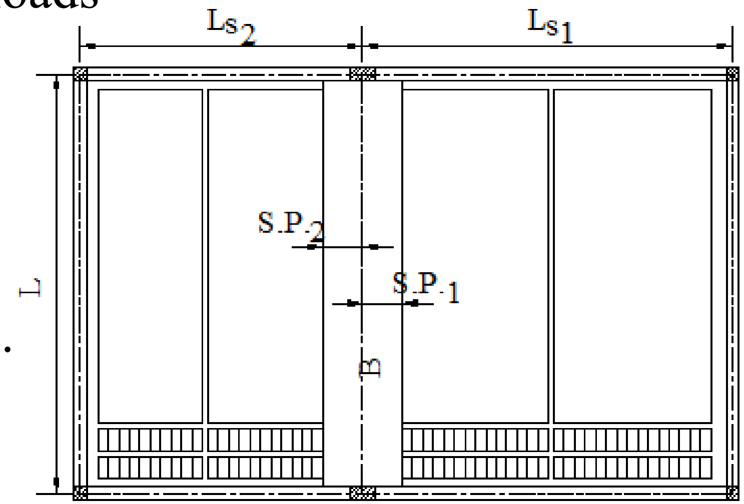


- The distribution of the slab load to the projected beams is
- The bending moments and shear forces are obtained using methods of structural analysis.
- Sections of +ve moments are designed as T-sec. while those of –ve moments are designed as R-sec.



DESIGN OF EMBEDDE BEAMS

- Beams are designed to carry the following loads
  - Own weight
  - Wall load (if any)
  - Loads transmitted from slabs

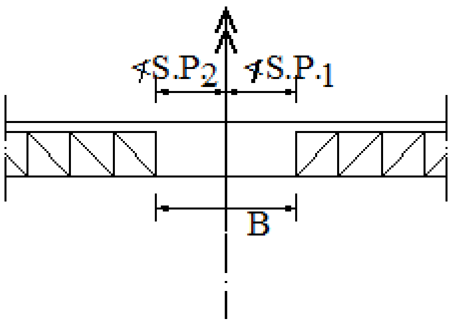


- The bending moments and shear forces are obtained using methods of structural analysis.
- Design of sections is as follows

$$B = S.P._1 + S.P._2 \quad mm \qquad d = t - 50 \quad mm$$

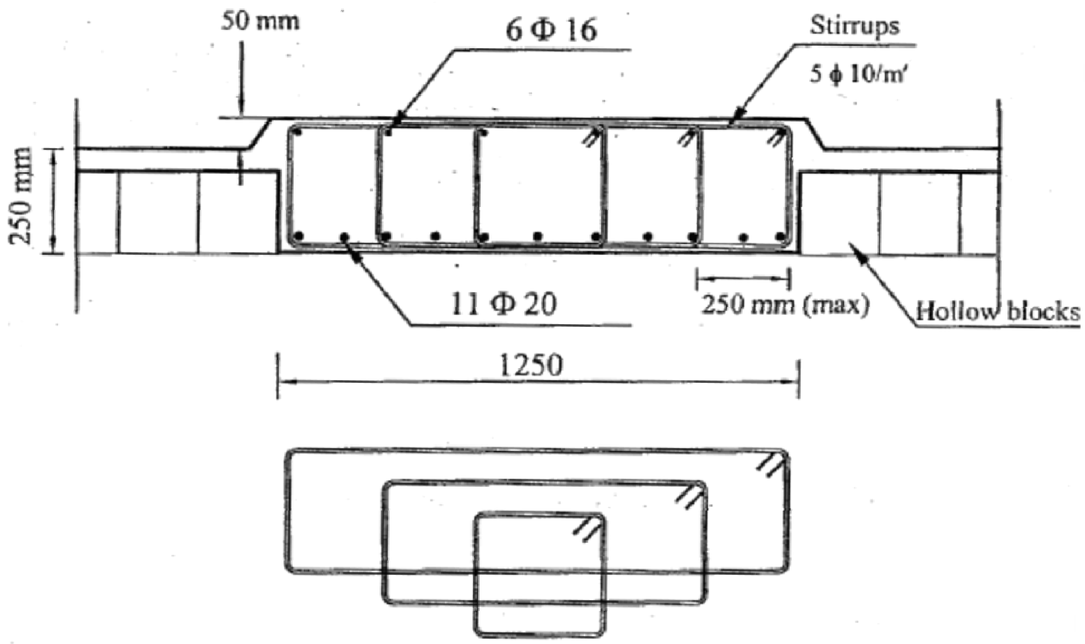
$$d = c_1 \sqrt{\frac{M}{fcu * B}} \qquad c_1 = \ldots\ldots \qquad j = \ldots\ldots$$

$$A_s = \frac{M}{fy\ j\ d} = \ldots\ldots mm^2$$



- Check Shear as slabs
- Check Deflection

DESIGN OF HIDDEN BEAMS



a. Section A-A

Cross Sectional Reinforcement of a Hidden beam

QUIZ