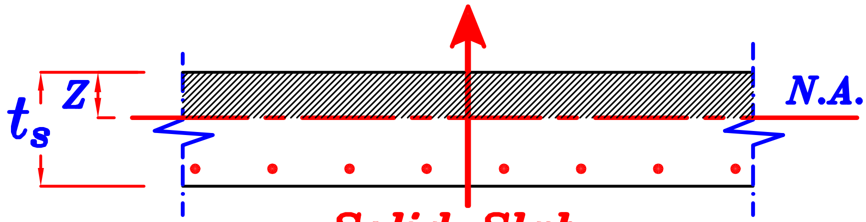
Introduction.

Solid Slab.

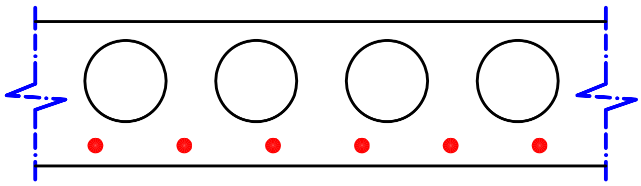


Solid Slab

فى البلاطات ذات المساحات الكبيره يكون ال deflection البلاطه كبير
و لتقليل ال deflection يجب زياده ال t_s للبلاطه مما يتسبب عنه زياده فى الوزن
مما يتسبب عنه زياده فى ال moment مما يتسبب عنه زياده فى التسليح
مما يتسبب عنه زياده فى التكلفه .
لذا نحتاج فى هذه الحاله لنوع من البلاطات تكون ال t كبيره لتقليل ال deflection
و فى نفس الوقت وزنها خفيف لتقليل العزوم لتقليل التكلفه .

و يوجد عده أنواع من هذه البلاطات منها :

① Hollow Core Slab.

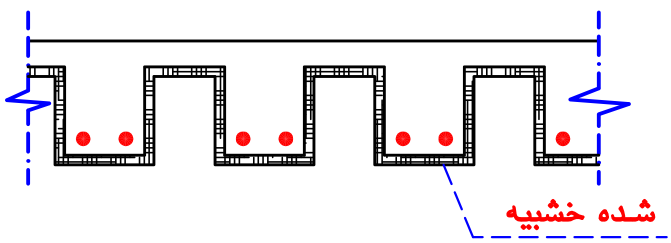

Hollow Core Slab

و تكون البلاطات مفرغه كما بالشكل و هذه النوعيه من البلاطات تكون
خرسانه سابقه الصب Pre-cast concrete.

ميزتها : خفيفه الوزن.

عيبها : غاليه الثمن و صعبه التنفيذ لذا لا تستعمل إلا مع التخانات الكبيره مثل الكبارى.

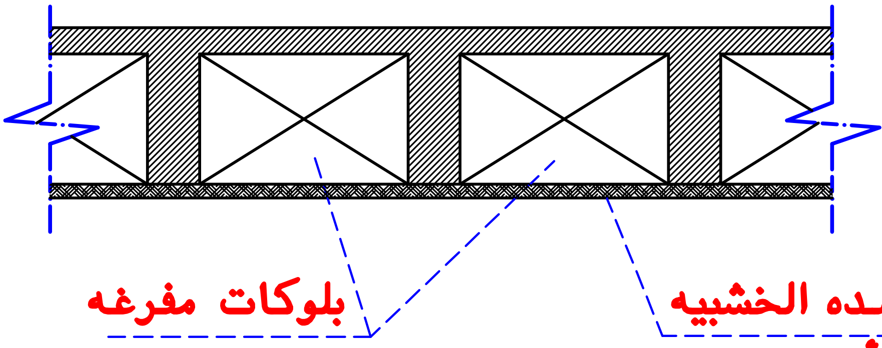
② Ribbed Slab.



ميزتها : خفيفه الوزن.

عيبها : الشده الخشبيه ليست مستقيمه لذا فهى صعبه التنفيذ و غاليه الثمن .

③ Hollow Block Slab.



Hollow Block Slab

تشبه كثيرا الـ Ribbed Slab لكن مع إستخدام بلوكات طوب مفرغه (خفيفه الوزن)

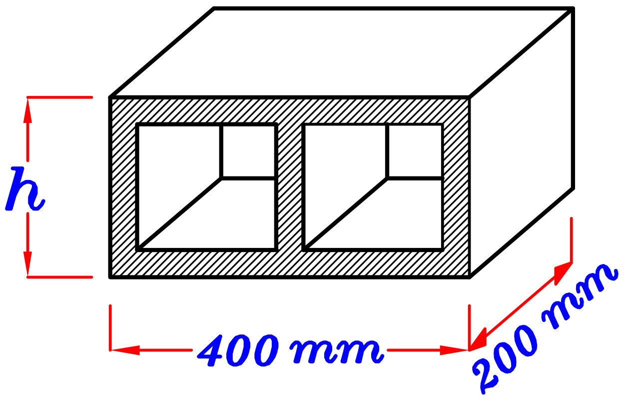
مميزاتها : خفيفه الوزن .

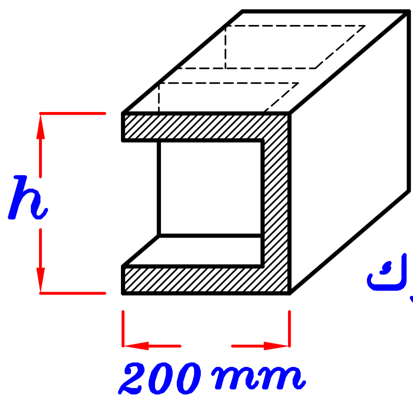
الشده الخشبيه أفقيه (سهله التنفيذ) .

أحجام و أوزان البلوكات المختلفه .

توجد للبلوكات أحجام مختلفه أشهرها $(200 * 400 * h)$

و غالبا تكون قيمه h | $h = 150$ mm **or** 200 mm **or** 250 mm





و أوزان البلوكات تختلف حسب حجم البلوك و الماده المصنوعه منها

فتوجد بلوكات مصنوعه من الحجر الجيرى و بلوكات مصنوعه من الطوب الاسمنتى

و بلوكات مصنوعه من الـ Foam .

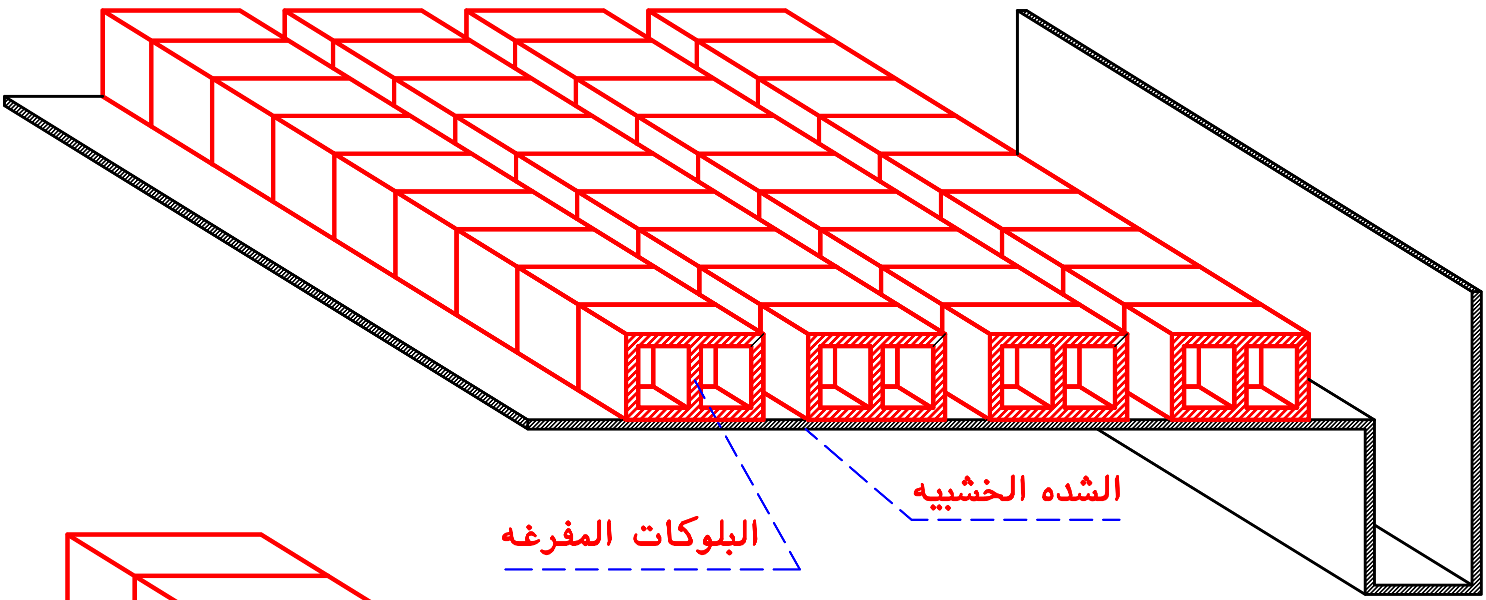
و أوزان البلوكات تختلف حسب حجم البلوك و الماده المصنوعه منها فتوجد بلوكات مصنوعه من الحجر الجيرى و بلوكات مصنوعه من الطوب الاسمنتى و بلوكات مصنوعه من ال $Foam$.

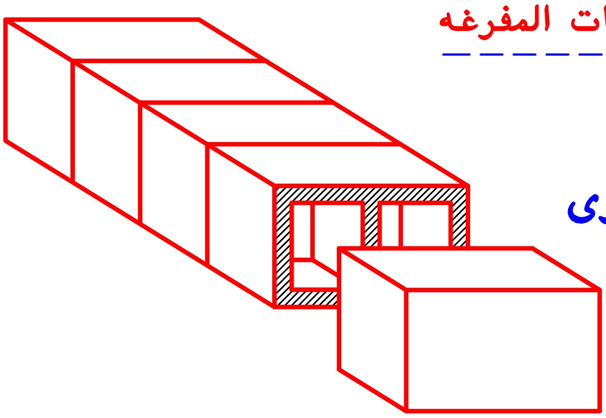
أوزان البلوكات $(200 * 400 * h)$

نوع ماده البلوك	ارتفاع البلوك بالمم		
	$h = 250$ mm	$h = 200$ mm	$h = 150$ mm
طوب أسمنتى مفرغ	320 N	250 N	190 N
طوب جيرى خفيف الوزن	150 N	120 N	90 N
طوب خرسانى مفرغ	240 N	190 N	140 N
طوب جيرى رملى مفرغ	280 N	220 N	170 N

عموما اذا لم نكن متأكدين من نوع ماده البلوك فالاضمن أخذ أكبر وزن

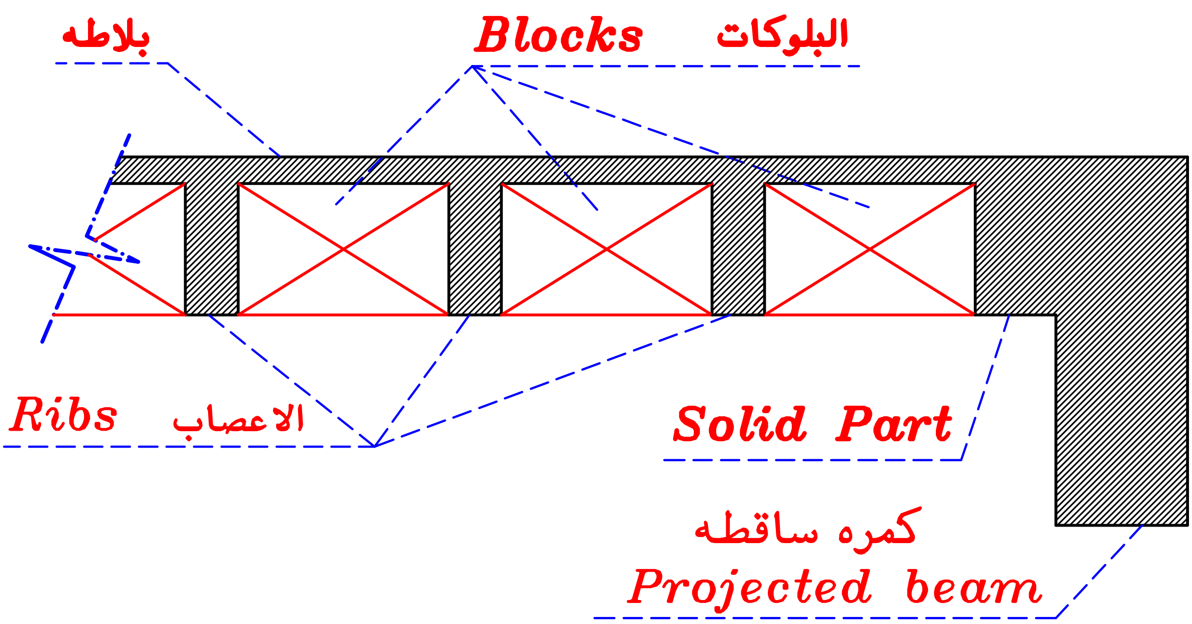
شكل الشده الخشبيه و البلوكات المفرغه قبل صب الخرسانه



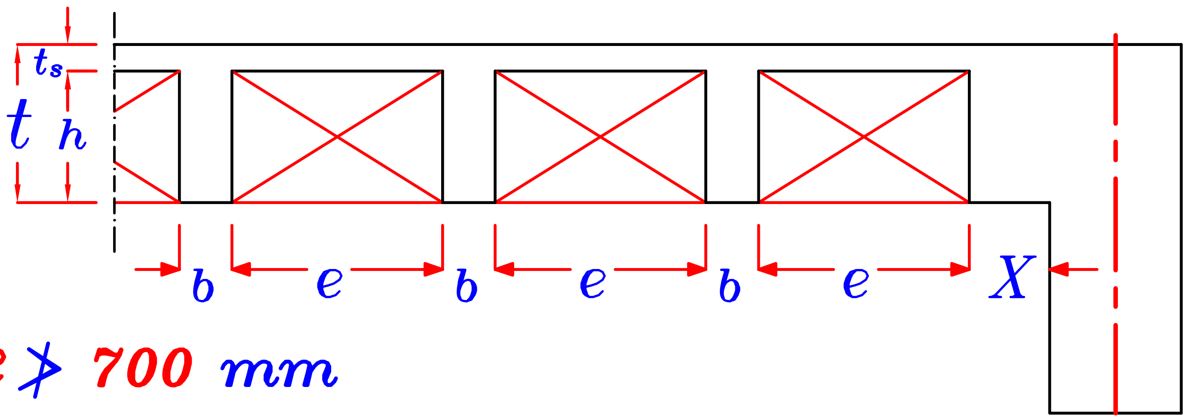


يوضع أخر بلوك عكس البلوكات الأخرى لمنع دخول الخرسانه داخل البلوك

Hollow Blocks الأجزاء المكونه للبلاطه ال



Hollow Blocks أبعاد البلاطه ال



إشتراطات الكود.

- $e \ngtr 700\ mm$
- $b \nless 100\ mm$, $\nless \frac{t}{3}$ } الأكبر
- $X \nless 150\ mm$
- $t_s \nless 50\ mm$, $\nless \frac{e}{10}$ } الأكبر

القيم العمليه.

$e = 400\ mm$, $b = 100\ mm$, $S = e + b$

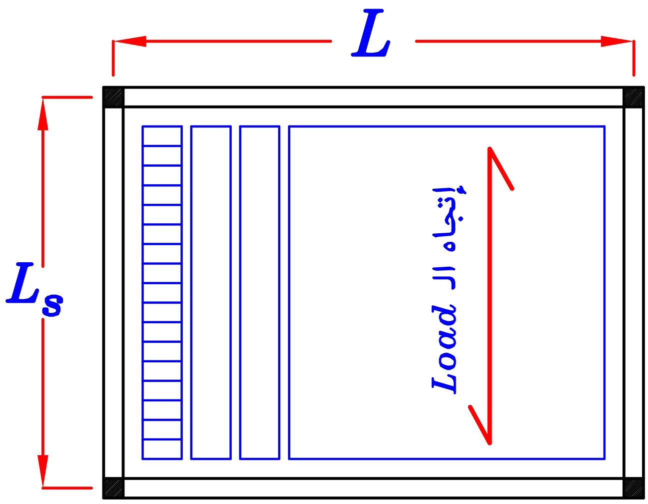
$h = 150\ mm$ or $200\ mm$ or $250\ mm$

$t_s = 50\ mm$ or $60\ mm$ or $70\ mm$

$t = h + t_s$

Types of Hollow Blocks Slab.

① One Way Hollow Block Slab.



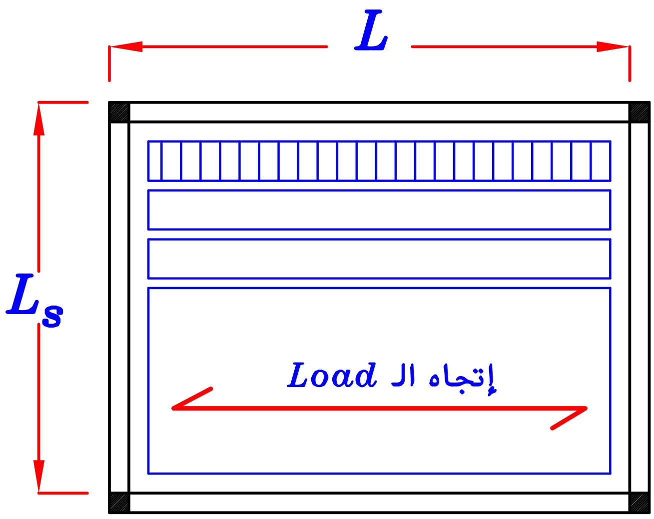
نستخدم بلاطه One Way

عندما تكون $5.0\ m < L_s \leq 7.0\ m$

OR $L_s \leq 8.0\ m$, $L.L. \leq 1.0\ kN\backslash m^2$

ملحوظه

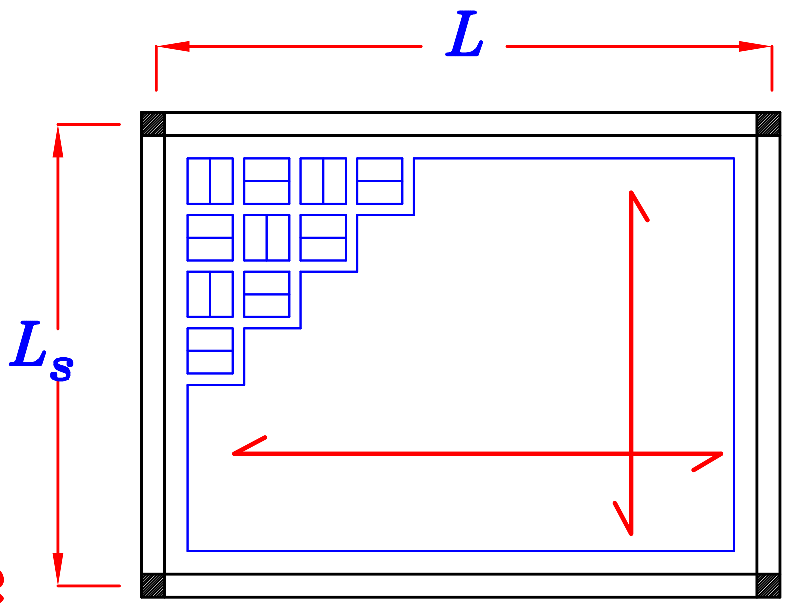
إتجاه ال Load هو نفس إتجاه ال ribs .



ملحوظه

لا يفضل أخذ ال ribs فى الاتجاه الطويل الا فى حالات خاصه .

② Two Way Hollow Block Slab.



نستخدم بلاطه Two Way

عندما تكون $L_s > 7.0\ m$

بشرط

فى الكود $\frac{L}{L_s} \ngtr 1.5$

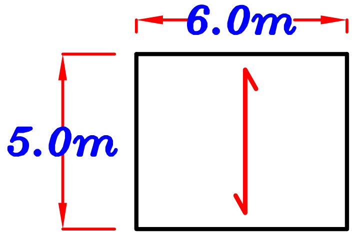
يفضل عملياً $\frac{L}{L_s} \ngtr \frac{4}{3}$

Example.

Which type of H.B. slab, We need in each case ??

One Way H.B. Slab.

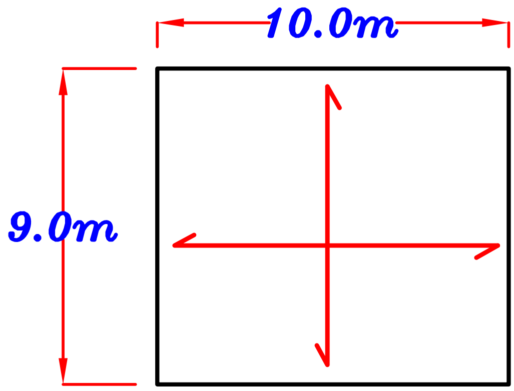
$L_s \leqslant 7.0\ m$



Two Way H.B. Slab.

$L_s > 7.0\ m$

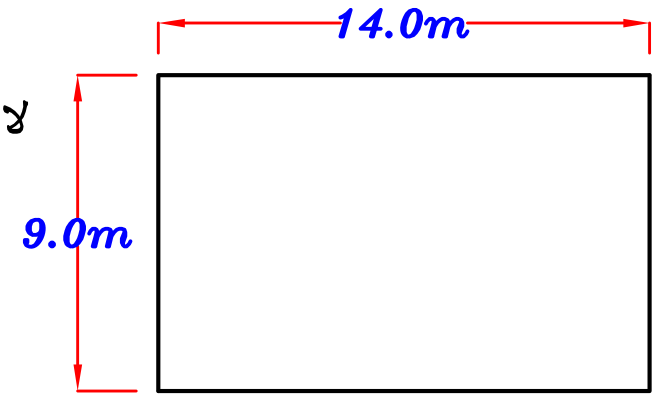
, $\frac{L}{L_s} \ngtr \frac{4}{3}$



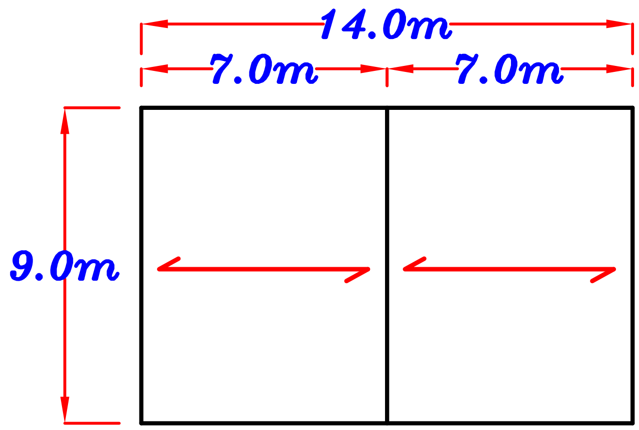
Can't be H.B. slab.

لا تصلح لأنْ تكون H.B. slab

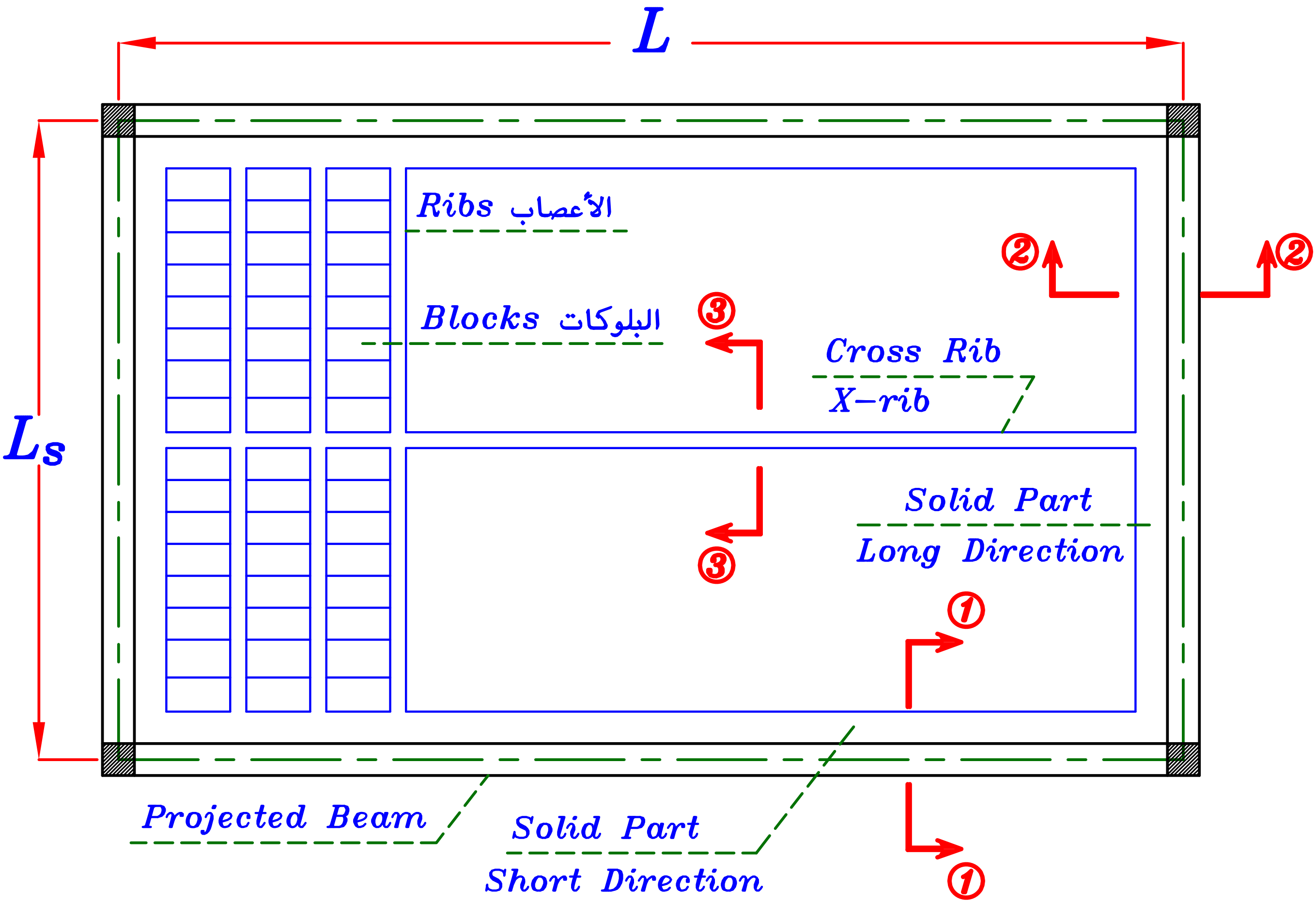
لأنْ $\frac{L}{L_s} > \frac{4}{3}$

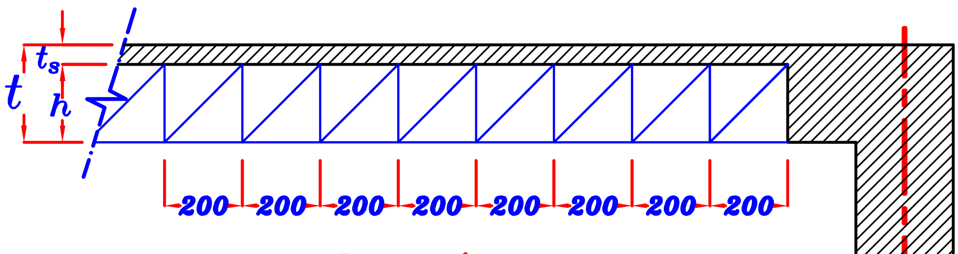


Use another system

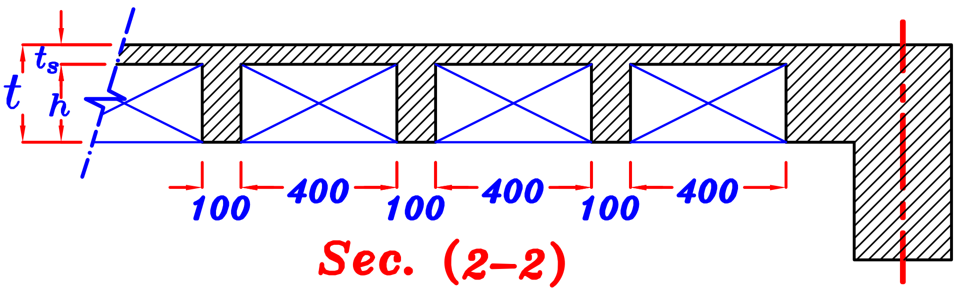


One Way Hollow Block Slab.

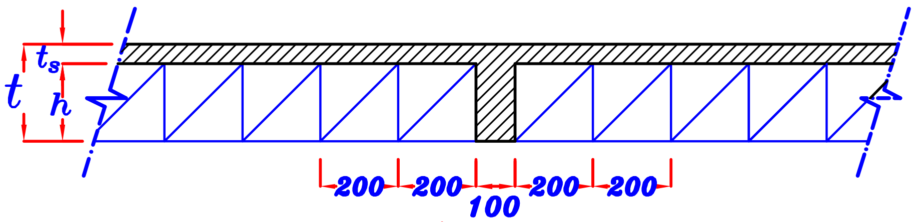




Sec. (1-1)

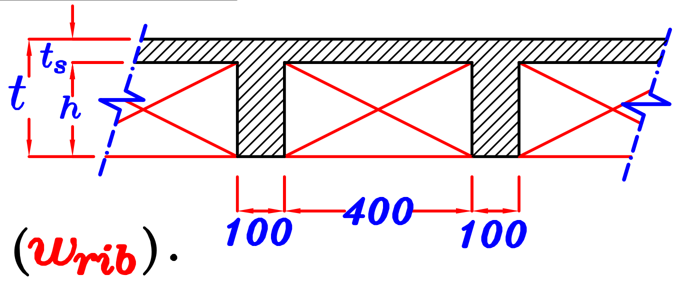


Sec. (2-2)



Sec. (3-3)

Steps of Design.



① Choose $t = t_s + h$

② Get the Loads on the Slab. (w_{rib}).

③ Take strip at the Load direction , and Get **B.M.** (kN.m\rib)

④ Design the Ribs. [**Dimensions** (b * h) & **RFT.** (2 Ø ✓ \rib)].

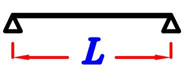
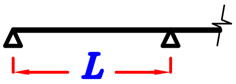
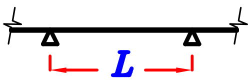
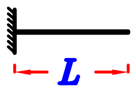
- Take the dimensions and RFT. of the X–rib the same as the designed ribs.
- Get the dimensions of the solid part & Arrangement of Blocks.

⑤ Draw the RFT. [Plan & Cross–Sections].

- Design the Beam. [Projected or Embedded].

① Choose (t).   ($t = t_s + h$)

Check deflection قيم (t) التى نأخذها لكى نتفادى عمل

				
st. 360\520	L/16	L/18	L/21	L/8
st. 240\350	L/(16 * 1.25)	L/(18 * 1.25)	L/(21 * 1.25)	L/(8 * 1.25)

و لكن هذه القيم تجعل t كبيره جداً جداً لذا غالباً ما نأخذ :

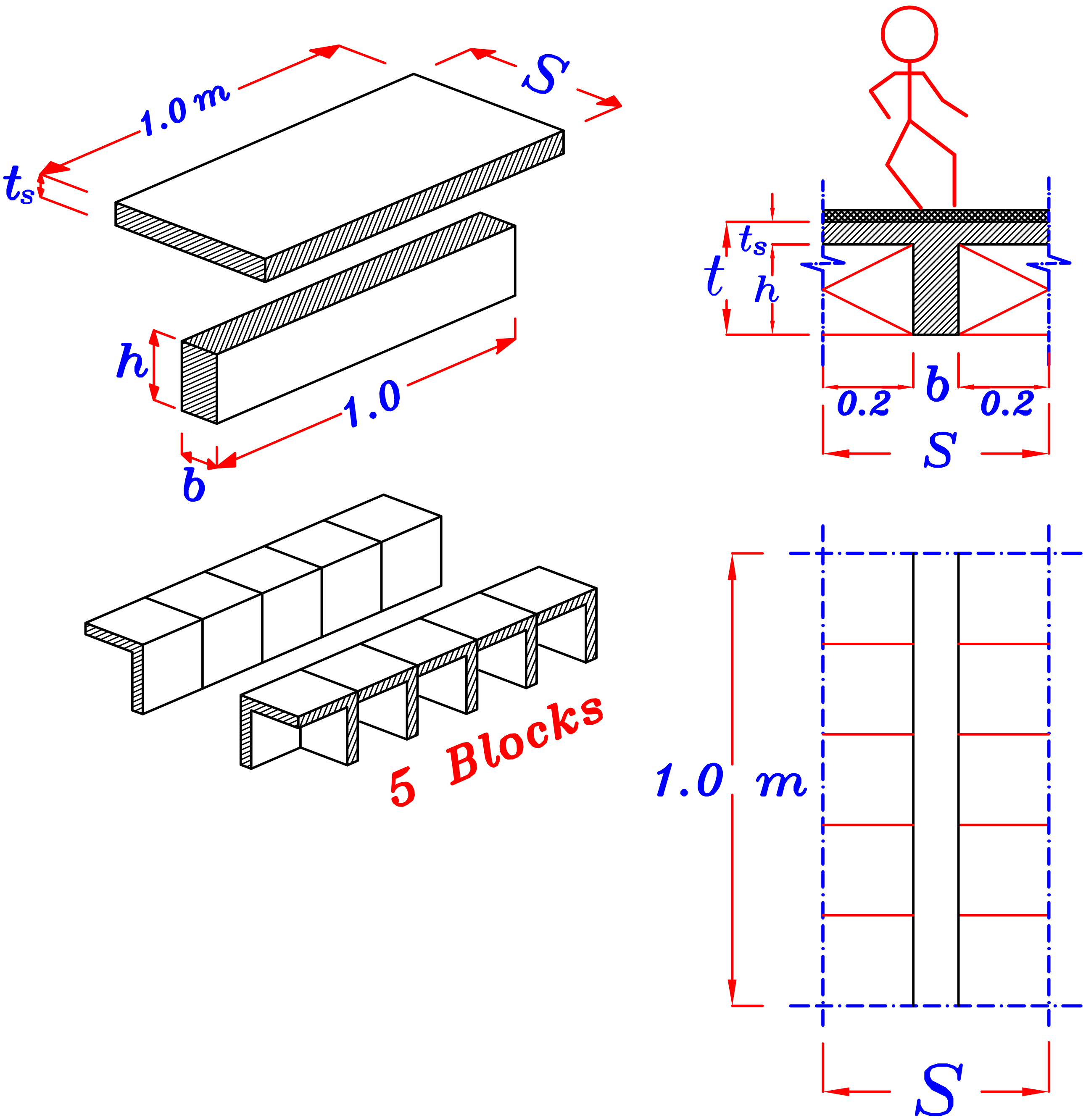
$t = 200\ mm\ (t_s = 50\ mm,\ h = 150\ mm)$.

$t = 250\ mm\ (t_s = 50\ mm,\ h = 200\ mm)$. ------ **الأكثر أستخداماً**

$t = 300\ mm\ (t_s = 50\ mm,\ h = 250\ mm)$.

و فى هذه الحاله **المفروض !!!** أن نعمل Check deflection.

② Get the Loads on the Slab. (w_{rib}) $(kN \backslash (1.0 * S)\, m^2)$.



$$S = e + b = 0.4 + 0.1 = 0.5 \ m$$

$$(w_{rib})_{U.L.} = \left[1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)\right] S$$

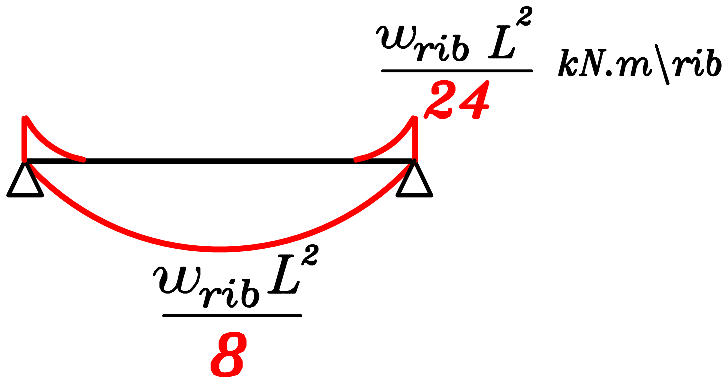
$$+ 1.4\,(b\,h * 1.0 * \gamma_c) + 1.4\left[5\,(\text{Weight of One Block})\right]$$

$$= \checkmark \ (kN \backslash (1.0 * S\ m^2))$$

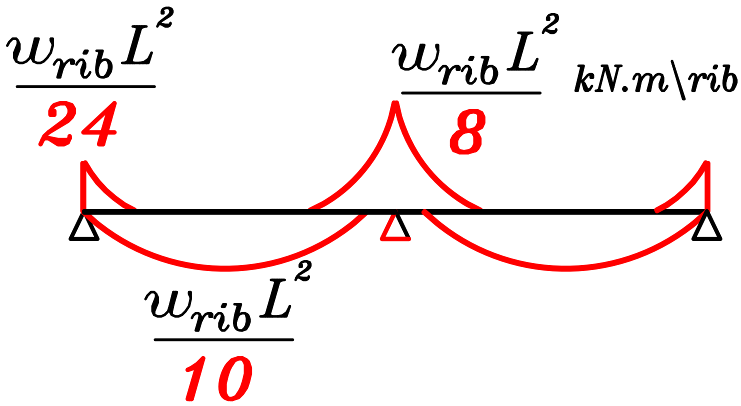
③ Take strip at the Load direction , and Get B.M. (kN.m\rib)

نأخذ شريحه عرضها $(S = 0.5\,m)$ فى إتجاه الحمل و نأتى بقيم الـ $B.M.$

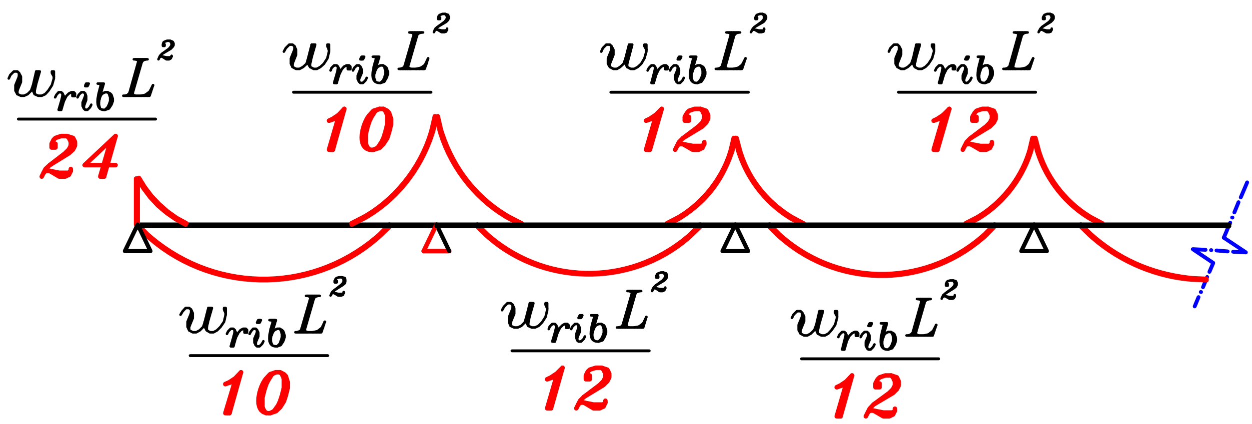
Simple Span.



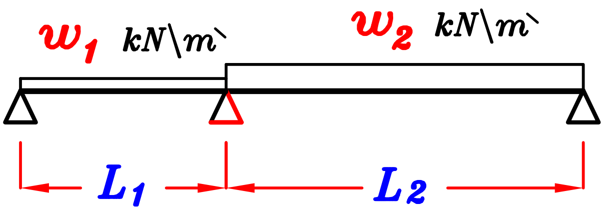
2 equal spans.



More than 2 equal spans.



IF not equal spans.



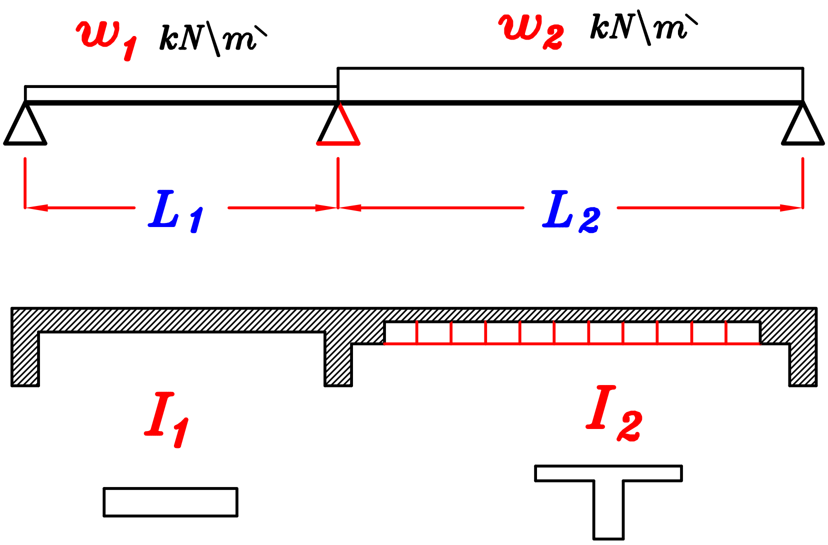
Use 3 Moment Equation.

$$M_1(L_1) + 2M_2(L_1+L_2) + M_3(L_2) = -6(r_1+r_2)$$

Special Case.

IF there is Solid Slab & H.B. Slab at the same Strip.

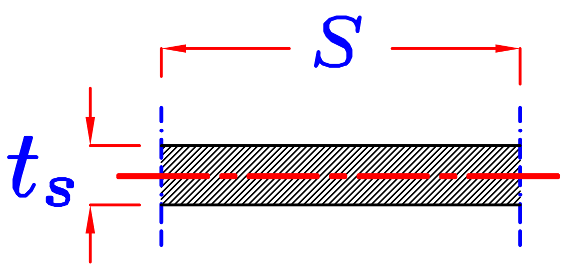
Note that $I_{s.s.} \neq I_{H.B.}$



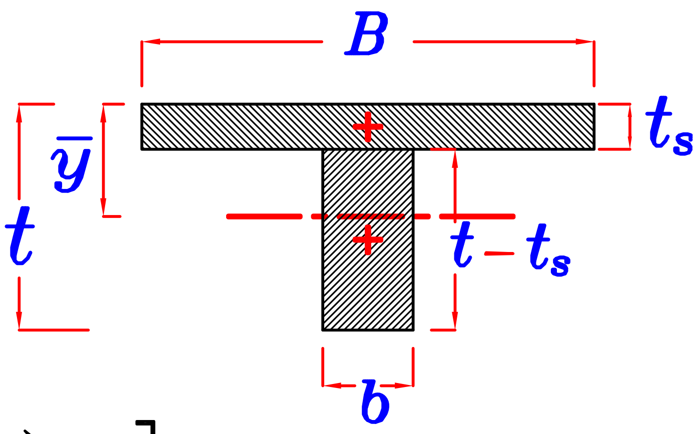
$$M_1\left(\frac{L_1}{I_1}\right) + 2M_2\left(\frac{L_1}{I_1}+\frac{L_2}{I_2}\right) + M_3\left(\frac{L_2}{I_2}\right) = -6\left(\frac{r_1}{I_1}+\frac{r_2}{I_2}\right)$$

* To Get $I_1 = I_{s.s.}$

$$I_{s.s.} = \frac{S\,(t_s)^3}{12}$$



* To Get $I_2 = I_{H.B.}$



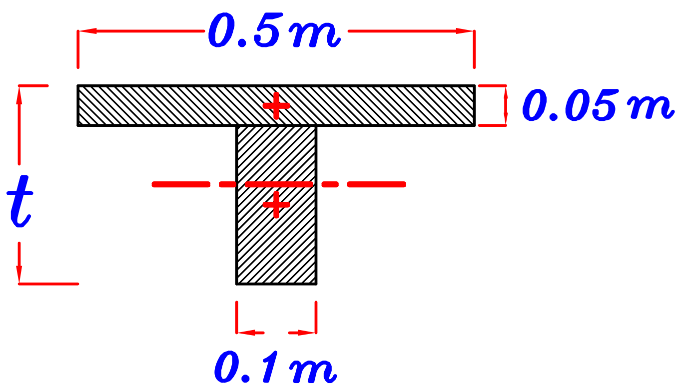
$$A = B\,t_s + b\,(t - t_s)$$

$$\bar{y} = \frac{B\,t_s\,\left(\frac{t_s}{2}\right) + b\,(t-t_s)\left[\left(\frac{t-t_s}{2}\right) + t_s\right]}{A}$$

$$I_{H.B.} = \frac{b\,(t-t_s)^3}{12} + b\,(t-t_s)\left(\left(\frac{t-t_s}{2}\right) + t_s - \bar{y}\right)^2 + \frac{B\,t_s^3}{12} + B\,t_s\left(\bar{y} - \frac{t_s}{2}\right)^2$$

For

S	=	$0.50\ m$
b	=	$0.10\ m$
t_s	=	$0.05\ m$



IF $t = 0.20\ m \longrightarrow I_{H.B.} = 1.27 * 10^{-4}\ m^4$

IF $t = 0.25\ m \longrightarrow I_{H.B.} = 2.45 * 10^{-4}\ m^4$

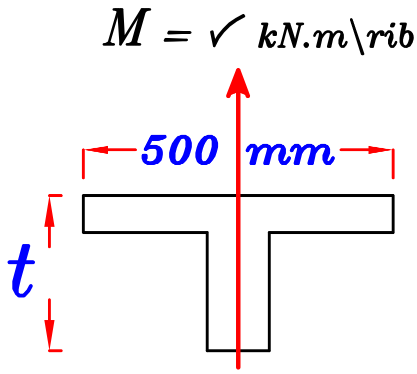
IF $t = 0.30\ m \longrightarrow I_{H.B.} = 4.16 * 10^{-4}\ m^4$

④ Design the Ribs. (Dimensions & RFT.)

AFter we get $M = \checkmark \; kN.m \backslash rib$

$\because t = \checkmark \; mm$

$\therefore d = t - 30 \; mm \; (Cover) = \checkmark \; mm$



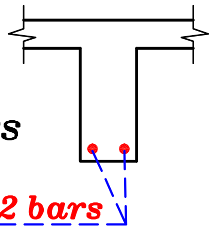
$\because d = C_1 \sqrt{\dfrac{M \; (kN.m \backslash rib)}{F_{cu} \; B}} \; , \quad B = 500 \; mm$

Get $C_1 = \checkmark \longrightarrow J = \checkmark$

$$A_s = \frac{M}{J \, F_y \, d} = \checkmark \; mm^2 \backslash rib = 2 \phi \checkmark \backslash rib$$

Choosing A_s — إختيار A_s

1- No. of bars\rib = 2 bars



١- عدد الأسياخ فى العصب =٢سيخ

2- min ϕ = ϕ 10

max ϕ = ϕ 22

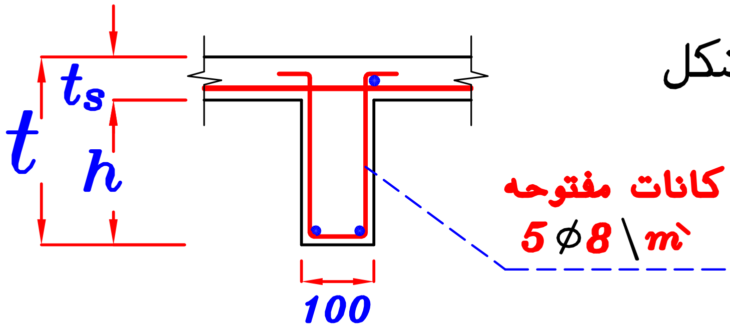
٢- أقل قطر للسيخ = ١٠ مم

أكبر قطر للسيخ= ٢٢ مم

٣- ممكن إستخدام قطرين مختليفين للسيخين فى العصب الواحد بشرط أن يكونا متتاليان فى الجدول 10,12,16,18,20,22

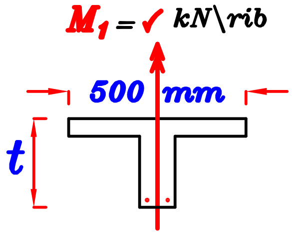
$1 \phi 12 + 1 \phi 16 \backslash rib$ OR $1 \phi 16 + 1 \phi 18 \backslash rib$

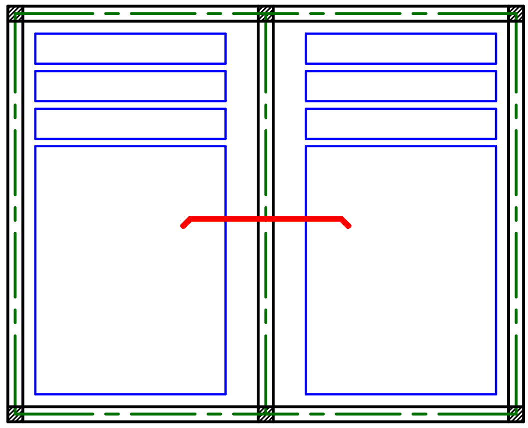
٤- تكون الكانات مفتوحه كما بالشكل



For Continuos H.B. Slab.

Sec. ①



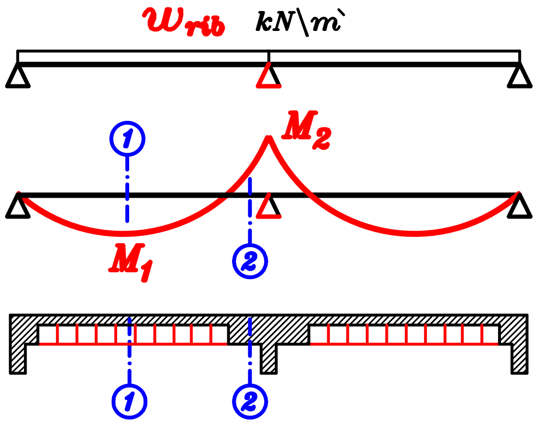


Get $M_1 =$ ✓ kN.m\rib

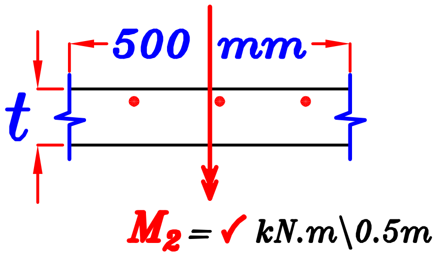
$$d = t - 30\,mm = C_1 \sqrt{\frac{M_1\,(kN.m\backslash rib)}{F_{cu}\;B}} \;,\; B = 500\,mm$$

Get $C_1 = \checkmark \longrightarrow J = \checkmark$

$$A_{s_1} = \frac{M_1}{J\,F_y\,d} = \checkmark\; mm^2\backslash rib = 2\,\phi\,\checkmark\,\backslash rib$$



Sec. ②



١- ممكن وضع التسليح العلوى 2 ϕ ✓ \rib

(إذا كانت البلاطتين .H.B)

Get $M_2 =$ ✓ kN.m\rib

عندما تكون بلاطة .H.B بجوار البلاطة ال .H.B

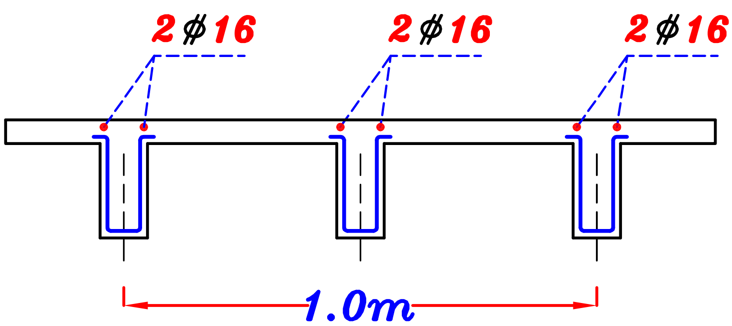
$$d = t - 30\,mm = C_1 \sqrt{\frac{M_2\,(kN.m\backslash rib)}{F_{cu}\;B}} \;,\; B = 500\,mm \quad Get\;\; C_1 = \checkmark \longrightarrow J = \checkmark$$

$$A_{s_2} = \frac{M_2}{J\,F_y\,d} = \checkmark\; mm^2\backslash rib = 2\,\phi\,\checkmark\,\backslash rib$$

Example.

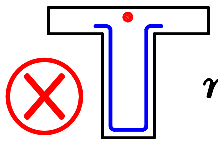
IF $A_{s_2} = 364\;\; mm^2\backslash rib$

$= 2\,\phi\,16\,\backslash rib$



٢ـ ممكن وضع التسليح العلوى $\checkmark \phi \checkmark \backslash m$

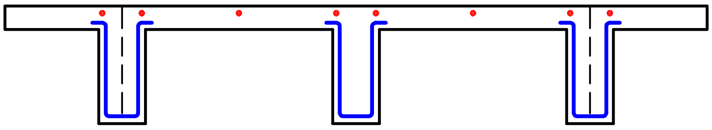
(إذا كانت البلاطتين واحده **H.B.** و واحده **S.S.**) يؤخذ التسليح فى المتر الطولى و ليس فى ال rib

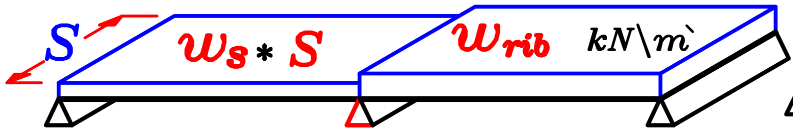


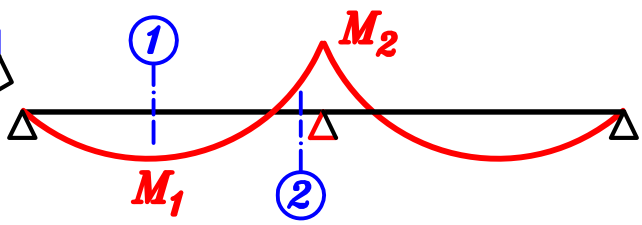
حتى لا تزيد المسافات بين الاسياخ فى البلاطه ال **Solid** عن ٢٠ سم

و حتى لكى لا توضع أسياخ علويه فوق ال rib مباشره حتى نتمكن من صب ال rib

و لذلك يجب أن نأخذ عدد الاسياخ زوجى فى المتر و يرص الحديد العلوى كالتالى

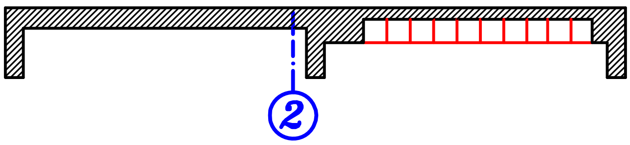






يتم التصميم للقطاع المشترك فى البلاطه ال $Solid$

لانه القطاع الاضعف .



Sec. ②

$$d = t_s - 20\ mm = C_1 \sqrt{\frac{M_{2\,(kN.m\backslash 0.5m)}}{F_{cu}\ B}} \quad , \quad B = 500\ mm$$

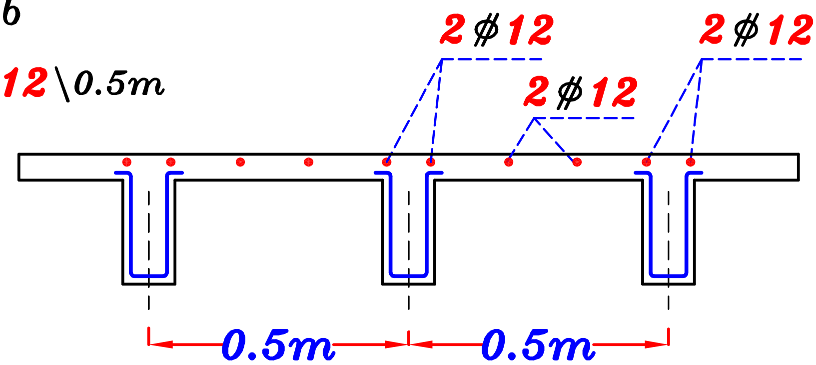
$$Get \quad C_1 = \checkmark \longrightarrow J = \checkmark$$

$$A_{s_2} = \frac{M_2}{J\ F_y\ d} = \checkmark\ mm^2\backslash 0.5m = \checkmark \phi \checkmark \backslash 0.5m$$

Example.

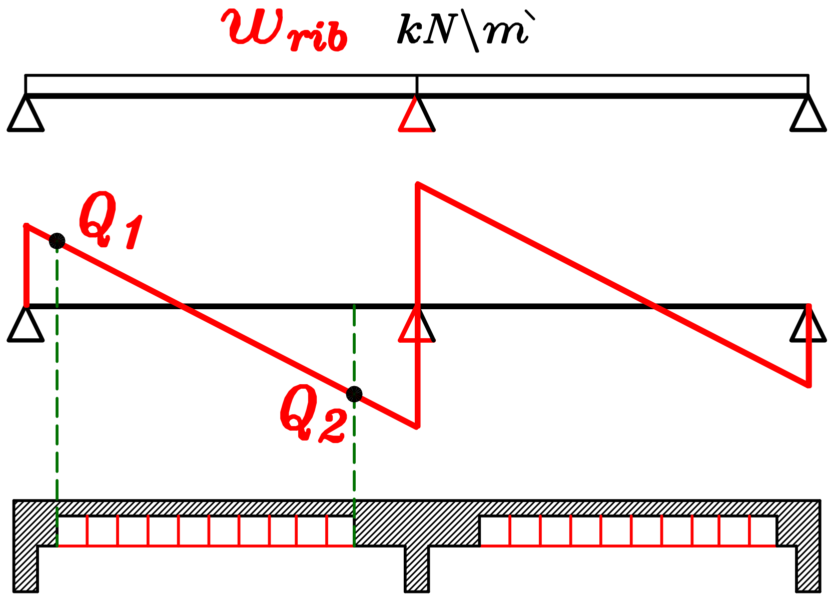
$$IF \quad A_{s_2} = 364\ mm^2\backslash rib$$

$$= 364\ mm^2\backslash 0.5m = 4\ \phi\ 12\backslash 0.5m$$



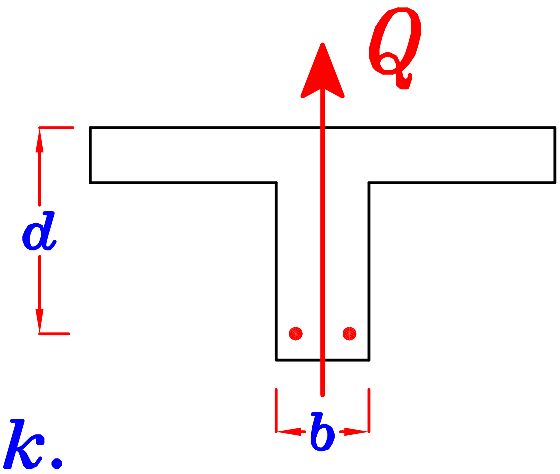
Check shear on the ribs.

$$q_{cu} = 0.16\sqrt{\frac{F_{cu}}{\gamma_c}} \quad N\backslash mm^2$$ للكمرات المدفونه و القواعد و البلاطات



S.F.D.

$$q_u = \frac{Q_{max}}{b * d}$$



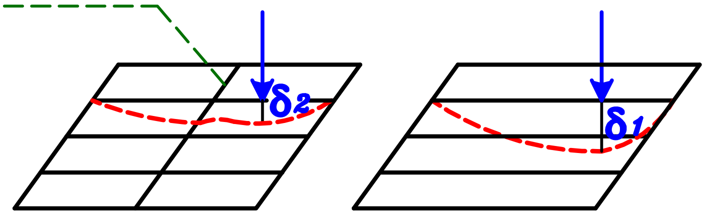
* IF $q_u \leqslant q_{cu}$ $\therefore$ o.k.

* IF $q_u > q_{cu}$ $\therefore$ Increase b or d

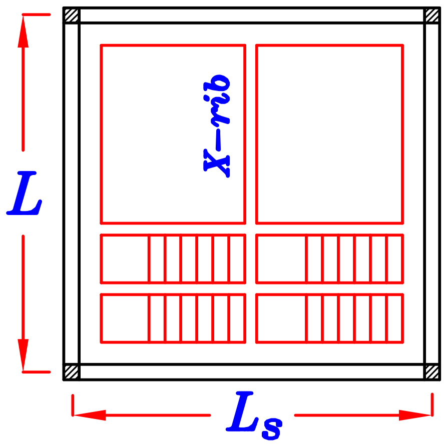
فائدة ال X-rib

١- تقليل ال Deflection على البلاطه

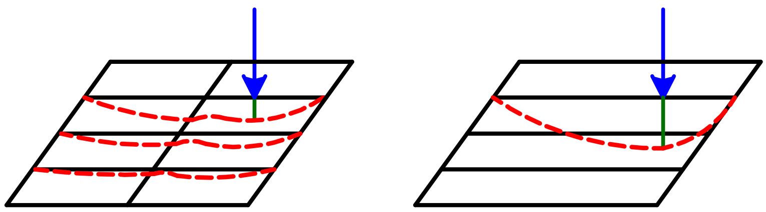
X-rib
Elastic Support



$\delta_2 < \delta_1$



٢- توزيع الاحمال المركزه على عصب واحد للاعصاب المجاوره
(Grid Action)



شروط وضع أقل عدد من ال X-rib فى البلاطه:

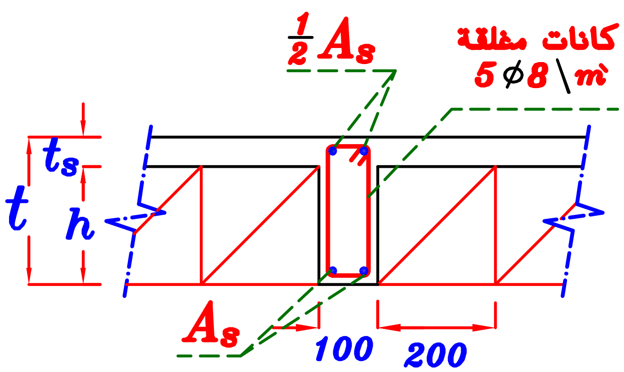
1- IF L.L. $\leqslant$ 3.0 kN\m², $L_s \leqslant$ 5.0 m — no need to use X-rib

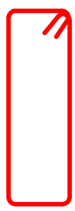
2- IF L.L. $\leqslant$ 3.0 kN\m², $L_s >$ 5.0 m — Use one X-rib

3- IF L.L. > 3.0 kN\m², L_s = (4.0 → 7.0 m) — Use one X-rib

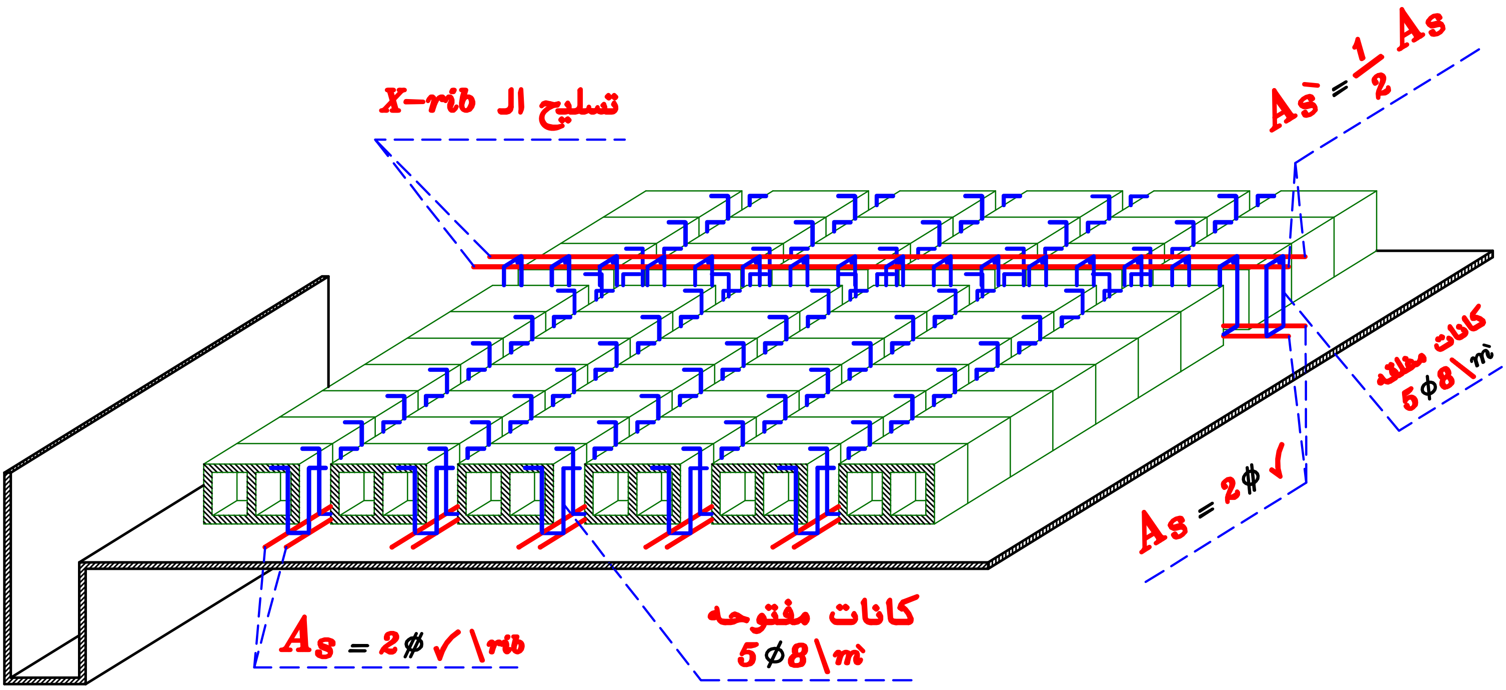
4- IF L.L. > 3.0 kN\m², $L_s >$ 7.0 m — Use Three X-rib

* أبعاد ال X-rib هى نفس أبعاد ال rib الأساسيه (b*h)
* تسليح ال X-rib السفلى هو نفس تسليح ال rib الأساسيه 2 ϕ ✓ \rib
و تسليحها العلوى لا يقل عن نصف تسليحها السفلى





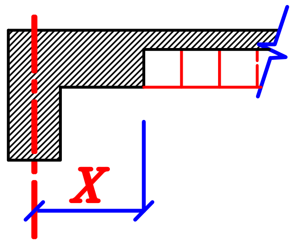
* الكــانــات مغلقه كما بالشكل
و تؤخذ بدون حساب 5 ϕ8 \m`



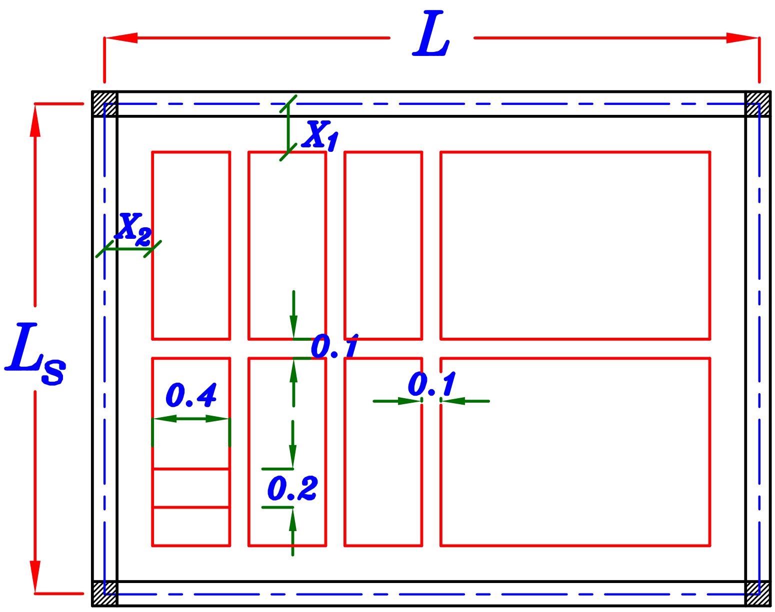
Reinforcement of the Ribs & X-Rib

Dimensions of the solid part & Blocks Arrangement.

فائدة ال Solid Part هى مقاومة كـلاً من ال **B.M.** و ال **S.F.**



أقل قيمة لل Solid Part ($X_{min} = 250\ mm$)



و هناك نوعان من ال Solid Part

١ـ فى إتجاه الحمل **(Short Dir.)**

٢ـ فى إتجاه عمودى على الحمل **(Long Dir.)**

min. Solid Part = 250 mm و تقاس من ال **C.L.**

To Calculate the Solid Part (X) & No. of Blocks (n)

1_ Short Direction.

$$\underset{(m)}{L_S} = 2\ \underset{?}{(\overset{(m)}{X_1})} + \underset{?}{(n_1)}(0.2) + (1)\ (0.1)$$ ---- (X_1, n_1) Unknowns

Take $X_1 = 0.25\ m.$ $\xrightarrow{Get}$ $n_1 = ✓$ تقرب لأقرب **أقل** رقم صحيح

$$L_S = 2\ \underset{?}{(X_1)} + \underset{✓}{(n_1)}\ (0.2) + (1)\ (0.1) \xrightarrow{Get} X_1 = ✓$$

2_ Long Direction.

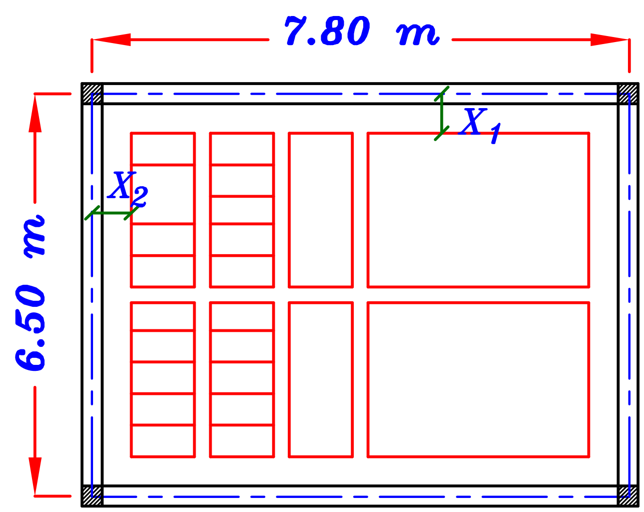
$$\underset{(m)}{L} = 2\ \underset{?}{(\overset{(m)}{X_2})} + \underset{?}{(n_2)}(0.4) + \underset{?}{(n_2 - 1)}(0.1)$$ ---- (X_2, n_2) Unknowns

Take $X_2 = 0.25\ m.$ $\xrightarrow{Get}$ $n_2 = ✓$ تقرب لأقرب **أقل** رقم صحيح

$$L = 2\ \underset{?}{(X_2)} + \underset{✓}{(n_2)}(0.4) + \underset{✓}{(n_2 - 1)}(0.1) \xrightarrow{Get} X_2 = ✓$$

Example.

Arrange the Blocks and get the dimensions of the Solid Part.



1_ Short Direction.

$L_S = 2\,(X_1) + (n_1)(0.2) + (1)\,(0.1)$ ---- (X_1, n_1) Unknowns

Take $X_1 = 0.25$ m.

$6.5 = 2\,(0.25) + (n_1)(0.2) + (1)(0.1) \xrightarrow{Get} n_1 = 29.5$ → $n_1 = 29$ Block

$6.5 = 2\,(X_1) + (29)(0.2) + (1)(0.1) \xrightarrow{Get} X_1 = 0.30$ → $X_1 = 0.30$ m.

2_ Long Direction.

$L = 2\,(X_2) + (n_2)(0.4) + (n_2 - 1)(0.1)$ ---- (X_2, n_2) Unknowns

Take $X_2 = 0.25$ m.

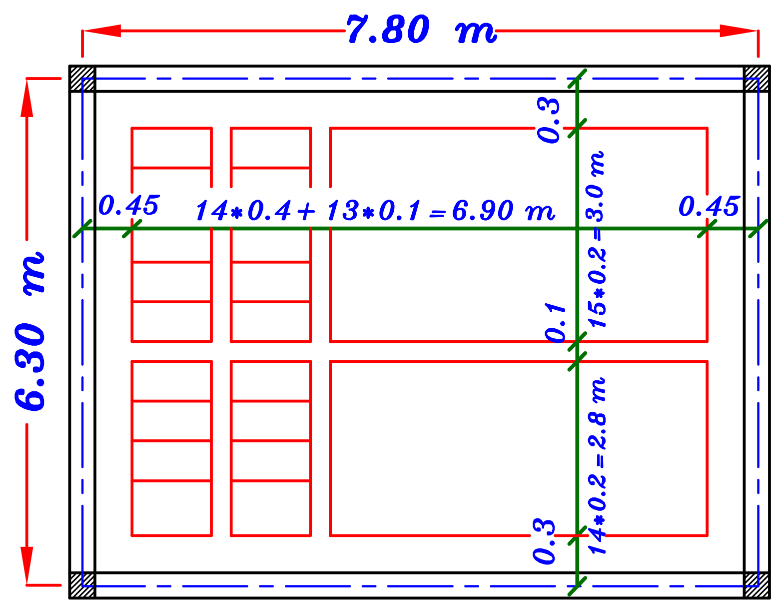
$7.8 = 2\,(0.25) + (n_2)(0.4) + (n_2 - 1)(0.1) \xrightarrow{Get} n_2 = 14.8$ → $n_2 = 14$ Block

$7.8 = 2\,(X_2) + (14)(0.4) + (14 - 1)(0.1) \xrightarrow{Get} X_2 = 0.45$ → $X_2 = 0.45$ m.

ملحوظة

ليس شرط أن تكون

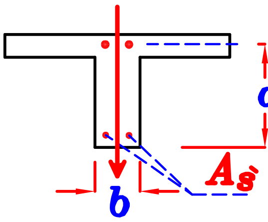
الـ X-rib في المنتصف تماما



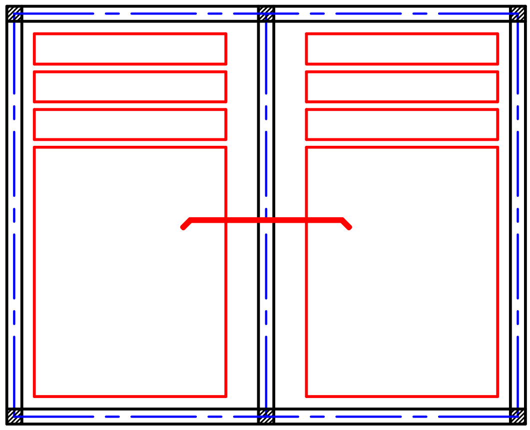
For Continuos slab.

For the middle Solid Part.

Calculate M_R For



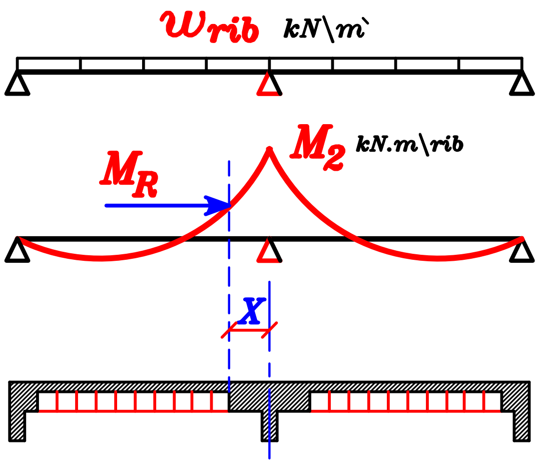
$M_R = \checkmark$ kN.m\rib



$$M_R = \left[\left(R_{max} \frac{F_{cu}}{\gamma_c} b\, d^2 \right) + A_s' \frac{F_y}{\gamma_s} (d - d') \right]$$

We can neglect the term oF

$$A_s' \frac{F_y}{\gamma_s} (d - d')$$

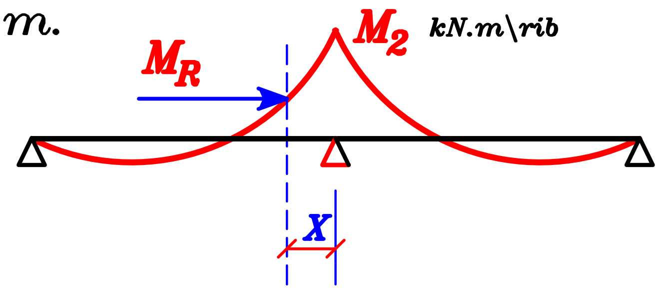


$$\therefore \quad \boxed{M_R = \left(R_{max} \frac{F_{cu}}{\gamma_c} b\, d^2 \right)}$$

* IF M_R (kN.m\rib) $\geq M_2$

Use min. Solid Part $X = 0.25$ m.

* IF M_R (kN.m\rib) $< M_2$

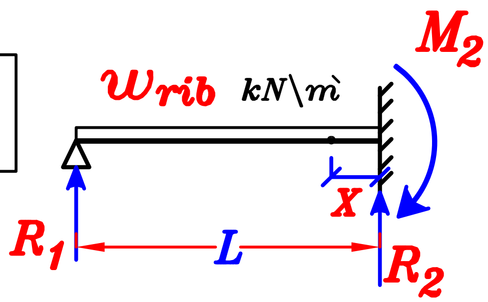


Get R_2 $\quad \boxed{M_2 + w_{rib} \frac{L^2}{2} = R_2 L}$

Calculate X From

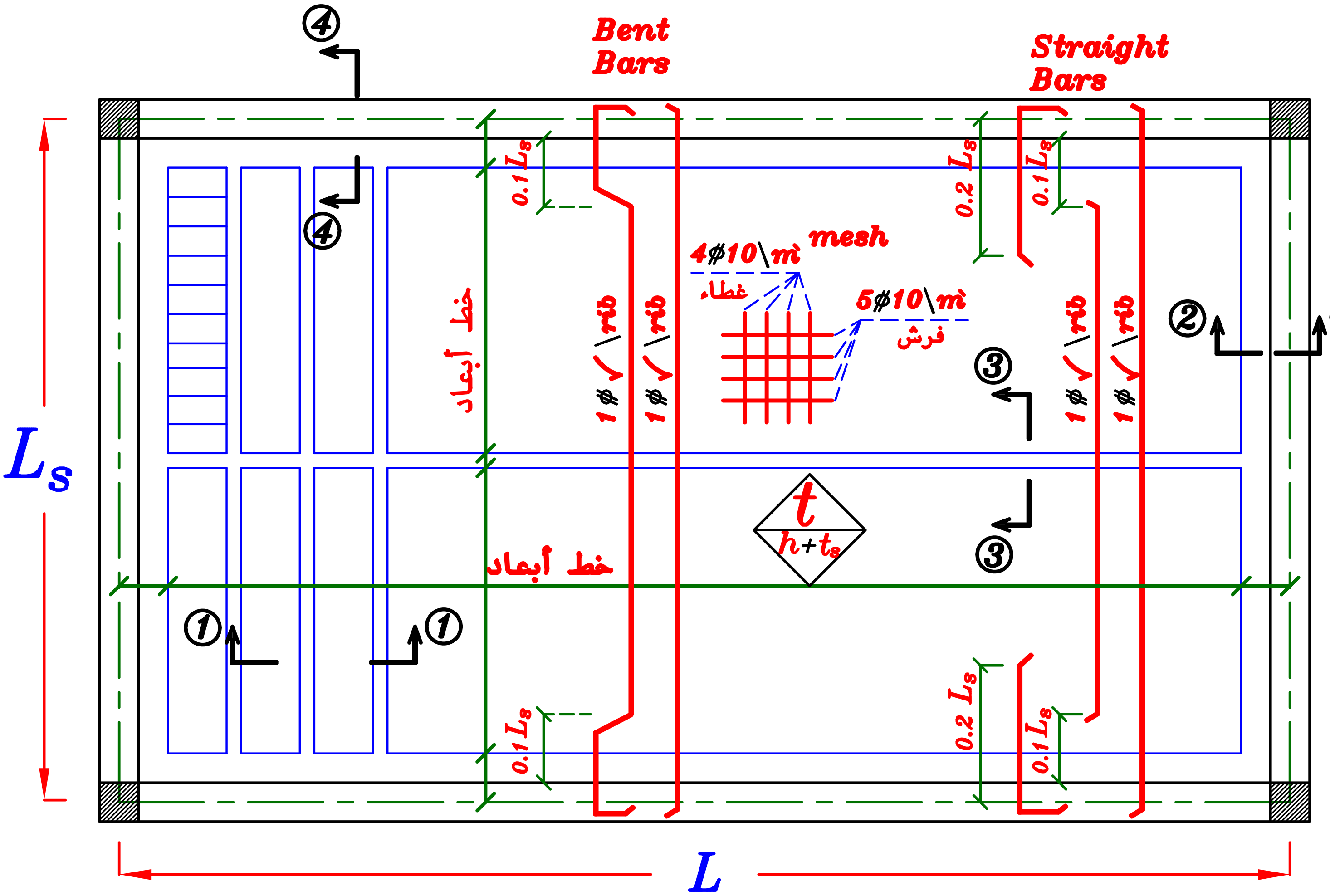
$$\boxed{M_R = M_2 - R_2 (X) + w_{rib} \frac{(X)^2}{2}}$$

Get $X = \checkmark$ m.

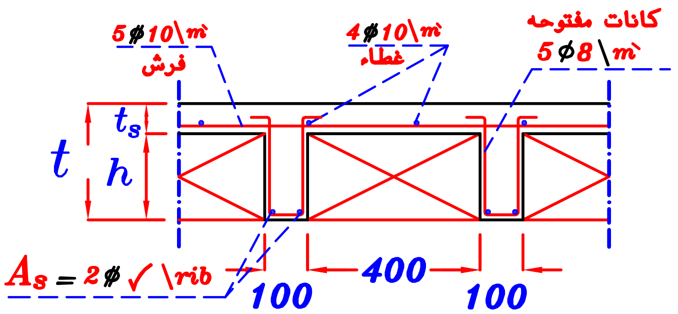


Note: IF $X < 0.25$ m. $\xrightarrow{\text{Take}}$ $X = 0.25$ m.

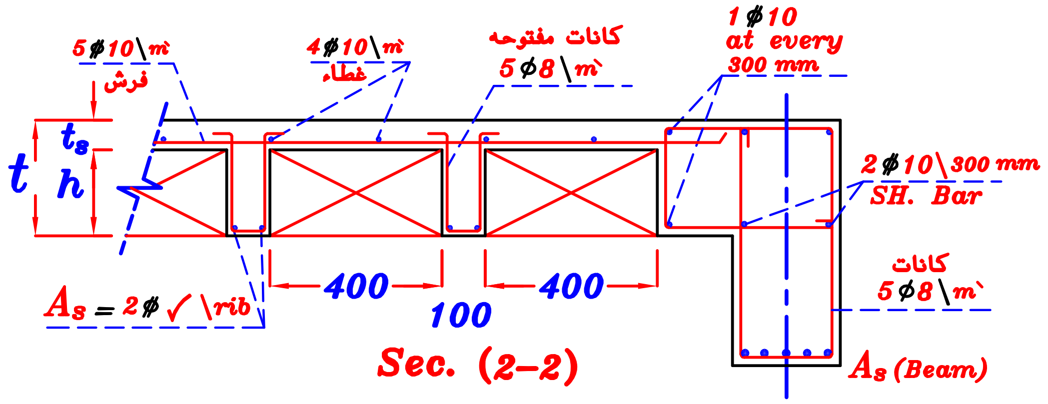
⑤ Drawing the RFT. [Plan & Cross-Sections].



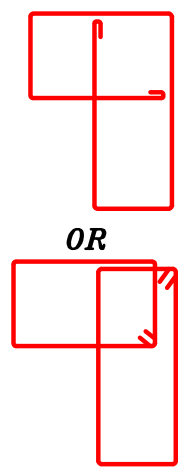
One Way Slab, Simple Span

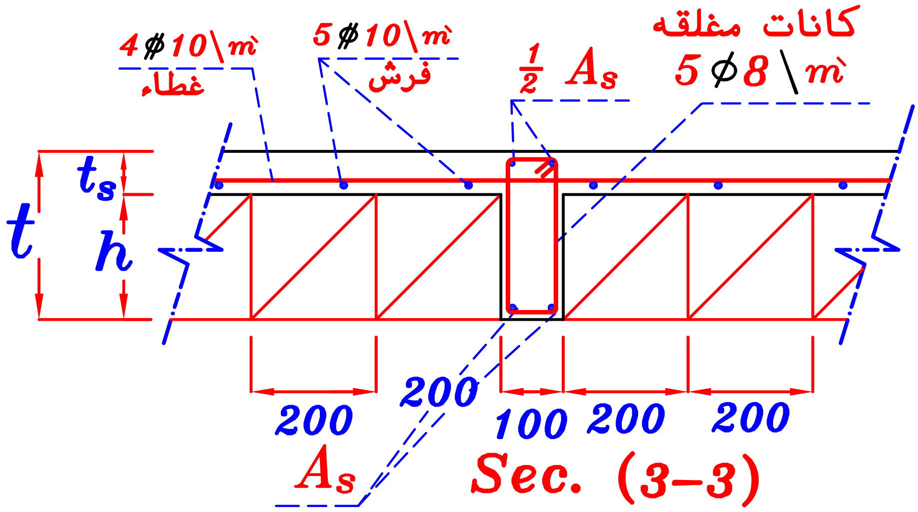


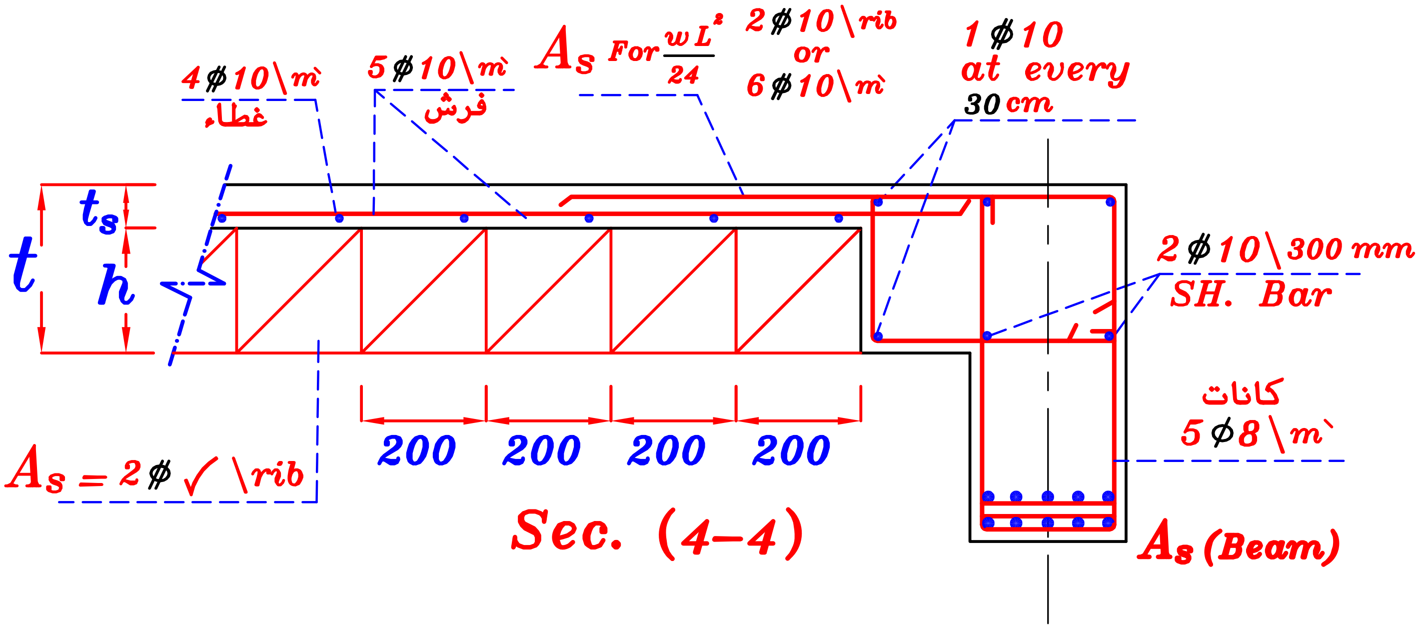
Sec. (1–1)

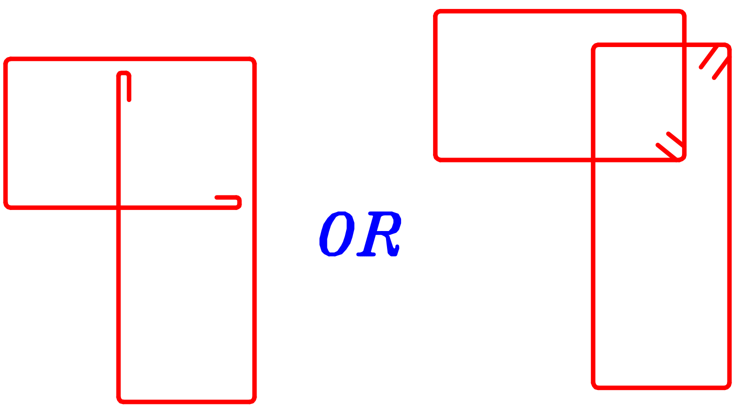


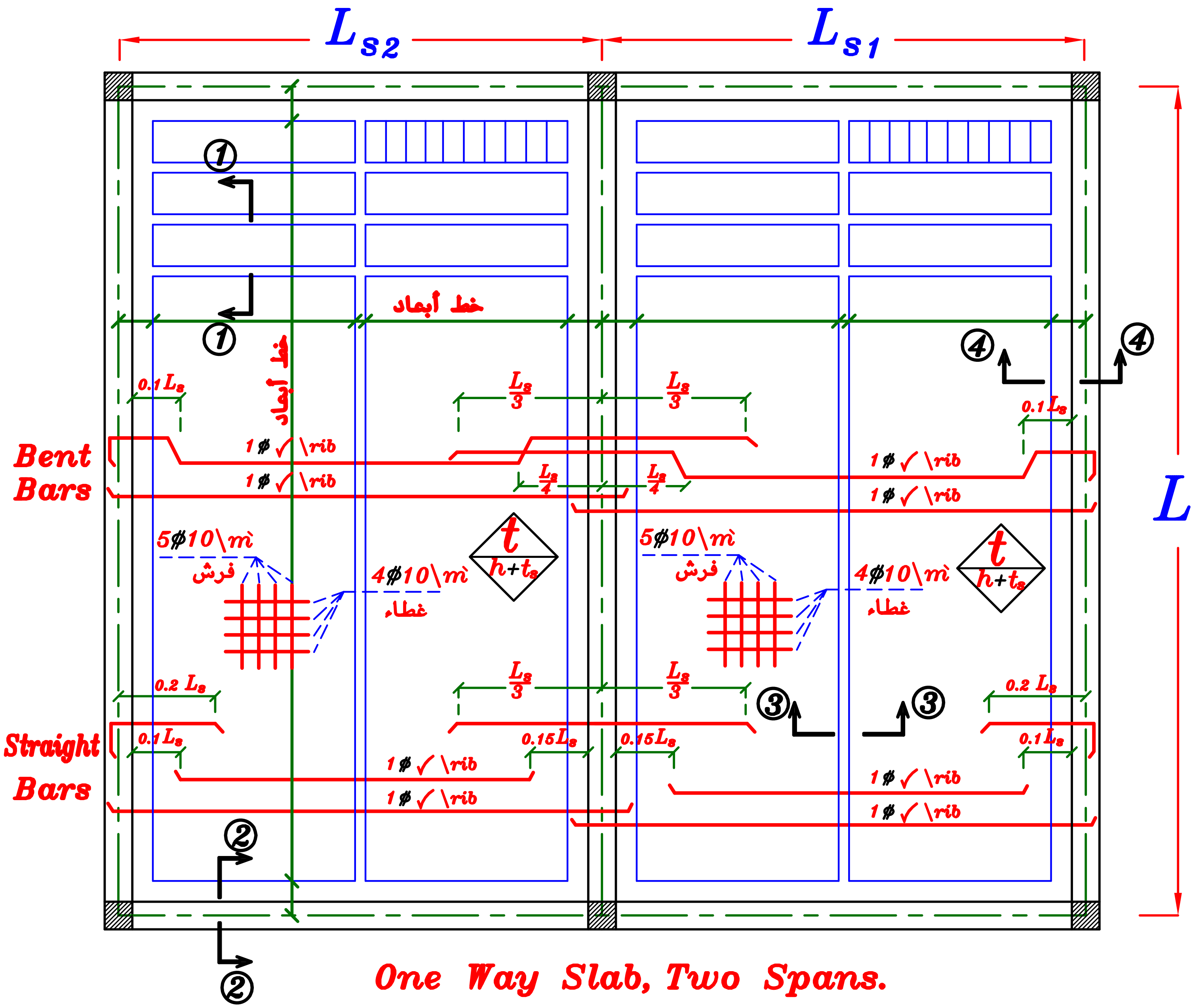
Sec. (2–2)



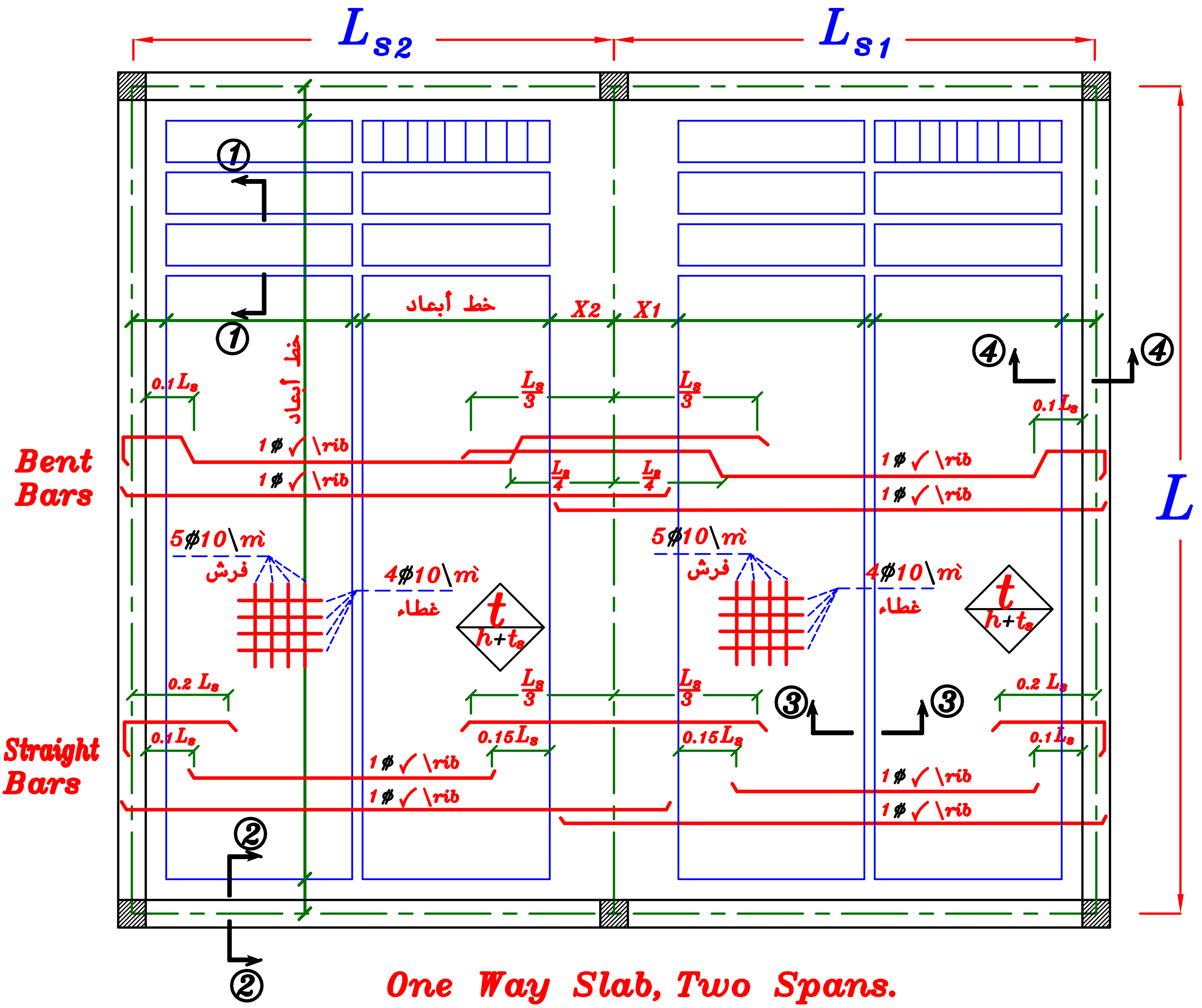

4Ø10\m`
غطاء
5Ø10\m`
فرش
1/2 As
كانات مغلقه
5Ø8\m`
t
ts
h
200
200
100
200
200
200
As
Sec. (3-3)


4Ø10\m`
غطاء
5Ø10\m`
فرش
As For wL²/24
2Ø10\rib
or
6Ø10\m`
1Ø10
at every
30 cm
t
ts
h
2Ø10\300 mm
SH. Bar
كانات
5Ø8\m`
As = 2Ø ✓ \rib
200
200
200
200
Sec. (4-4)
As (Beam)

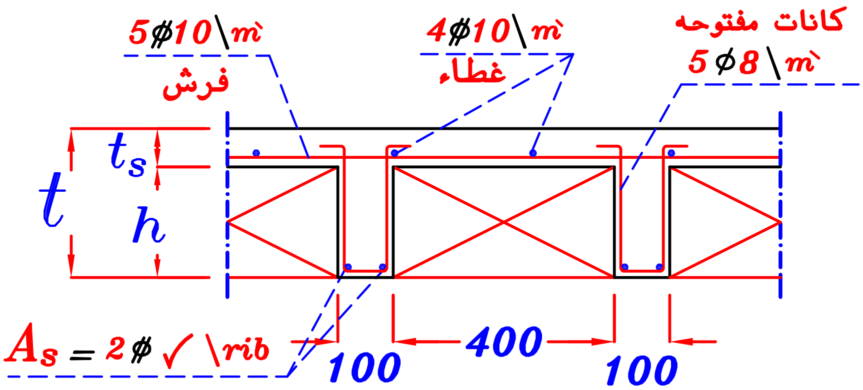

OR



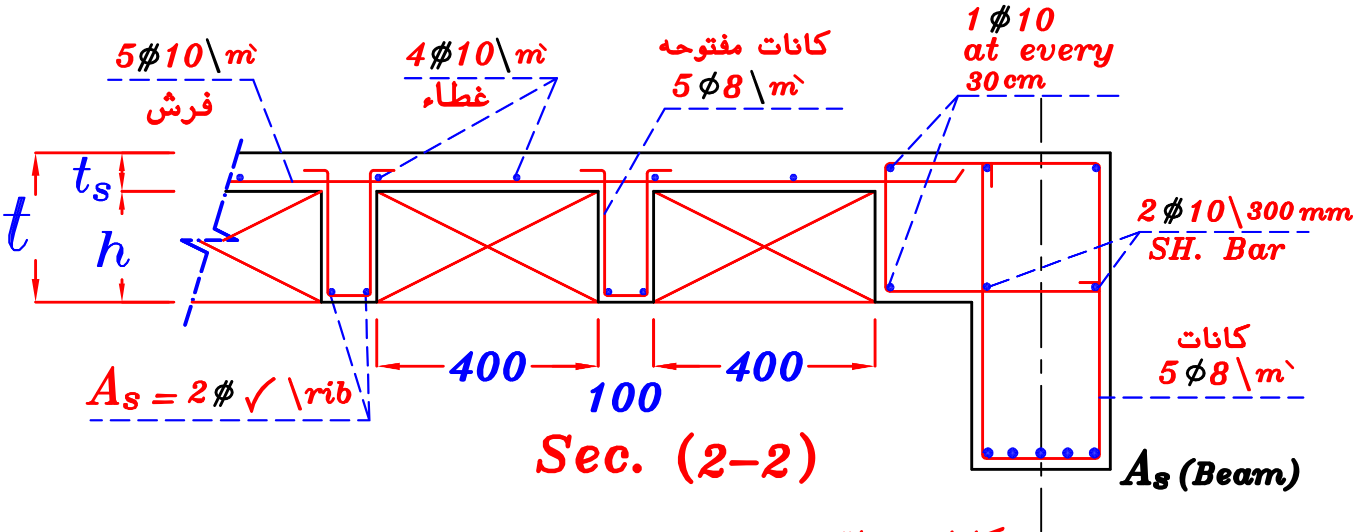
One Way Slab, Two Spans.
With Projected Beam.



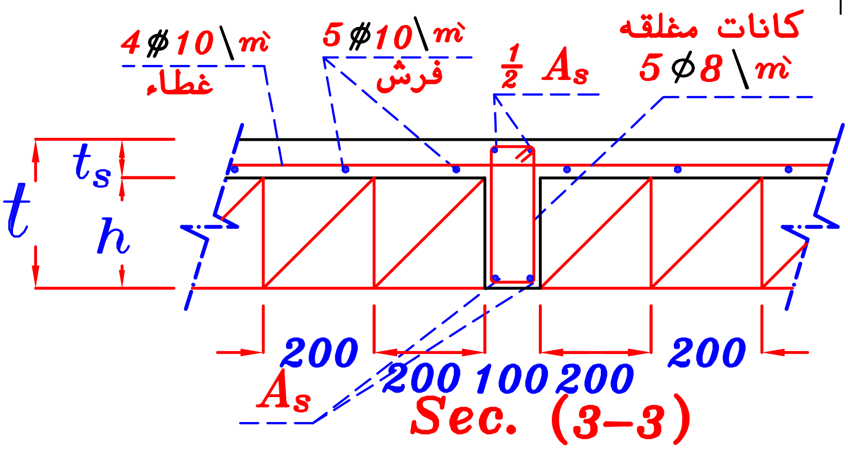
One Way Slab, Two Spans.
With Embedded Beam.



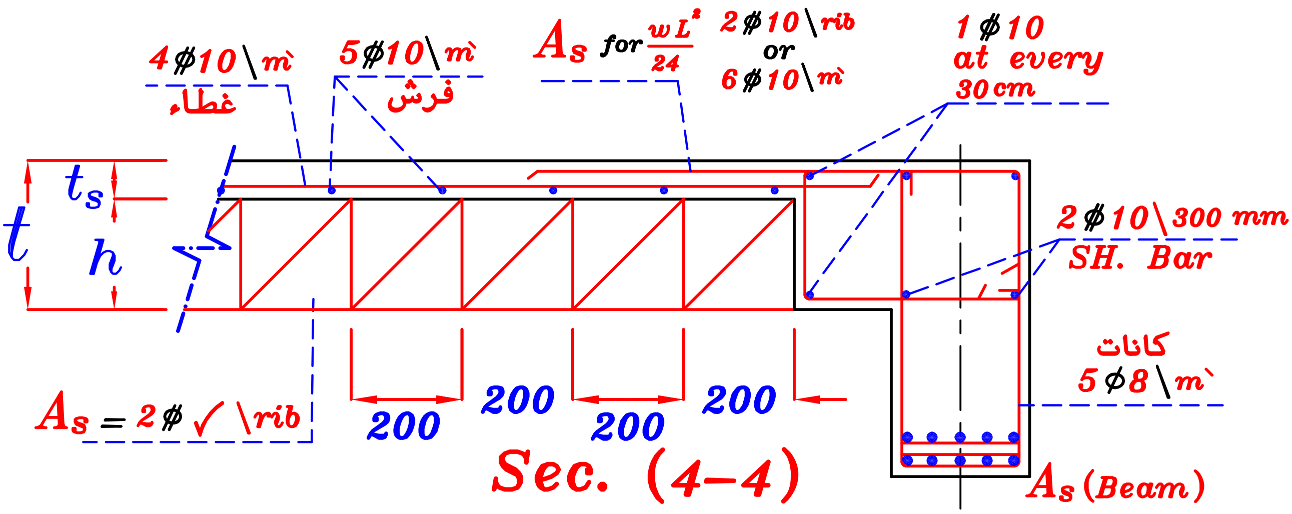
Sec. (1-1)



Sec. (2-2)



Sec. (3-3)



Sec. (4-4)

Example.

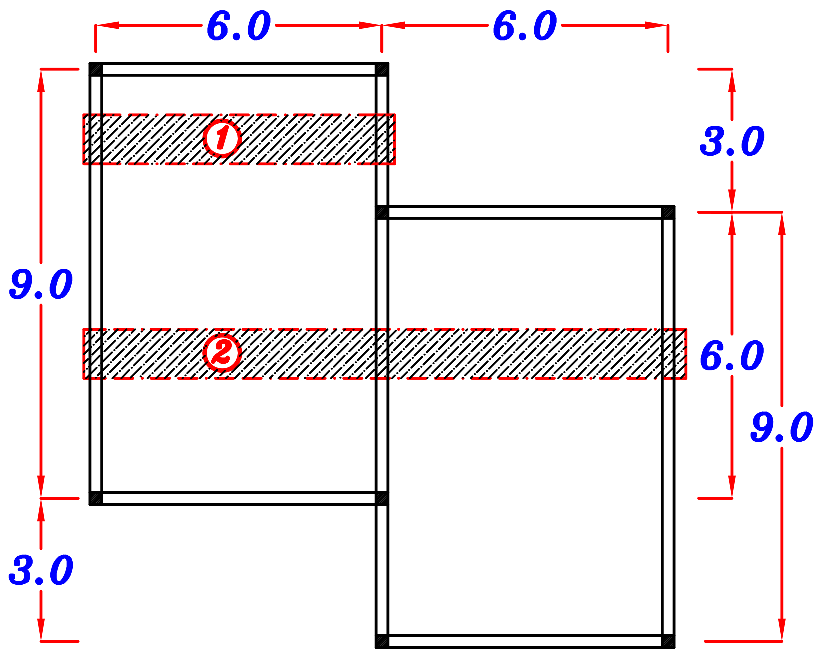
Data.

$F_{cu} = 25 \; N\backslash mm^2$

$F_y = 360 \; N\backslash mm^2$

$F.C. = 1.50 \; kN\backslash m^2$

$L.L. = 3.0 \; kN\backslash m^2$



Req.

Design the Slab & Draw Details of RFT.

Solution.

The Slab is (6.0 m. * 9.0 m.) $L_s = 6.0$ m

$\because L_s > 4.5$ m ⟶ Use H.B. Slab.

$\because L_s < 7.0$ m ⟶ Use one way H.B. Slab.

$\because L_s > 5.0$ m ⟶ Use one cross rib.

Take: $t = 250$ mm $t_s = 50$ mm $h = 200$ mm

Weight of Block = 160 N

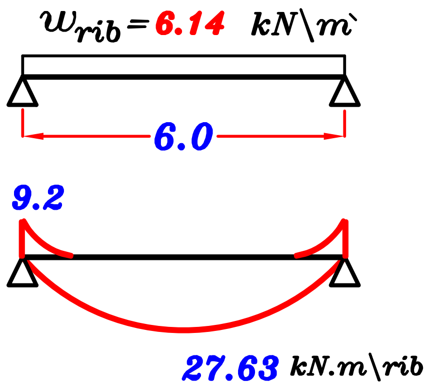
$S = e + b = 0.4 + 0.1 = 0.5$ m

$$(w_{rib})_{U.L.} = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)]\,S$$
$$+ 1.4\,(b\,h * 1.0 * \gamma_c) + 1.4\,[5\,(\text{Weight of One Block})]$$

$$\therefore (w_{rib})_{U.L.} = [1.4\,(0.05 * 25 + 1.50) + 1.6\,(3.0)]\,(0.50)$$
$$+ 1.4\,(0.1 * 0.2 * 25) + 1.4\,[5\,(\tfrac{160}{1000})] = 6.145$$

$(kN\backslash(1.0 * S\; m^2))$

Strip ①



$M = 27.63 \ kN.m \backslash rib$

$d = t - 30 \ mm = 250 - 30 = 220 \ mm$

$$d = C_1 \sqrt{\frac{M \ (kN.m \backslash rib)}{F_{cu} \ B}}$$

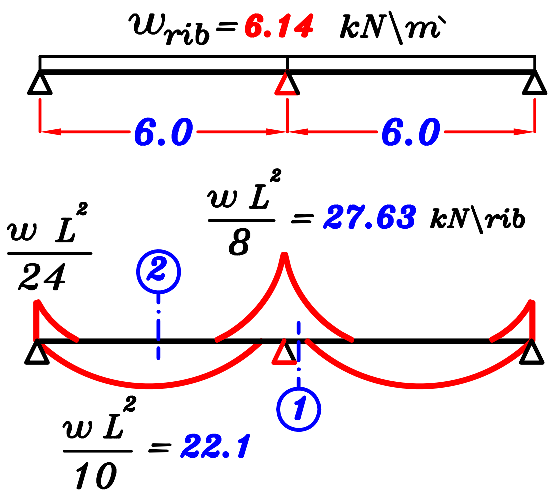
$$\therefore \ 220 = C_1 \sqrt{\frac{27.63 * 10^6}{25 * 500}} \rightarrow C_1 = 4.67 \rightarrow J = 0.822$$

$$A_s = \frac{M}{J \ F_y \ d} = \frac{27.63 * 10^6}{0.822 * 360 * 220} = 424 \ mm^2 \backslash rib$$

2 ϕ18\rib

Strip ②

Sec. ①



$M = 27.63 \ kN.m \backslash rib$

$d = t - 30 \ mm = 250 - 30 = 220 \ mm$

$$220 = C_1 \sqrt{\frac{27.63 * 10^6}{25 * 500}}$$

$$\rightarrow C_1 = 4.67 \rightarrow J = 0.822$$

$$A_s = \frac{27.63 * 10}{0.822 * 360 * 220} = 424 \ mm^2 \backslash rib$$

2 ϕ18\rib

Sec. ②

$M = 22.1 \ kN.m \backslash rib$

$d = t - 30 \ mm = 250 - 30 = 220 \ mm$

$$220 = C_1 \sqrt{\frac{22.1 * 10^6}{25 * 500}} \rightarrow C_1 = 5.53 \rightarrow J = 0.826$$

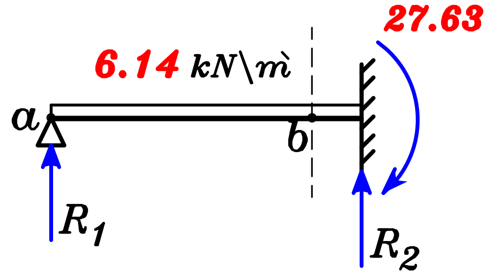
$$A_s = \frac{22.1 * 10}{0.826 * 360 * 220} = 337.8 \ mm^2 \backslash rib$$

2 ϕ16\rib

Check the dimensions of the Solid Part.

$$M_R = \left[R_{max}\,\frac{F_{cu}}{\gamma_c}\,b\,d^2\right] = \left[0.194\left(\frac{25}{1.5}\right)(100)(220)^2\right] = 15649333 \text{ N.mm}$$

$M_R = 15.64$ kN.m $<$ $M = 27.63$ kN.m



$\because \sum M_a = Zero$

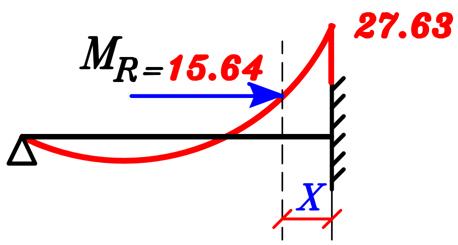
$\therefore 27.63 + 6.14 * 6 * 3 - 6 R_2 = Zero$

→ $R_2 = 23.02$ kN

$\therefore M_R = M_2 - R_2(X) + w_{rib}\frac{(X)^2}{2}$

$15.64 = 27.63 - 23.02\,(X) + 6.14\,\frac{(X)^2}{2}$

→ $X_{min} = 0.563$ m.



1_ Short Direction.

$L_S = 0.25 + (X_1) + (n_1)(0.2) + (1)(0.1)$

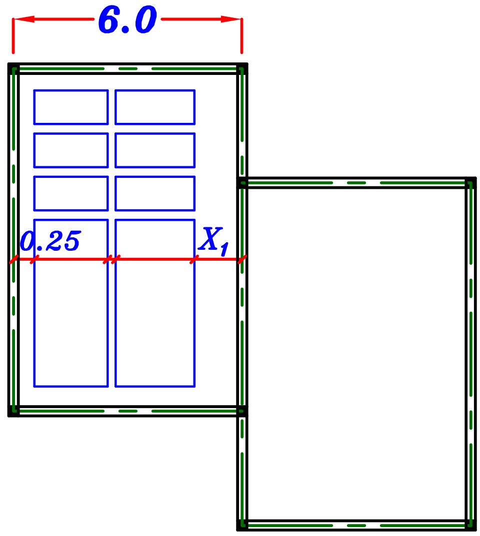
Take $X_1 = X_{min} = 0.563$ m.

$6.0 = 0.25 + 0.563 + (n_1)(0.2) + (1)(0.1)$

Get → $n_1 = 25.43$ $\quad$ $n_1 = 25$ Block

$6.0 = 0.25 + (X_1) + (25)(0.2) + (1)(0.1)$

Get → $X_1 = 0.60$ $\quad$ $X_1 = 0.65$ m.



2_ Long Direction.

$L = 2(X_2) + (n_2)(0.4) + (n_2 - 1)(0.1)$

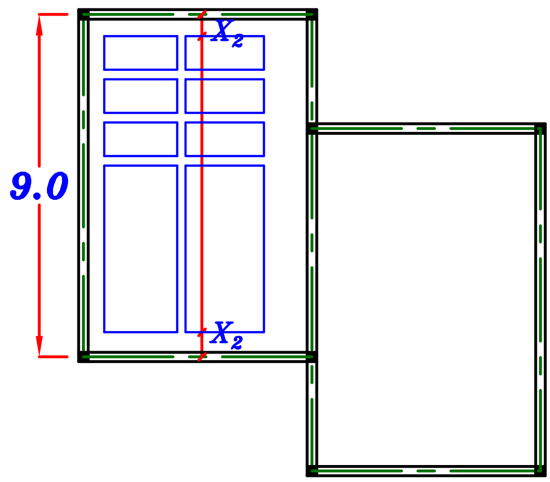
Take $X_2 = 0.25$ m.

$9.0 = 2(0.25) + (n_2)(0.4) + (n_2 - 1)(0.1)$

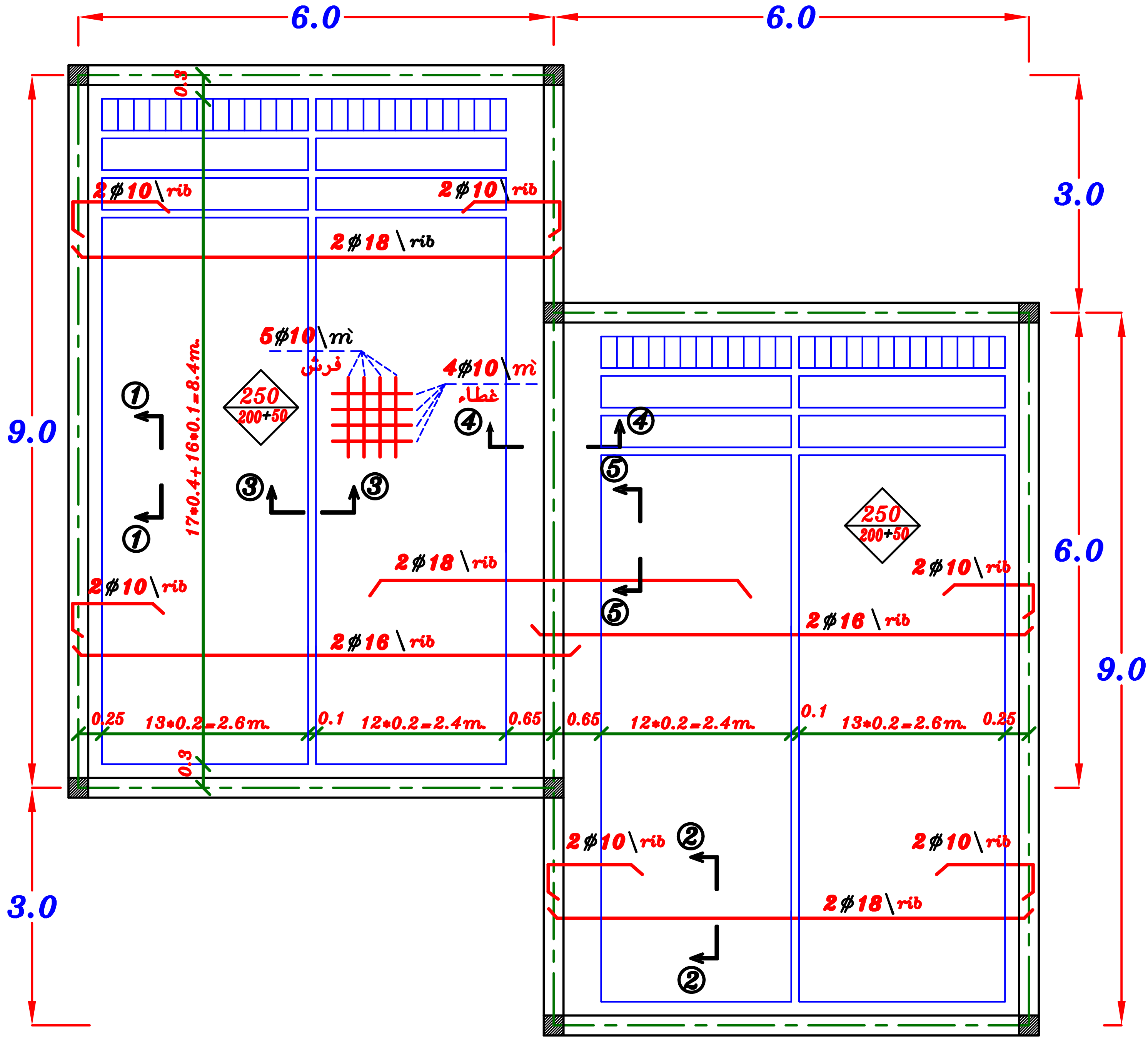
Get → $n_2 = 17.2$ $\quad$ $n_2 = 17$ Block

$9.0 = 2(X_2) + (17)(0.4) + (17 - 1)(0.1)$

Get → $X_2 = 0.30$ $\quad$ $X_2 = 0.30$ m.

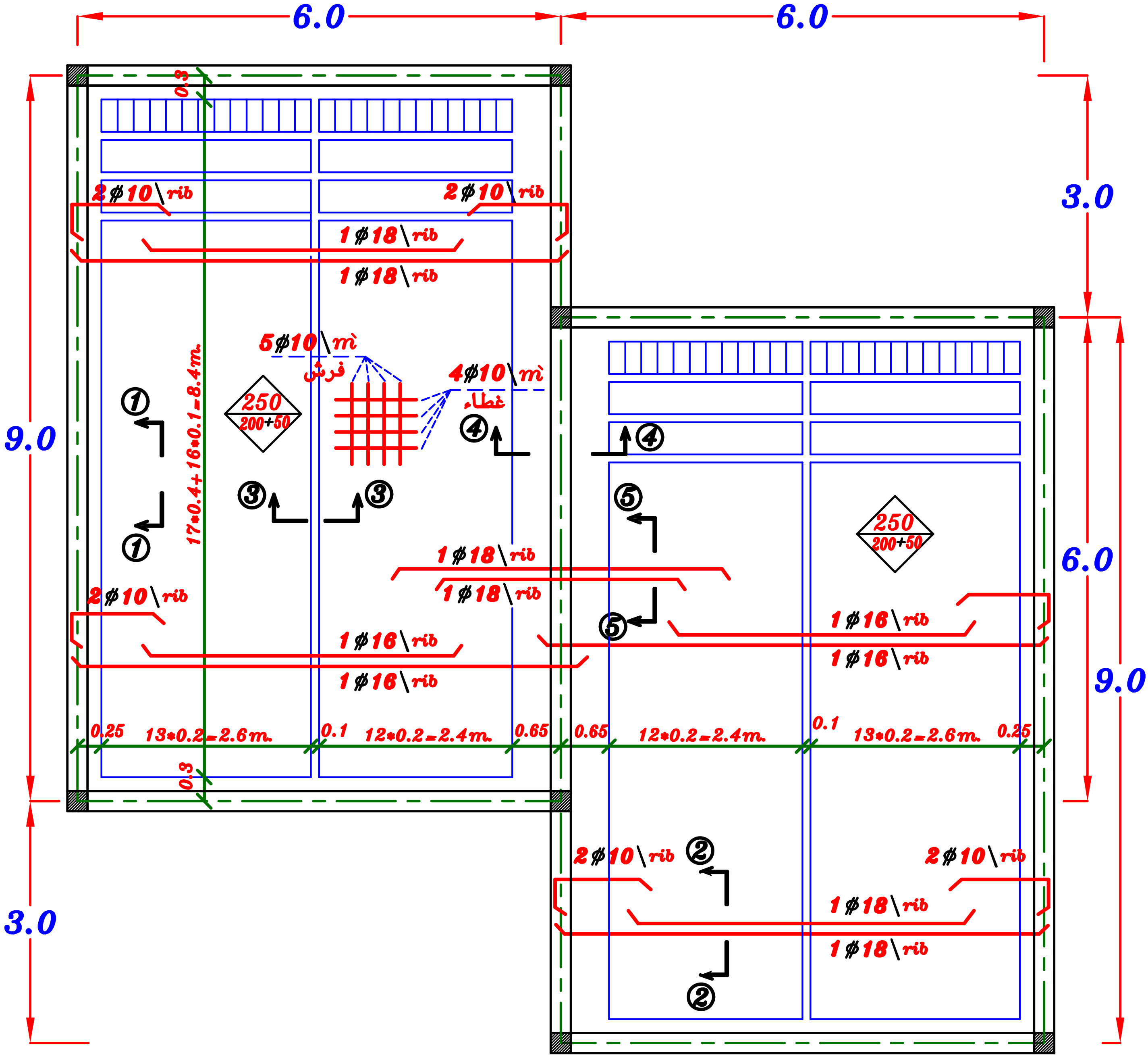


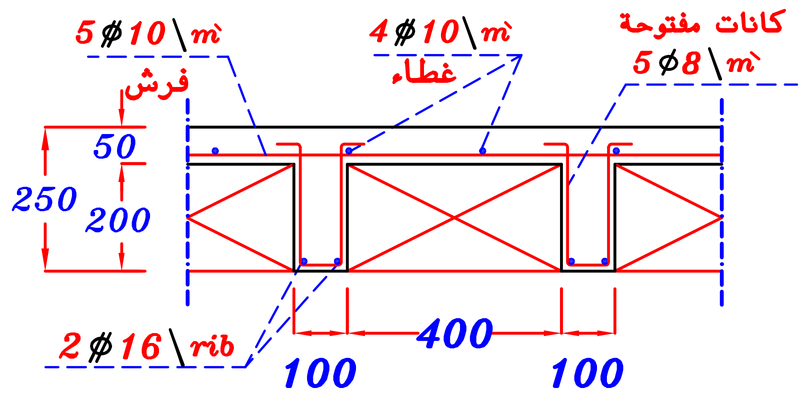
RFT. of the slab in plan.



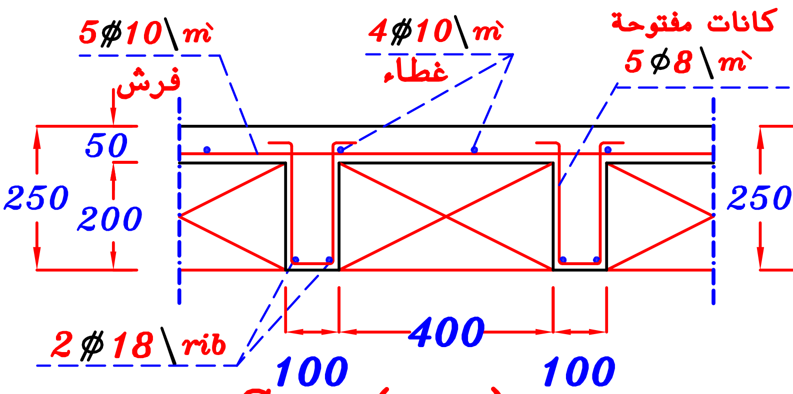
RFT. of the slab in plan.

ممكن للتوفير توقيف الحديد فى العصب الواحد بحيث سيخ يكمل و سيخ يقف .

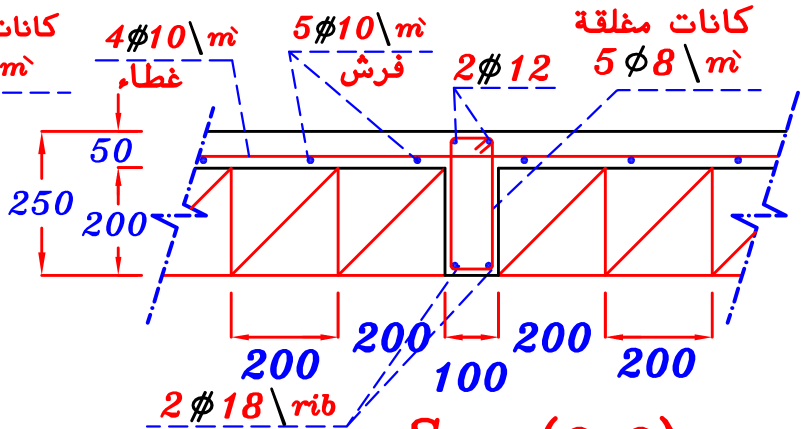




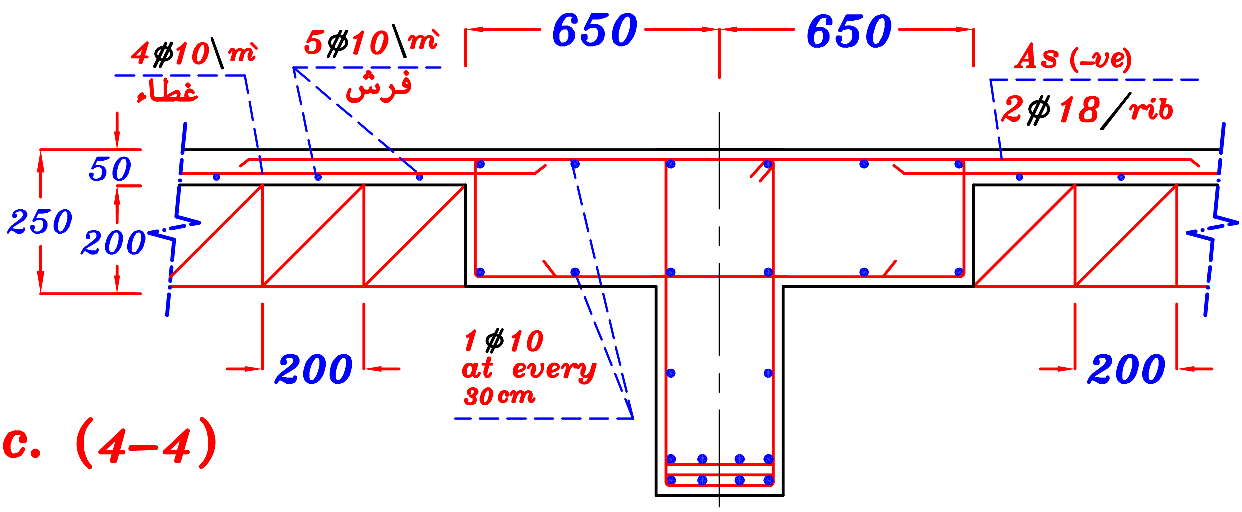
Sec. (1-1)



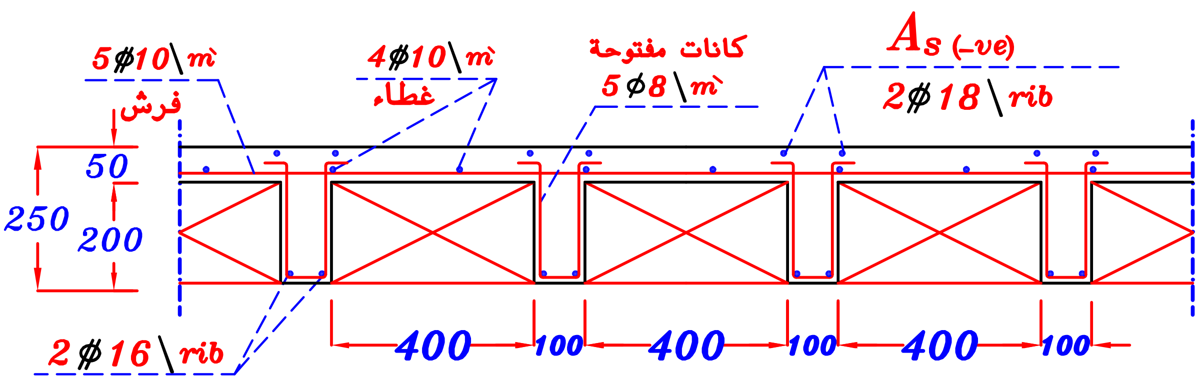
Sec. (2-2)



Sec. (3-3)

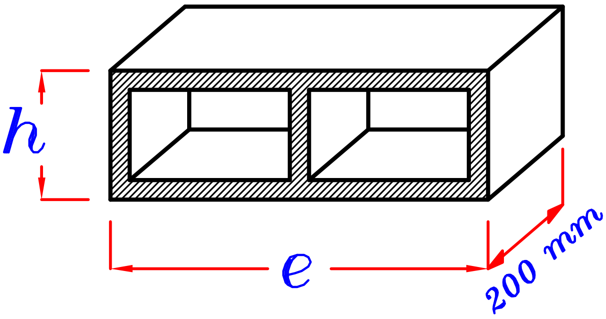


Sec. (4-4)



Sec. (5-5)

Special Blocks Dimensions.



هناك أحجام أخرى للبلوكات

Block $(200 * e * h)$

$O.W.\ (Block) = \checkmark\ kN\backslash Block$

$t_s \left\{ \begin{array}{l} \not< 50mm \\ \not< \frac{e}{10} \end{array} \right\}$ الأكبر

و سوف يكون هناك بعض التغيرات فى طريقه الحل

Choose (t) ,(b).

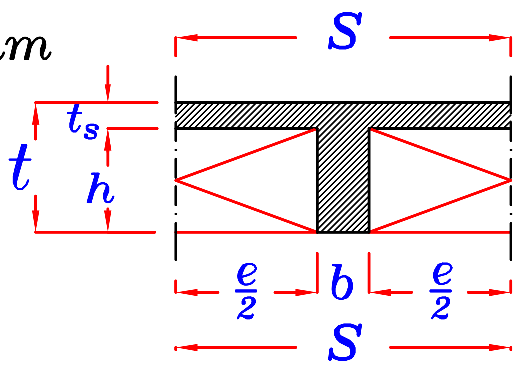
$(t = t_s + h)$

$t = (t_s\ ,\ h = 150\ mm)$.

$t = (t_s\ ,\ h = 200\ mm)$. ------- الأكثر أستخداما

$t = (t_s\ ,\ h = 250\ mm)$.

$, b = 100\ mm$ or $120\ mm$ or $150\ mm$

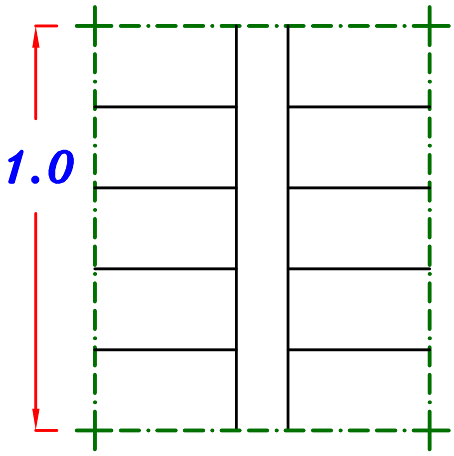


Get (S).

$$S = e + b$$

Get the Loads on the slab.

$(w_{rib})\ (kN\backslash(1.0 * S))$



$$(w_{rib})_{U.L.} = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)]\ S$$

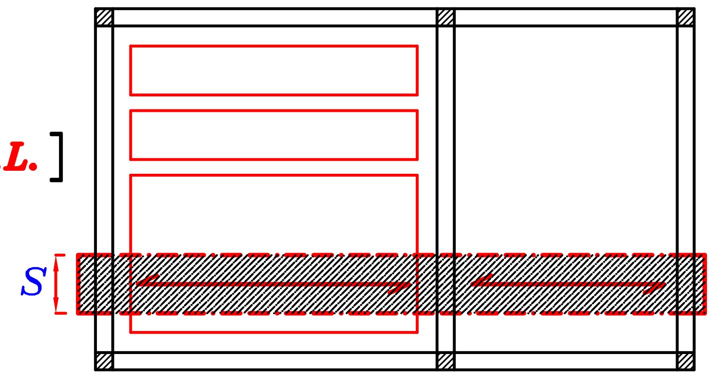
$$+ 1.4\,(b\ h * 1.0 * \gamma_c) + 1.4\,[5\,(\text{Weight of One Block})]$$

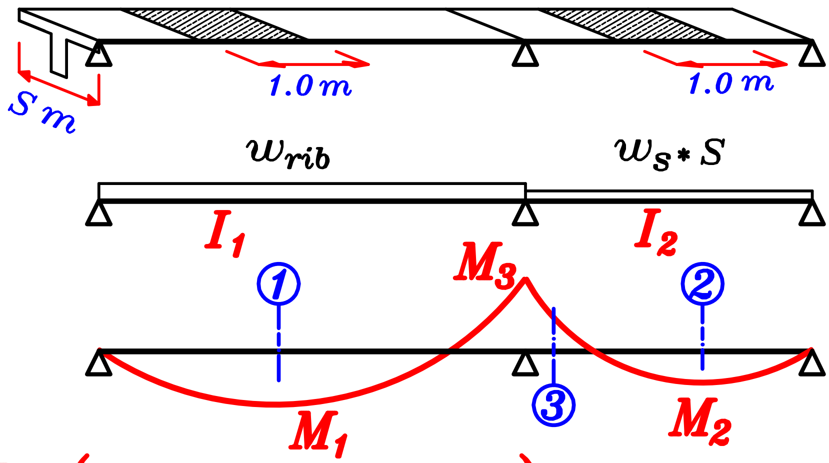
$$= \checkmark\ (kN\backslash(1.0 * S\ m^2))$$

Take strip at the Load direction, and Get B.M. (kN.m\ S)

Take a Strip width in the Slab = S m.

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





Design the Ribs. (Dimensions & RFT.)

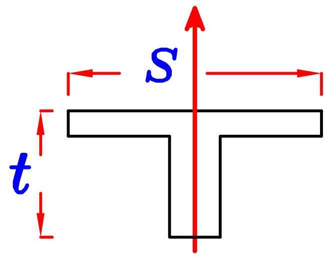
Design of Sections.

Sec. ① Get $M_1 = \checkmark$ kN.m\rib

$M_1 = \checkmark$ kN.m\rib

$d = t - 30\ mm = C_1 \sqrt{\frac{M_1\ (kN.m\backslash rib)}{F_{cu}\ S}}$ Get $C_1 = \checkmark \longrightarrow J = \checkmark$

$A_{s_1} = \frac{M_1}{J\, F_y\, d} = \checkmark\ mm^2\backslash rib = 2\phi \checkmark \backslash rib$



Sec. ②

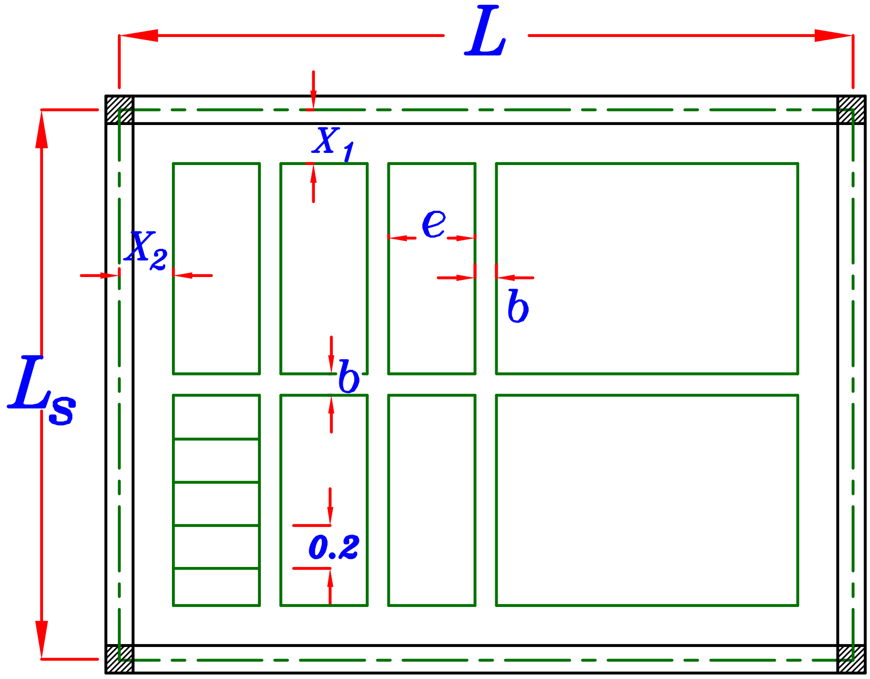
$\because M_2 = \checkmark$ kN.m\m` , $t_s = \checkmark mm$ $\therefore d = t_s - 20\ mm\ (Cover) = \checkmark mm$

$\because d = C_1 \sqrt{\frac{M_{U.L.}}{F_{cu}\, S}}$ Get $C_1 = \checkmark \longrightarrow J = \checkmark$

$A_s = \frac{M_{U.L.}}{J\, F_y\, d} = \checkmark\ mm^2 \backslash (S)$, $A_{s2} = \frac{A_s}{S} = \checkmark\ mm^2\backslash m`$

Sec. ③ The Same Steps of Design as Sec. ②

Dimensions of the solid part & Blocks Arrangement



To Calculate the Solid Part (X) & No. of Blocks (n)

1 – Short Direction.

(m.) (m.)

$$L_s = 2\,(X_1) + (n_1)(0.2) + (1)\,(b) \quad ---- \quad (X_1, n_1) \text{ Unknowns}$$

? ?

Take $X_1 = 0.25$ m. $\xrightarrow{\text{Get}}$ $n_1 = ✓$ تقرب لأقرب أقل رقم صحيح

$$L_s = 2\,(X_1) + (n_1)\,(0.2) + (1)\,(0.1) \xrightarrow{\text{Get}} X_1 = ✓$$

? ✓

2 – Long Direction.

(m.) (m.)

$$L = 2\,(X_2) + (n_2)(e) + (n_2 - 1)(b) \quad ---- \quad (X_2, n_2) \text{ Unknowns}$$

? ? ?

Take $X_2 = 0.25$ m. $\xrightarrow{\text{Get}}$ $n_2 = ✓$ تقرب لأقرب أقل رقم صحيح

$$L = 2\,(X_2) + (n_2)(e) + (n_2 - 1)(b) \xrightarrow{\text{Get}} X_2 = ✓$$

? ✓ ✓

Example.

Data.

$F_{cu} = 25 \quad N\backslash mm^2$

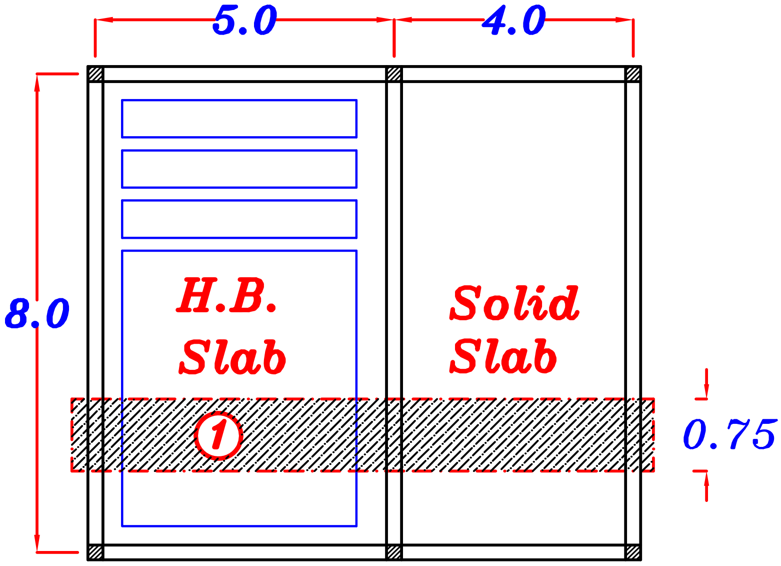
$F_y = 360 \quad N\backslash mm^2$

$F.C. = 1.50 \; kN\backslash m^2$

$L.L. = 2.0 \quad kN\backslash m^2$

Use Blocks $(200 * 200 * 600)$

$O.W.\ (Block) = 220 \quad N\backslash Block$



Req.

Design the Slabs & Draw Details of RFT.

Solution.

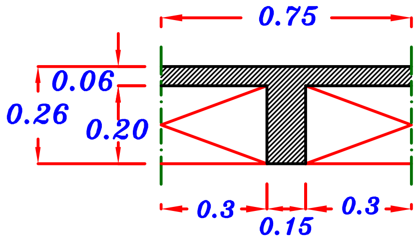
The Slab is $(5.0\ m. * 8.0\ m.)$ $\quad L_s = 5.0\ m$

$\because\ L_s = 5.0\ m$ → Can be S.S. or H.B. (Take it H.B.)

$\because\ L_s < 7.0\ m$ → Use one way H.B. Slab

$\because\ L_s = 5.0\ m$ → Don't Use Cross rib

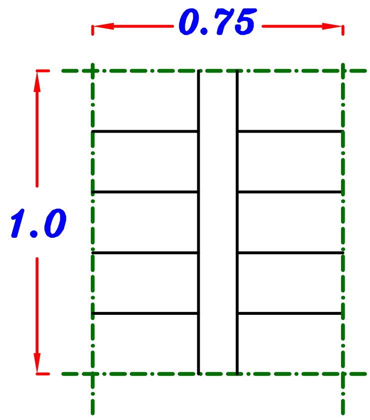
① For H.B. Slab.



Take: $t_s = \frac{e}{10} = \frac{600}{10} = 60\ mm$ $\quad$ $t_s = 60\ mm$

, $h = 200\ mm$, $t = 260\ mm$

, $b = 150\ mm$



$$(w_{rib})_{H.B.} = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,L.L.]\,(S)$$

$$+ 1.4\,(b * h * 1.0 * \gamma_c)$$

$$+ 1.4\,(5.0 * \text{weight of one block})$$

$$= \checkmark \quad (kN\backslash(1.0 * S)\,m^2)$$

$$(w_{rib}) = [1.4\,(0.06 * 25 + 1.5) + 1.6\,(2.0)]\,(0.75)$$

$$+ 1.4\,(0.15 * 0.20 * (1.0) * 25) + 1.4\,\left(5\,\left(\frac{220}{1000}\right)\right)$$

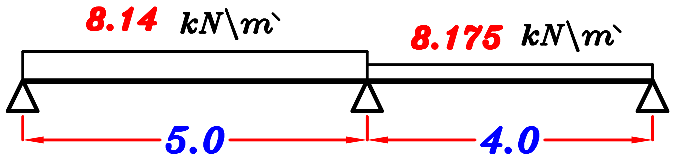
$$= 8.14 \quad (kN\backslash(1.0 * 0.75)\,m^2)$$

② For Solid Slab.

$$t_s = \frac{L_s}{30} = \frac{4000}{30} = 133.3 \ mm \qquad \boxed{t_s = 160 \ mm}$$

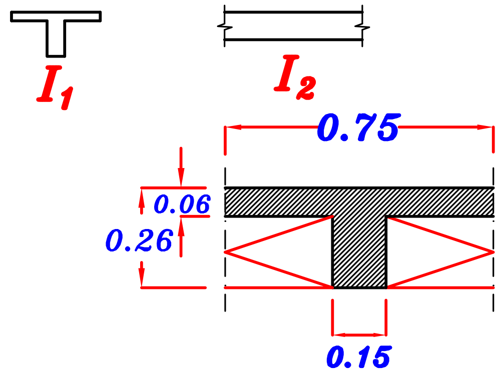
$$(w_s)_{S.S.} = (S)\left[1.4\left(t_s \, \gamma_c + F.C.\right) + 1.6 \ L.L.\right]$$

$$(w_s)_{S.S.} = 0.75\left[1.4\,(0.16 * 25 + 1.50) + 1.6\,(2.0)\right] = 8.175 \ \left(kN \backslash (1.0 * 0.75 \ m^2)\right)$$



$$I_1 = 4.1655 * 10^{-4} \ m^4$$

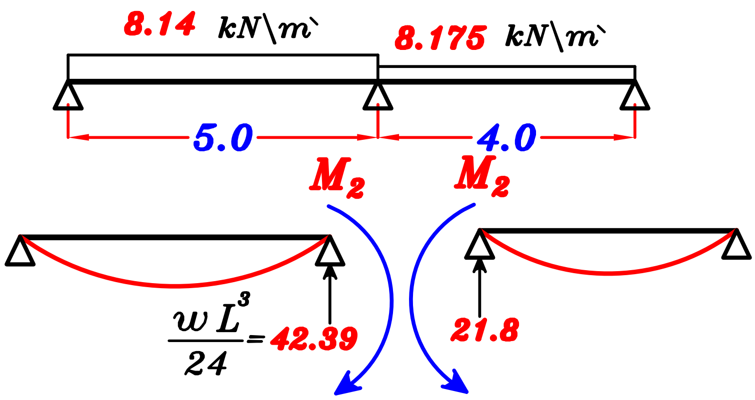
$$I_2 = \frac{S\,(t_s)^3}{12} = \frac{0.75\,(0.16)^3}{12} = 2.56 * 10^{-4} \ m^4$$



$$\therefore \ \frac{I_1}{I_2} = \frac{4.1655}{2.56} = 1.627$$

$$\therefore \ \boxed{I_1 = 1.627 \, I_2}$$

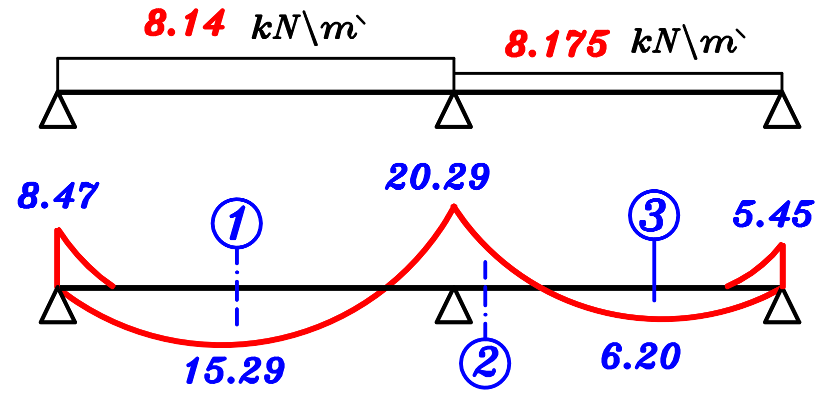
Use 3 Moment Equation.



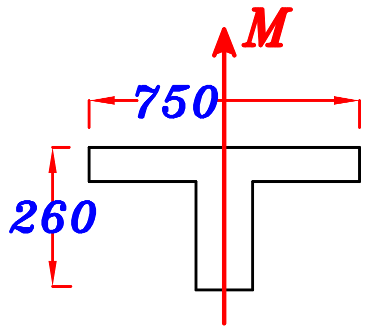
$$M_1\left(\frac{L_1}{I_1}\right) + 2\,M_2\left(\frac{L_1}{I_1} + \frac{L_2}{I_2}\right) + M_3\left(\frac{L_2}{I_2}\right) = -6\left(\frac{r_1}{I_1} + \frac{r_2}{I_2}\right)$$

$$0.0 + 2\,M_2\left(\frac{5.0}{1.627} + \frac{4.0}{1.0}\right) + 0.0 = -6\left(\frac{42.39}{1.627} + \frac{21.8}{1.0}\right)$$

$$\boxed{M_2 = -\ 20.29 \ \ kN.m \backslash 0.75\,m}$$



Sec. ①



$M = 15.29 \quad kN.m\backslash rib$

$d = t - 30\ mm = 260 - 30 = 230\ mm$

$d = C_1 \sqrt{\dfrac{M\ (kN.m\backslash rib)}{F_{cu}\ S}}\ , \quad S = 750\ mm$

$\therefore\ 230 = C_1 \sqrt{\dfrac{15.29 * 10^6}{25 * 750}} \longrightarrow C_1 = 7.85 \longrightarrow J = 0.826$

$A_s = \dfrac{M}{J\ F_y\ d} = \dfrac{15.29 * 10^6}{0.826 * 360 * 230} = 234\ mm^2\backslash rib$

$2\phi 12\backslash rib$

Sec. ②

$M_{U.L.} = 20.29 \quad kN.m\backslash 0.75m`$

$,\ t_s = 160\ mm\ ,\ d = 160 - 20 = 140\ mm\ ,\ B = 750\ mm$

$140 = C_1 \sqrt{\dfrac{20.29 * 10^6}{25 * 750}} \longrightarrow C_1 = 4.25 \longrightarrow J = 0.812$

$A_s = \dfrac{20.29 * 10^6}{0.812 * 360 * 140} = 495.7\ mm^2/0.75\ m`$

$A_s = \dfrac{495.7}{0.75} = 661\ mm^2/m`$

$6\phi 12\backslash m`$

Sec. ③

$M_{U.L.} = 6.20 \quad kN.m\backslash 0.75m`$

$,\ t_s = 160\ mm\ ,\ d = 160 - 20 = 140\ mm\ ,\ B = 750\ mm$

$140 = C_1 \sqrt{\dfrac{6.20 * 10^6}{25 * 750}} \longrightarrow C_1 = 7.69 \longrightarrow J = 0.826$

$A_s = \dfrac{6.20 * 10^6}{0.826 * 360 * 140} = 148.93\ mm^2/0.75\ m`$

$A_s = \dfrac{148.93}{0.75} = 198.5\ mm^2/m`$

$6\phi 8\backslash m`$

Check the dimensions of the Solid Part.

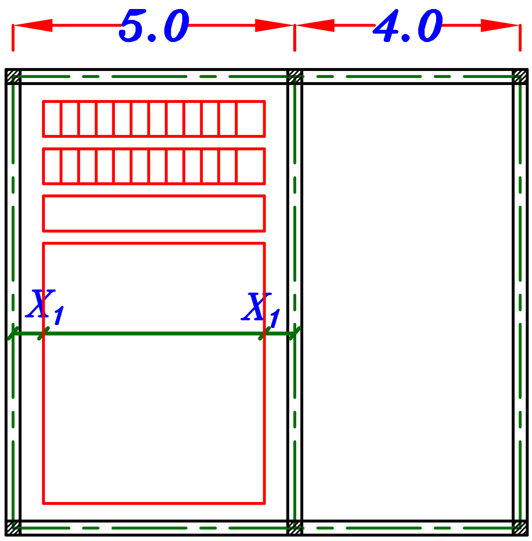
$$M_R = \left[R_{max}\frac{F_{cu}}{\gamma_c}\, b\, d^2\right] = \left[0.194\left(\frac{25}{1.5}\right)(150)(230)^2\right] = 25656500 \ N.mm$$

$\because M_R = 25.65 \ kN.m > M = 20.29 \ kN.m \backslash 0.75 \ m'$

$\therefore$ Use min. Solid Part $\boxed{X_{min.} = 0.25 \ m.}$

Arrangement of Blocks.

1_ Short Direction.



$L_S = 2\,(X_1) + (n_1)(0.2)$

Take $X_1 = X_{min.} = 0.25$ m.

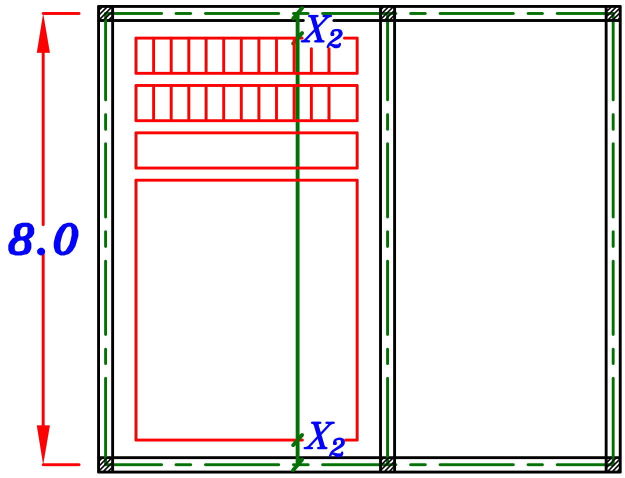
$5.0 = 2\,(0.25) + (n_1)(0.2)$

$\xrightarrow{Get} n_1 = 22.5$ $\boxed{n_1 = 22 \text{ Block}}$

$5.0 = 2\,(X_1) + (22)(0.2)$

$\xrightarrow{Get} X_1 = 0.30$ $\boxed{X_1 = 0.30 \ m.}$

2_ Long Direction.



$L = 2(X_2) + (n_2)(0.6) + (n_2 - 1)(0.15)$

Take $X_2 = X_{min.} = 0.25$ m.

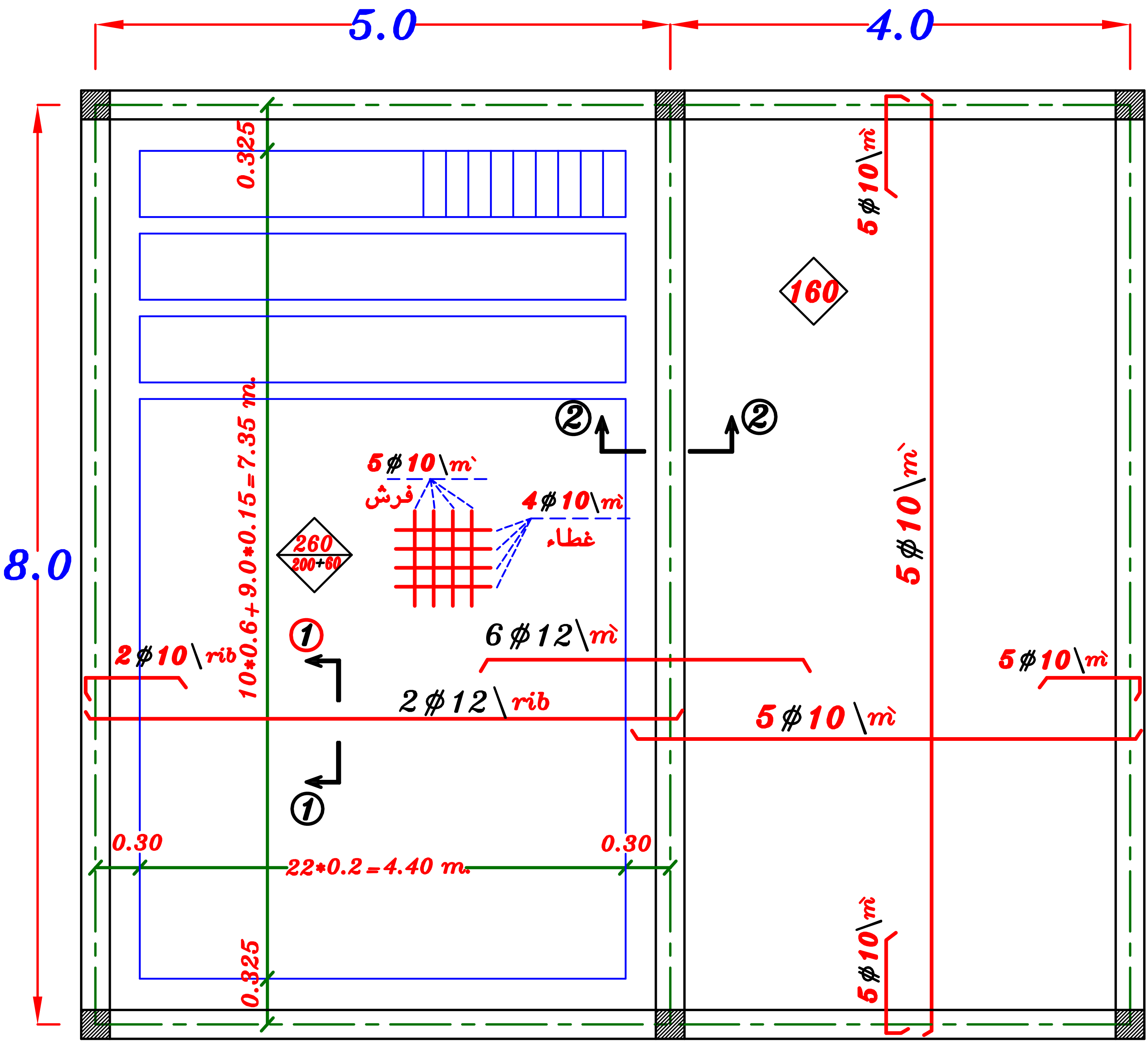
$8.0 = 2(0.25) + (n_2)(0.6) + (n_2 - 1)(0.15)$

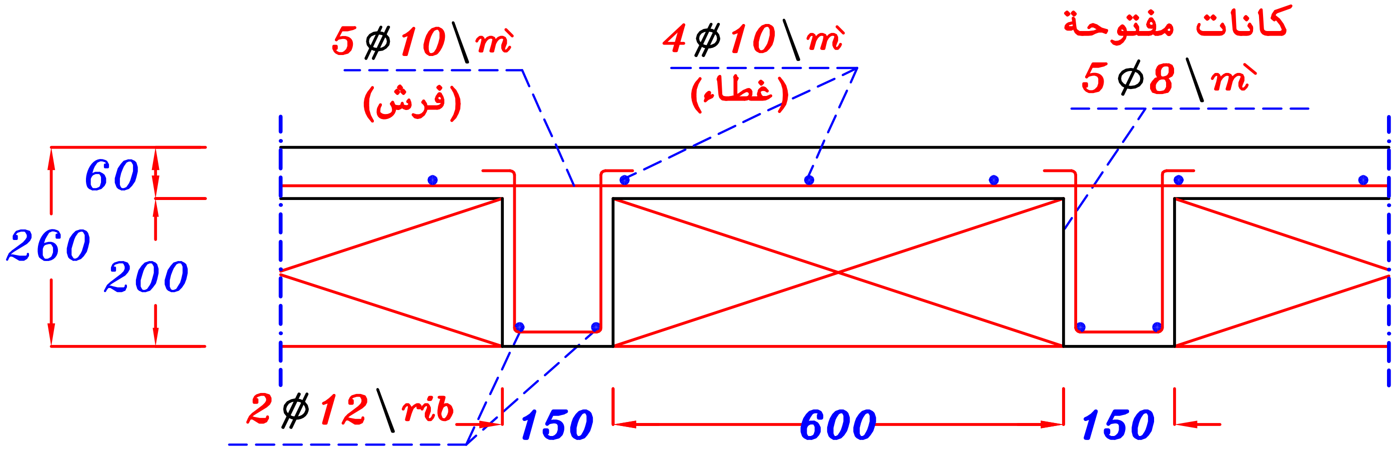
$\xrightarrow{Get} n_2 = 10.20$ $\boxed{n_2 = 10 \text{ Block}}$

$8.0 = 2(X_2) + (10)(0.6) + (10 - 1)(0.15)$

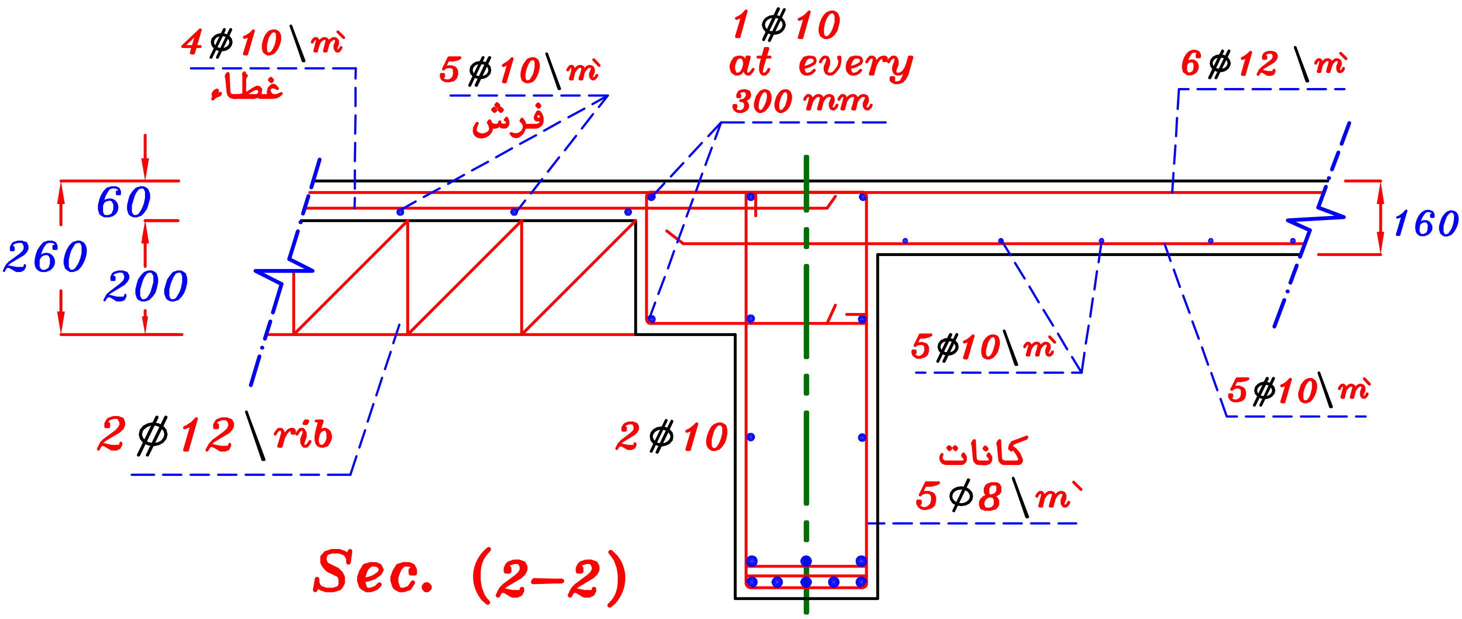
$\xrightarrow{Get} X_2 = 0.325$ $\boxed{X_2 = 0.325 \ m.}$

RFT. of the slab in plan.




5ϕ10\m`
(فرش)
4ϕ10\m`
(غطاء)
كانات مفتوحة
5ϕ8\m`
60
260
200
2ϕ12\rib
150
600
150

Sec. (1-1)


4ϕ10\m`
غطاء
5ϕ10\m`
فرش
1ϕ10
at every
300 mm
6ϕ12 \m`
60
260
200
160
5ϕ10\m`
5ϕ10\m`
2ϕ12\rib
2ϕ10
كانات
5ϕ8\m`

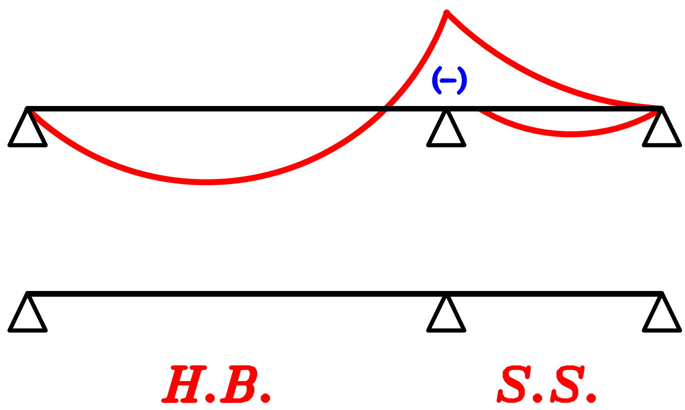
Sec. (2-2)

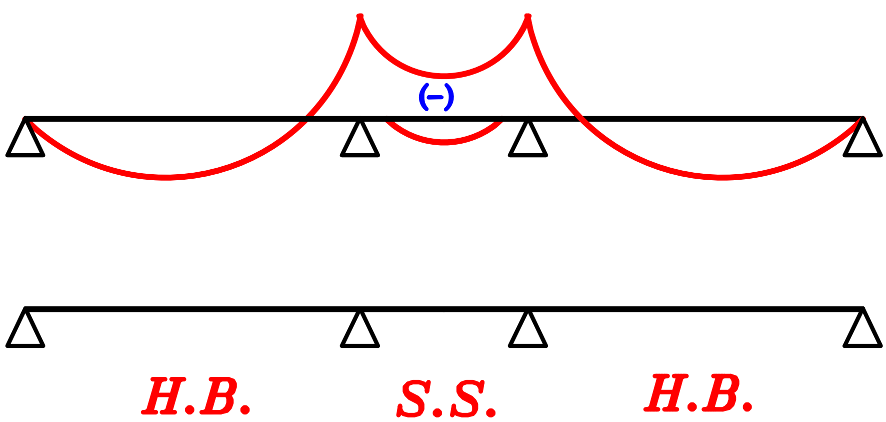
Notes.

الحالات التى لا يفضل فيها استخدام بلاطات .H.B

* بلاطات الحمام . (مالم يتم العزل جيدا)
* الأدوار النهائية . (مالم يتم العزل جيدا)
* الكبارى و الجراچات . (Dynamic Loads)
* البحور التى يكون عليها moment (-ve) بالكامل .

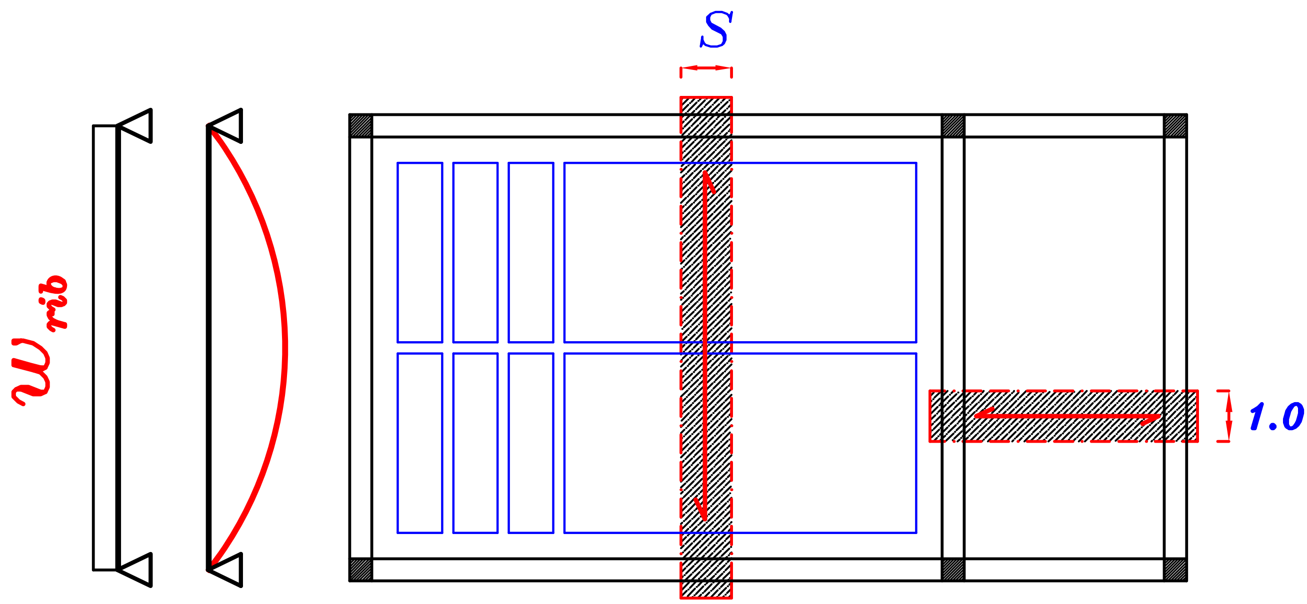
مثل ال Small Spans .



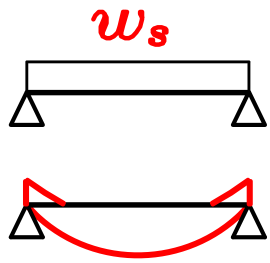


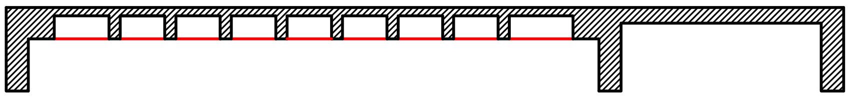
Special Cases.

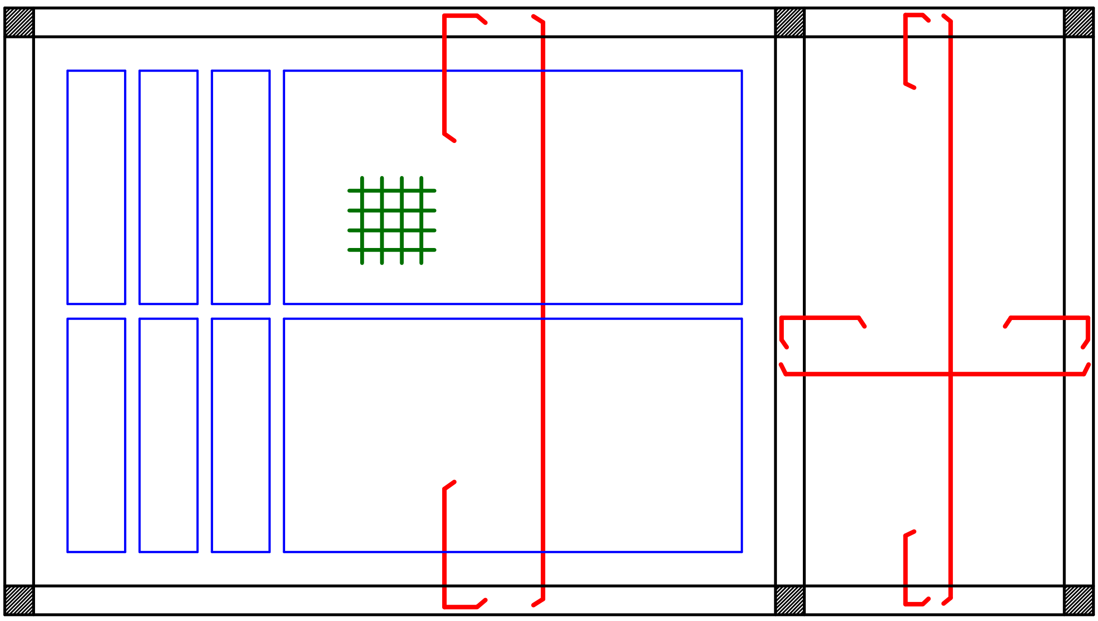
اذا كان ال **Load** لا يكمل فى البلاطه ال **H.B.** لا نكمل الشريحه



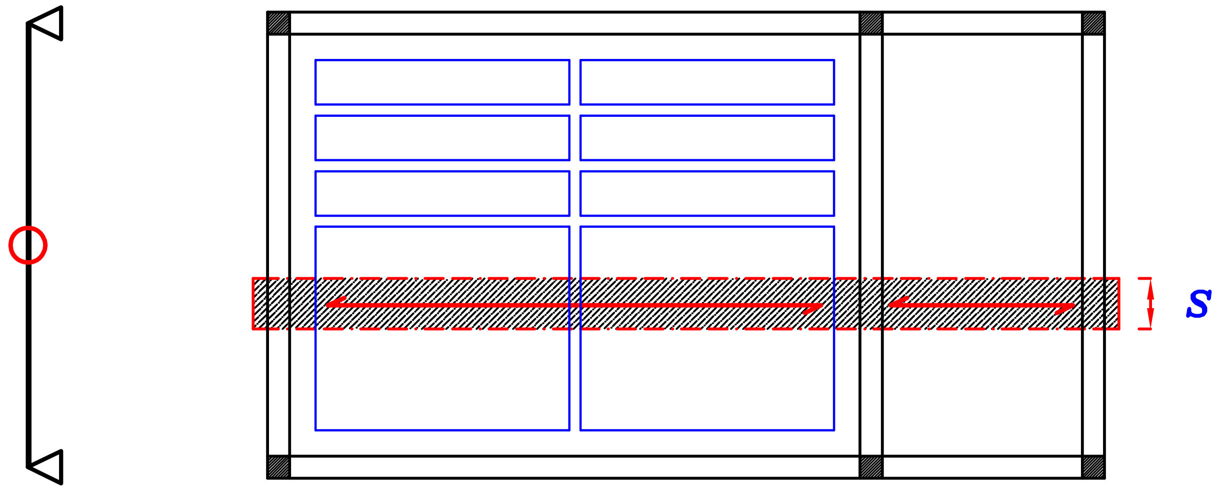
Simply supported

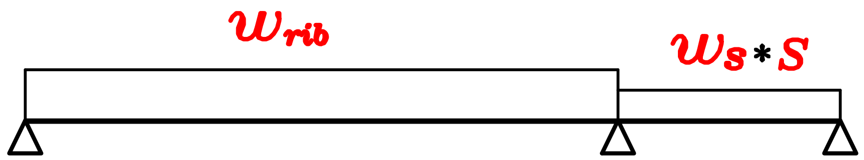




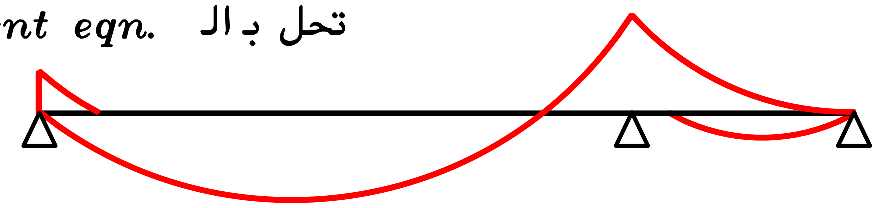


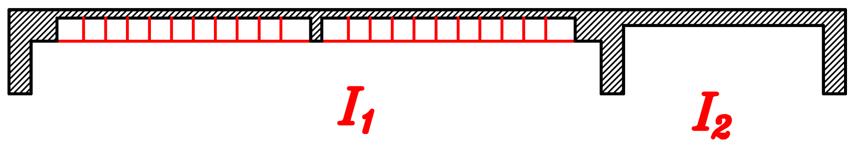
اذا كان ال Load يكمل فى البلاطه ال H.B. نكمل الشريحه

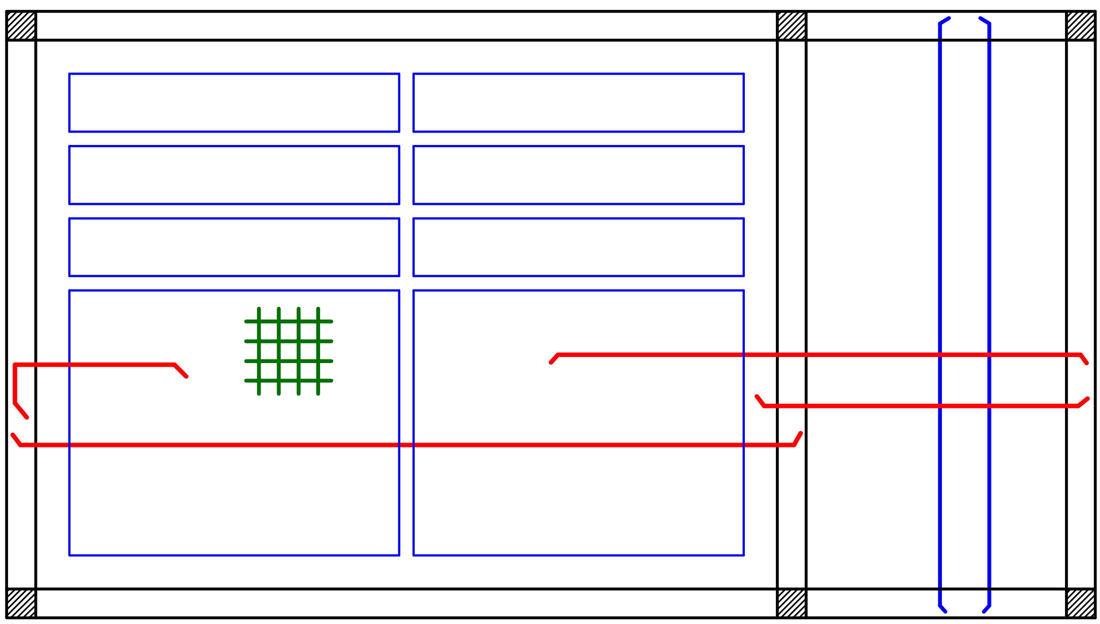




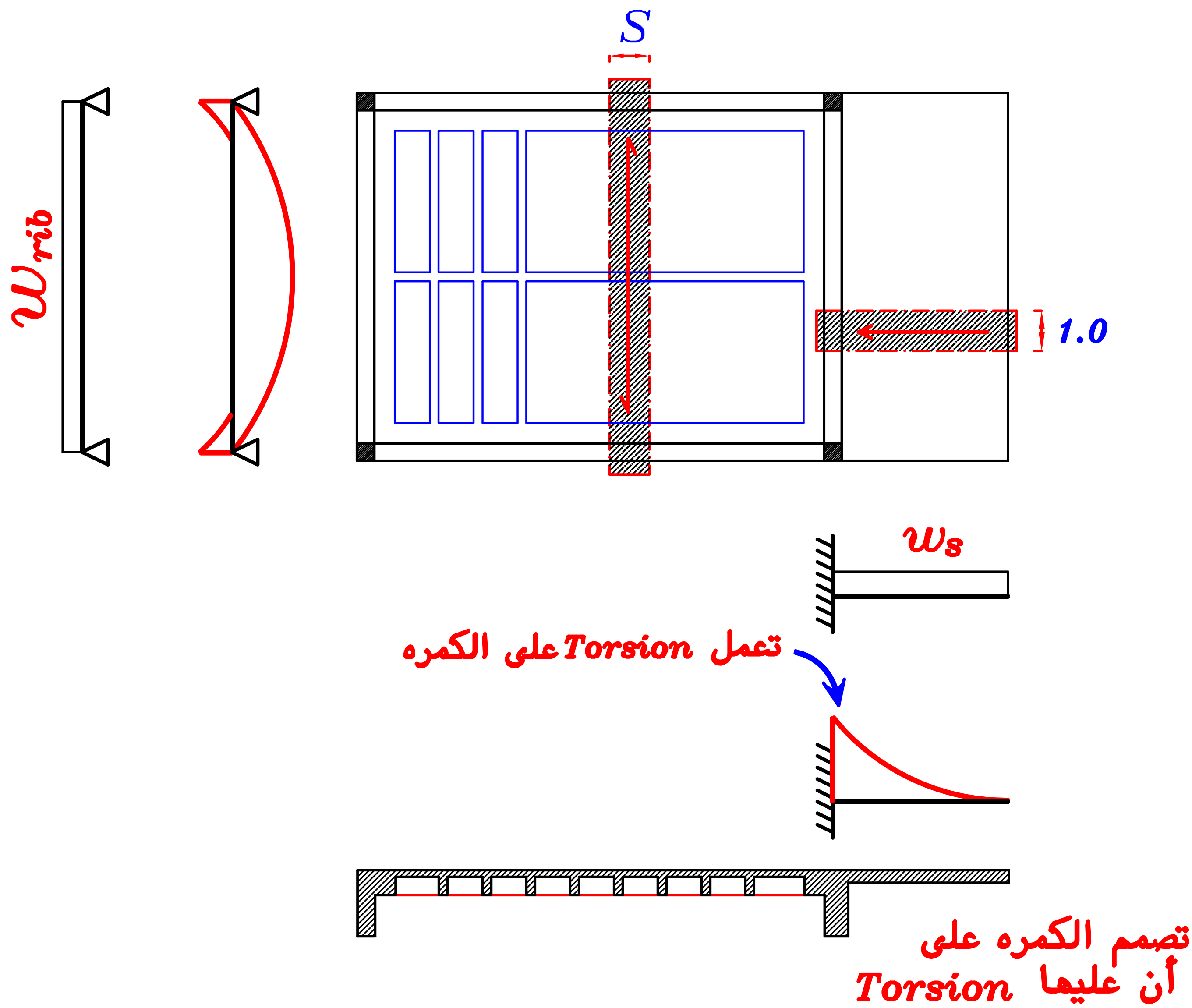
تحل بـ ال 3 moment eqn.

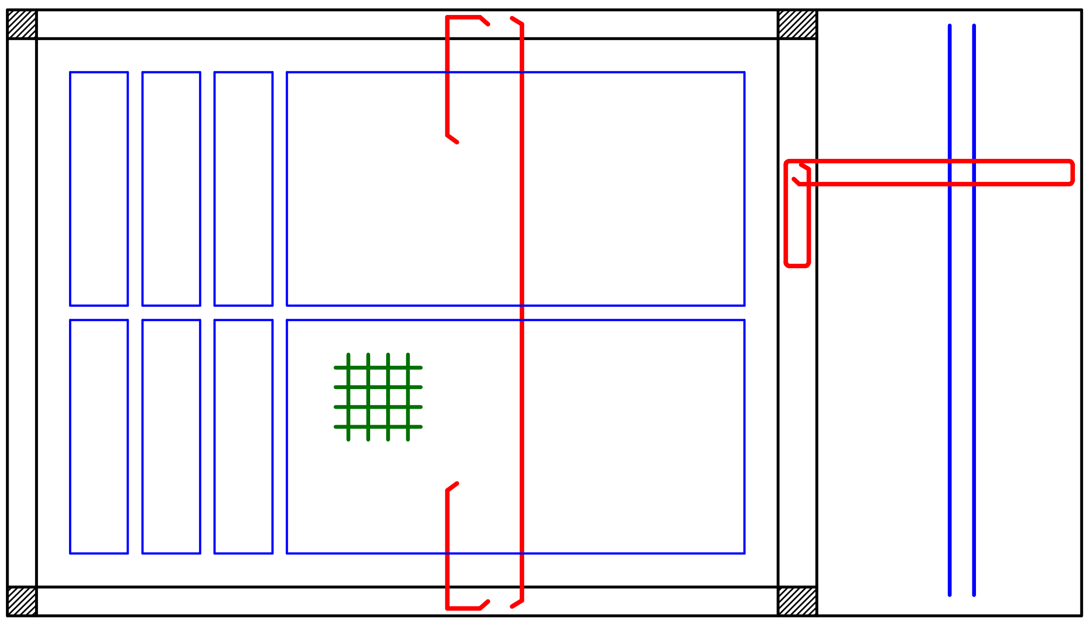




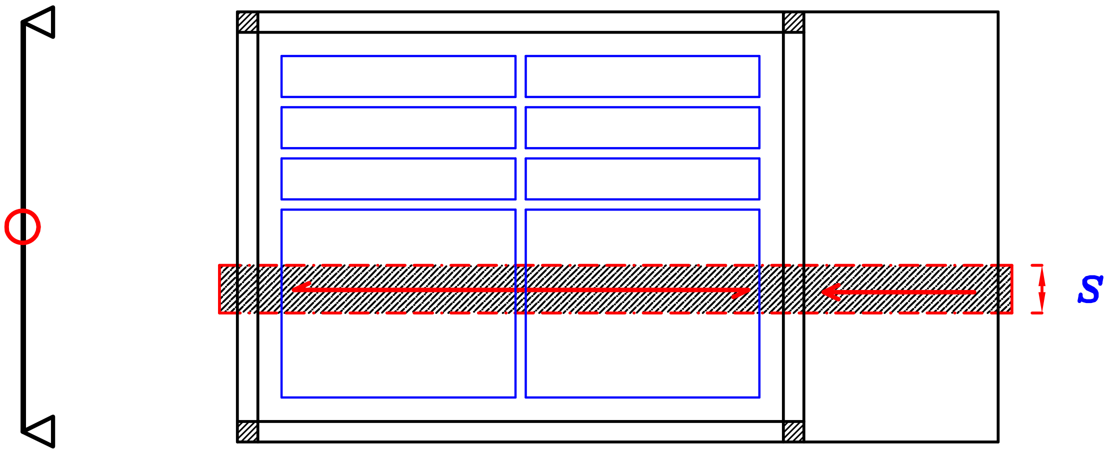


اذا كان ال *Load* لا يكمل فى البلاطه ال *H.B.* لا نكمل الشريحه

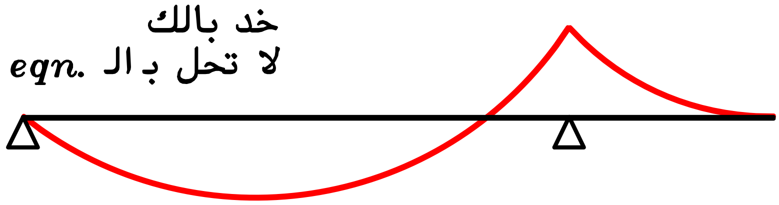


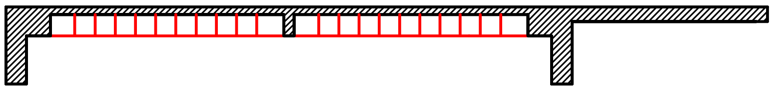


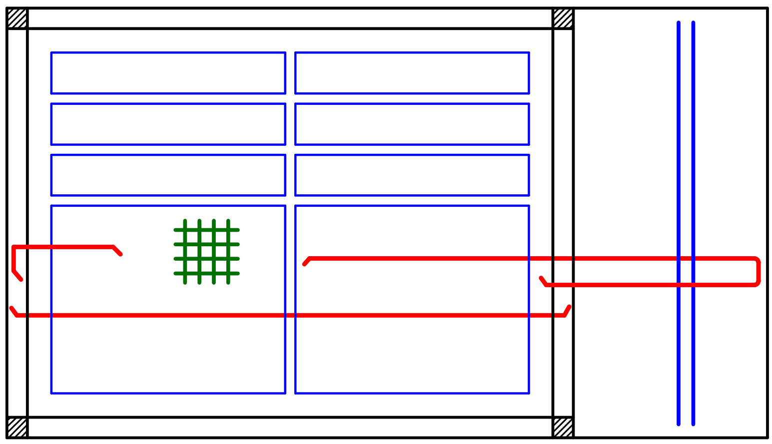
اذا كان ال Load يكمل فى البلاطه ال H.B. نكمل الشريحه



خد بالك
لا تحل بـ ال 3 moment eqn.



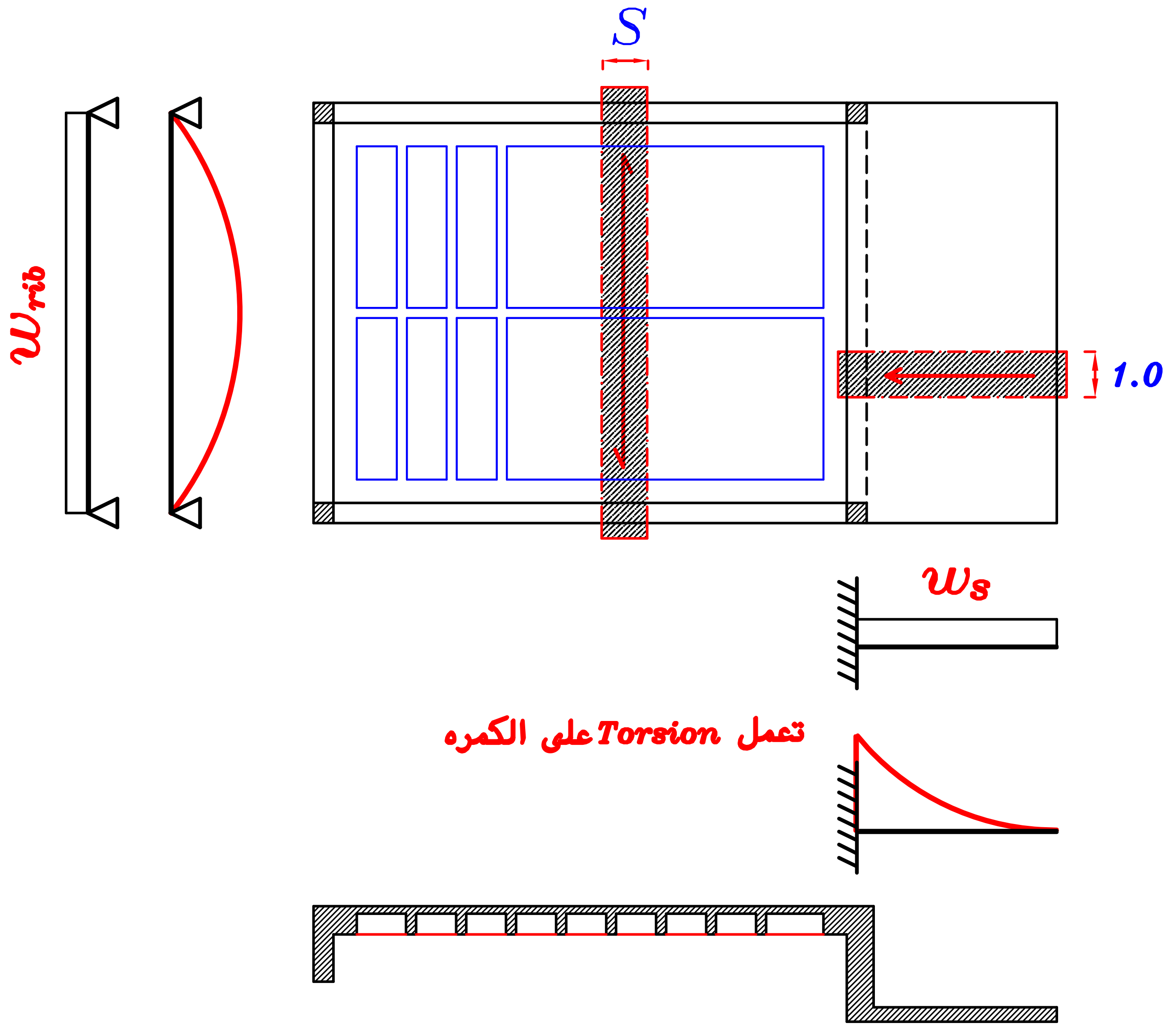




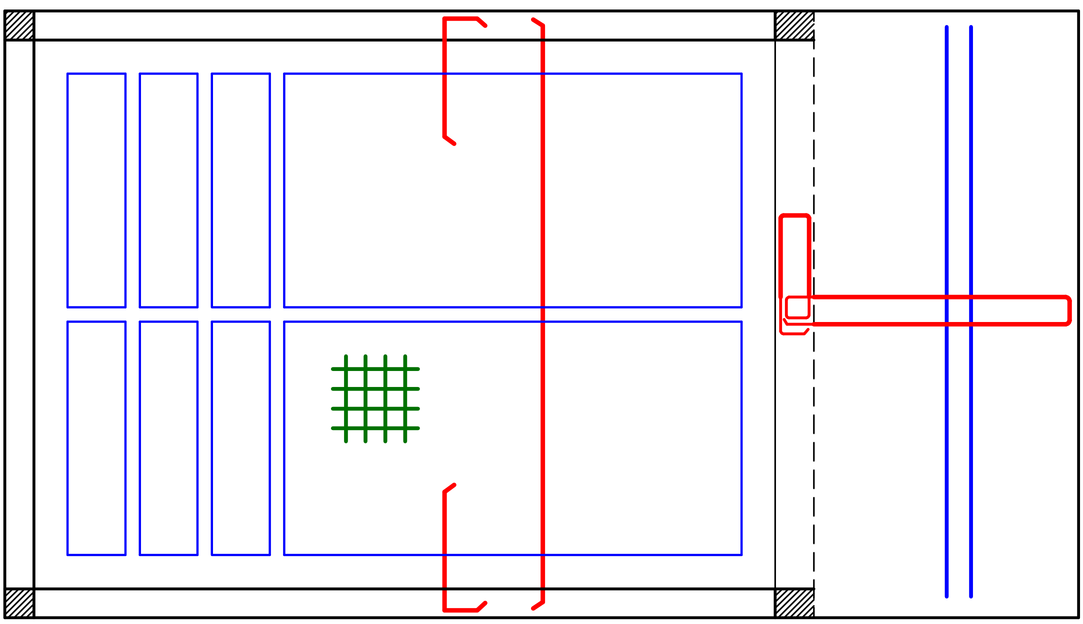
ملحوظه

يفضل عند وجود Cantilever أن تكون الأعصاب فى جهه ال Cantilever حتى لا تعمل Torsion على الكمرة حتى لو كانت ال ribs فى الاتجاه الطويل بشرط أن لا يزيد طول ال ribs عن ٠,٧ م

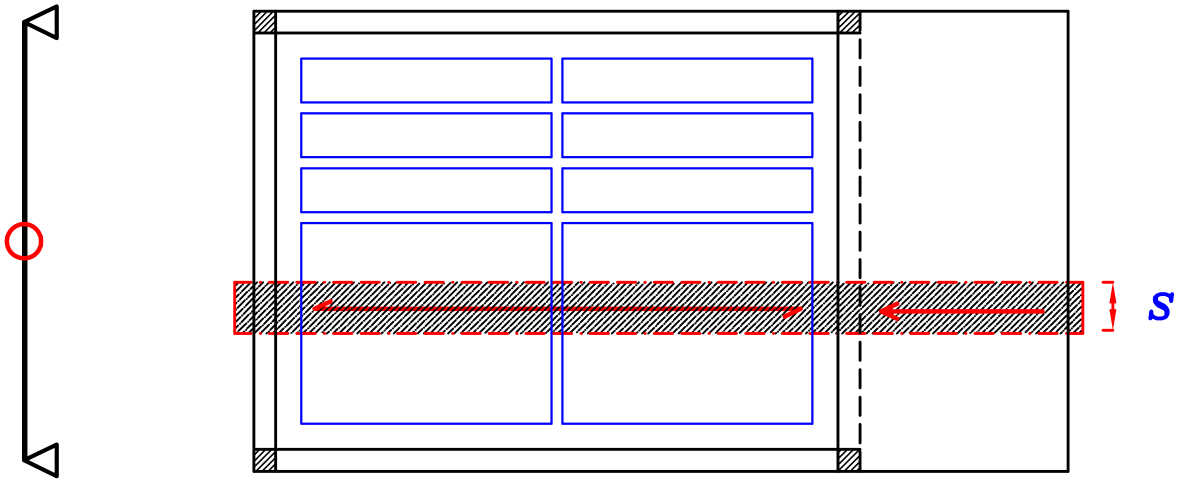
اذا كان ال *Load* لا يكمل فى البلاطه ال *H.B.* لا نكمل الشريحه

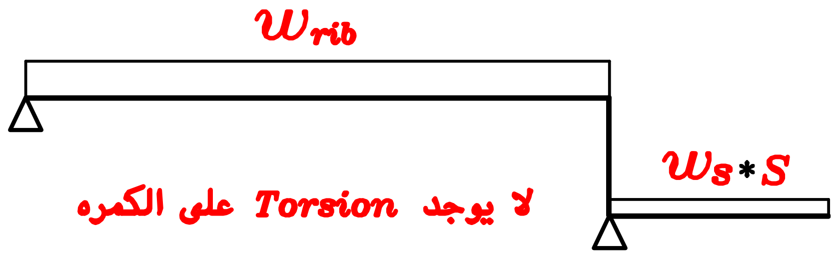


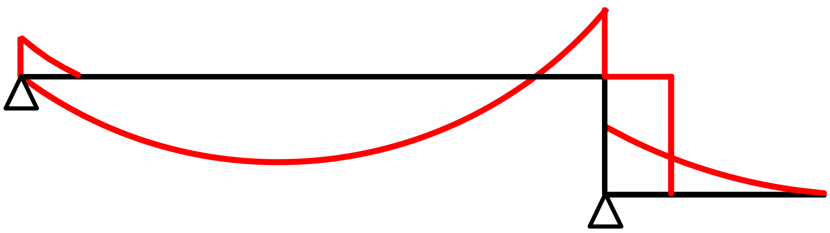
تصمم الكمره على أن عليها *Torsion*

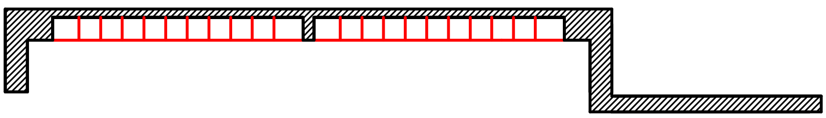


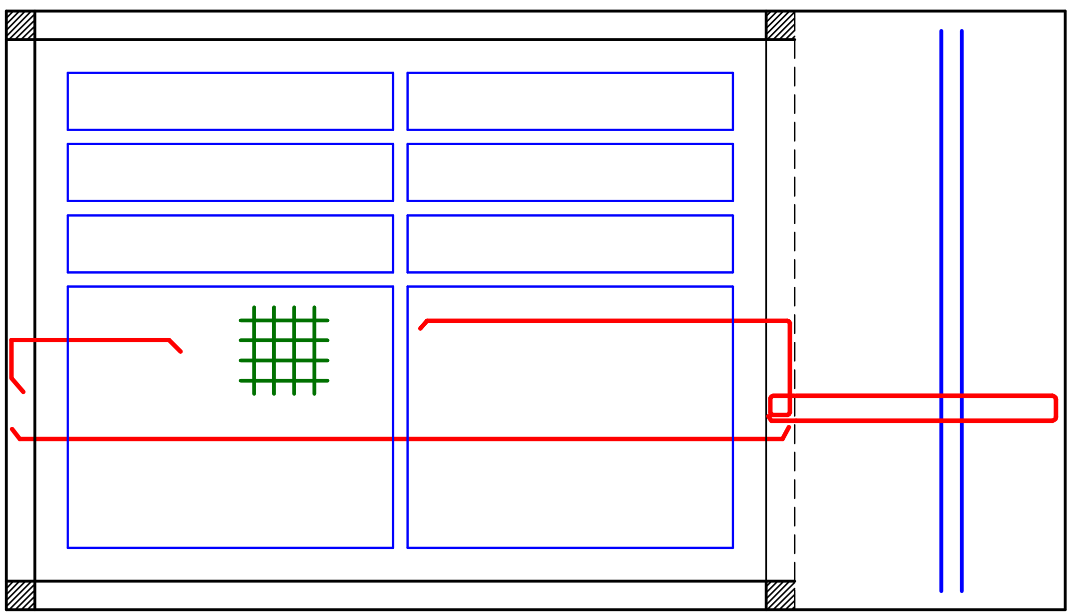
فى هذه الحاله ممكن توقيف شريحه ال Cantilever و عمل Torsion على الكمره لانه يوجد فرق فى ال Level أو تكمله الشريحه كالتالى





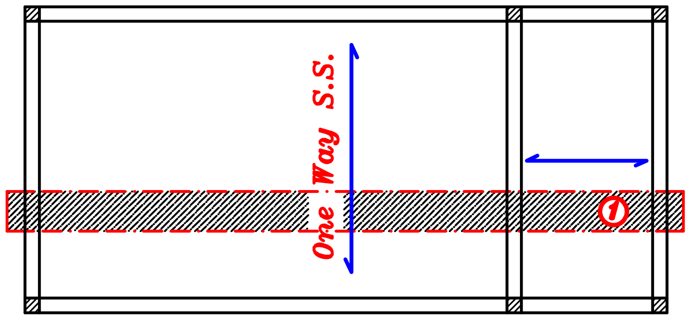






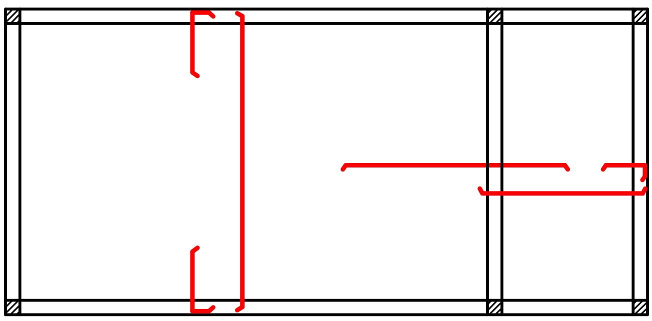
Special Cases.

اذا كان ال *Load* لا يكمل فى البلاطه ال *S.S.* نكمل الشريحه و نعمل *damping moment*



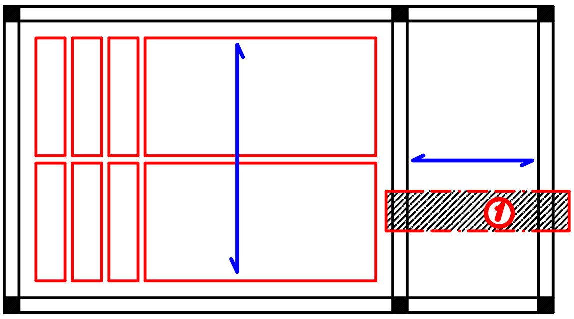
تحل بـ ال *3 moment eqn.*

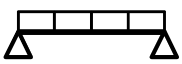
أو بال *empirical*

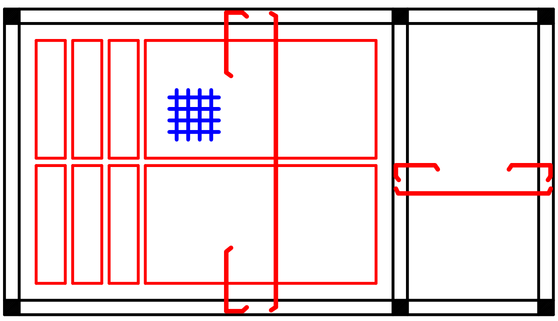


شكل التسليح الرئيسى فى البلاطه

اذا كان ال *Load* لا يكمل فى البلاطه ال *H.B.* لا نكمل الشريحه



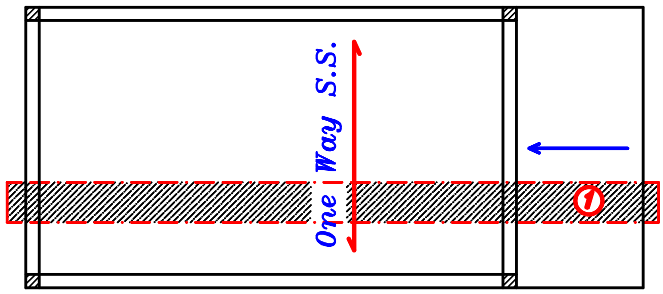


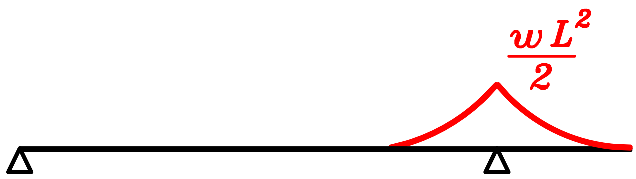


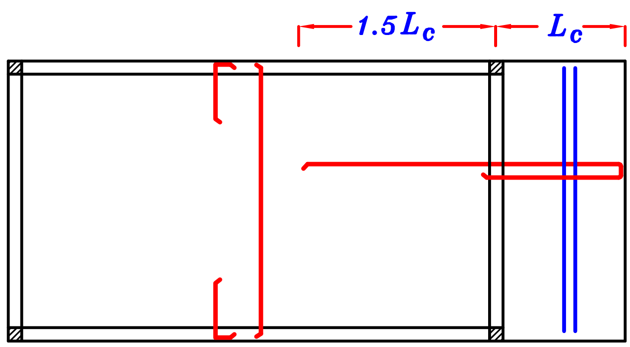
شكل التسليح الرئيسى فى البلاطه

Special Cases.

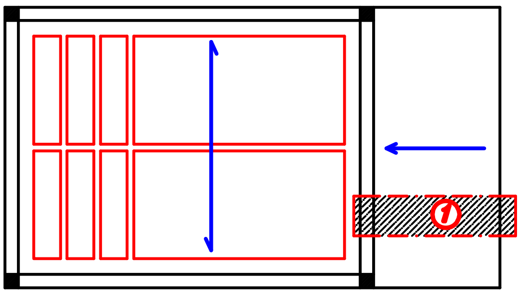
اذا كان ال *Load* لا يكمل فى البلاطه ال *S.S.* نكمل الشريحه و نعمل *damping moment*

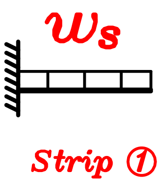


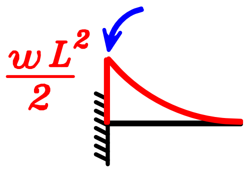


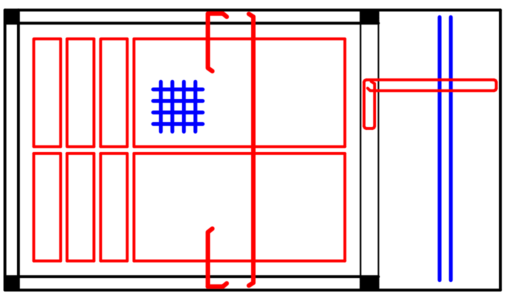


اذا كان ال *Load* لا يكمل فى البلاطه ال *H.B.* لا نكمل الشريحه



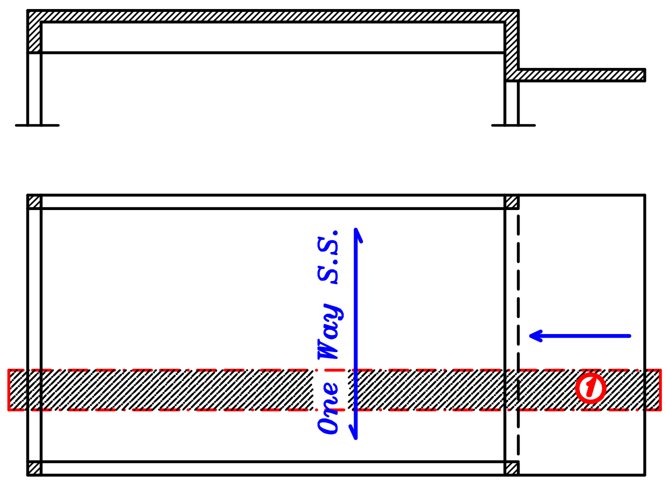


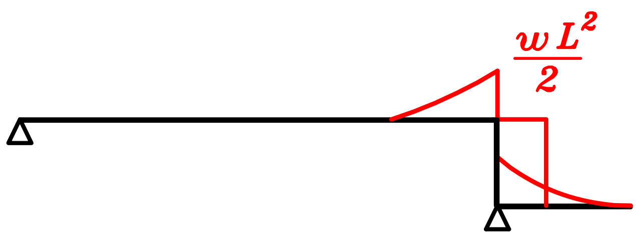


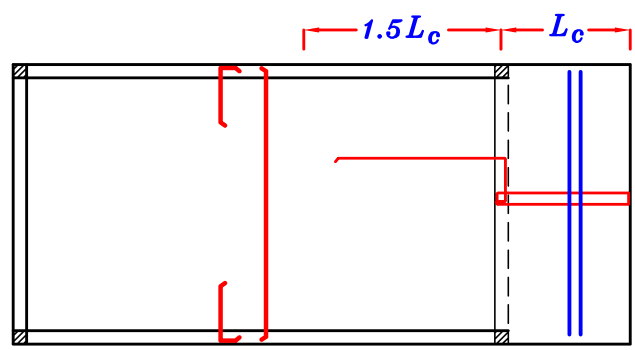


Special Cases.

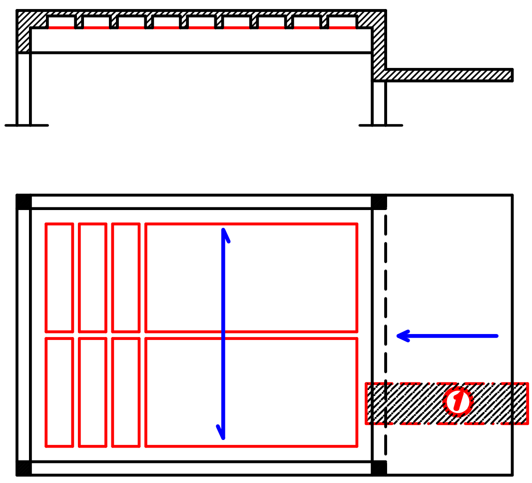
فى هذه الحاله ممكن توقيف شريحه الـ Cantilever و عمل Torsion على الكمره لانه يوجد فرق فى الـ Level أو تكمله الشريحه كالتالى

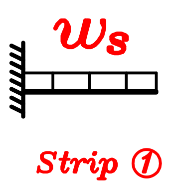


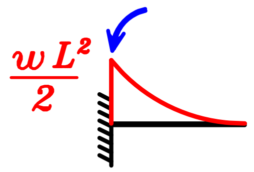


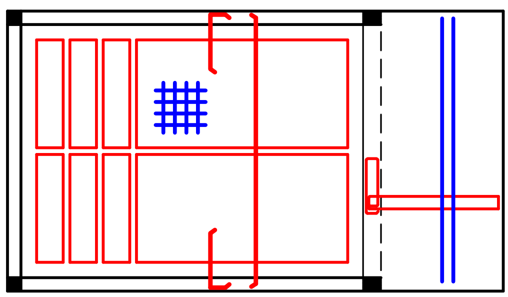


اذا كان الـ Load لا يكمل فى البلاطه الـ H.B. لا نكمل الشريحه

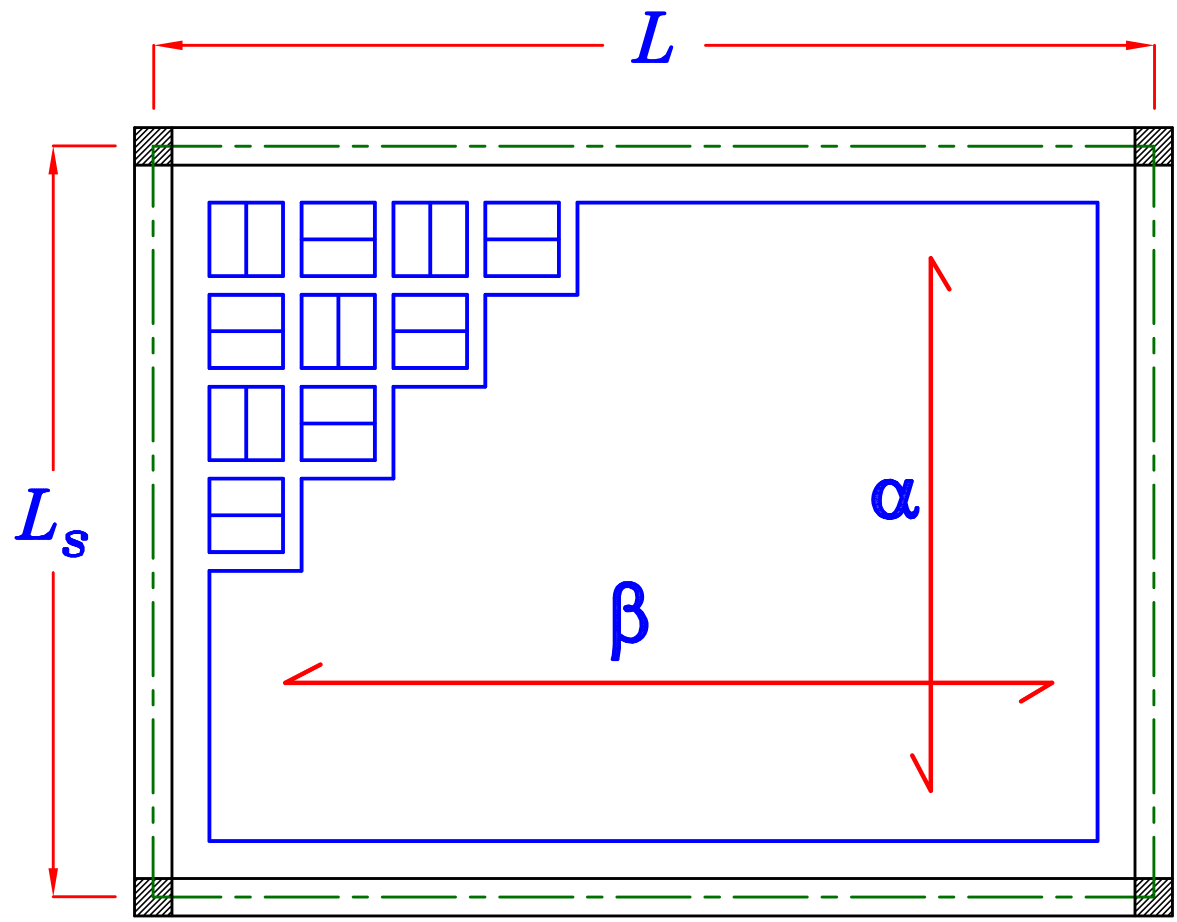








Two Way Hollow Block Slab.



نستخدم بلاطه **H.B.** *Two Way* عندما تكون $L_s > 7.0\ m$

بشرط

في الكود $\frac{L}{L_s} \ngtr 1.5$	يفضل عملياً $\frac{L}{L_s} \ngtr \frac{4}{3}$ ✓✓

عملياً عاده تستخدم البلاطات الـ ***Two Way H.B.***

للابعاد التى تبدأ من $6.0\ m \times 6.0\ m$

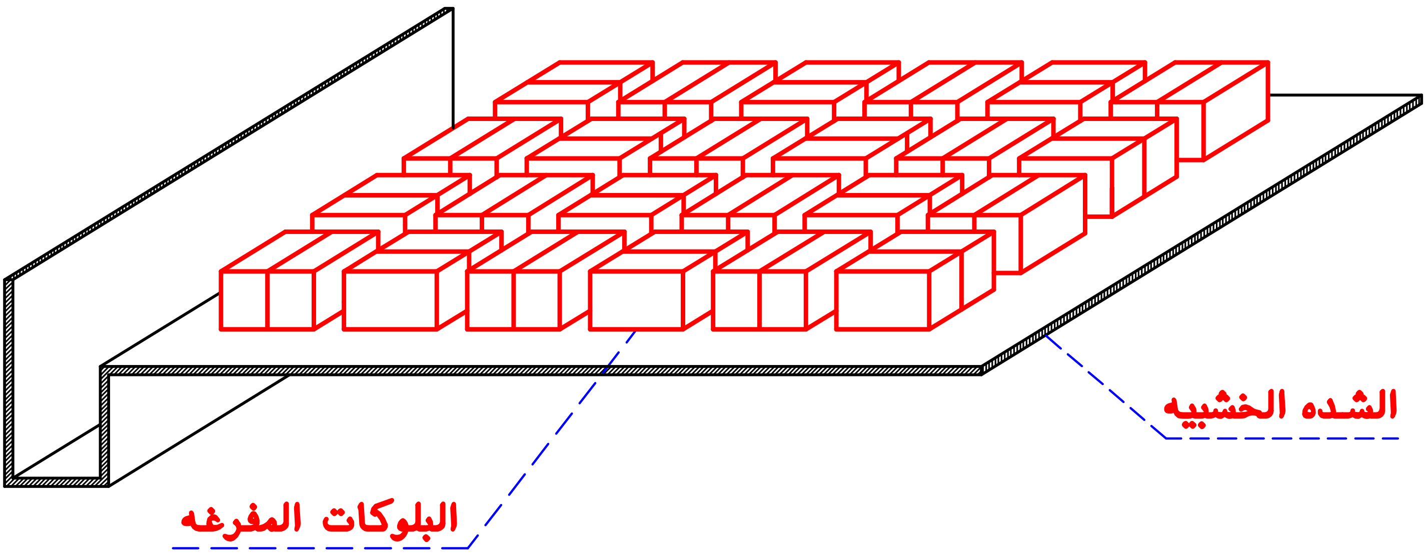
أو $7.0\ m \times 7.0\ m$

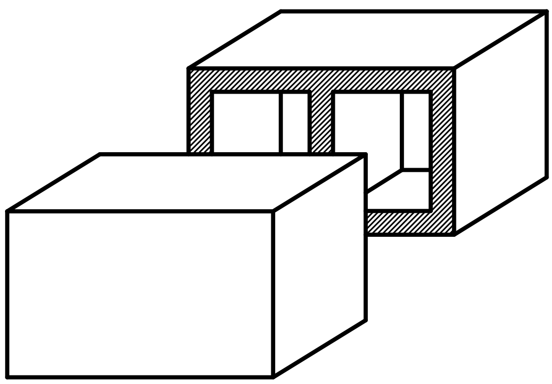
أو $8.0\ m \times 8.0\ m$

أو $9.0\ m \times 9.0\ m$ ----- لا تُفضل

شكل الشده الخشبيه و البلوكات المفرغه قبل صب الخرسانه

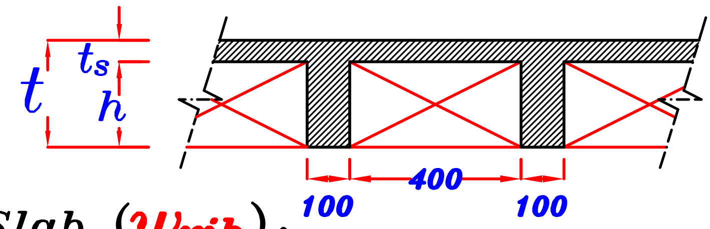
للبلاطه ال Two Way Hollow Blocks Slab





يوضع البلوكين بحيث
يكون الفراغ مقابل للفراغ

Steps of Design.



① Choose $t = t_s + h$

② Get the Loads on the Slab. (w_{rib}).

③ Calculate the Load Factors. α , β

④ Take strip at the Load directions, and Get B.M. (kN.m\rib)

⑤ Design the Ribs. [Dimensions ($b * h$) & RFT. (2∅ ✓ \rib)].

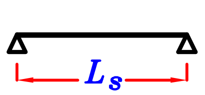
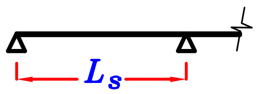
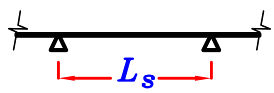
– Get the dimensions of the solid part & Arrangement of Blocks.

⑥ Draw the RFT. [Plan & Cross-Sections] .

– Design the Beams. [Projected or Embedded] .

① Choose (t). ($t = t_s + h$)

قيم (t) التى نأخذها لكى نتفادى عمل Check deflection

			
st. 360\520	$L_s/16$	$L_s/18$	$L_s/21$
st. 240\350	$L_s/(16*1.25)$	$L_s/(18*1.25)$	$L_s/(21*1.25)$

و لكن هذه القيم تجعل t كبيره جداً جداً لذا غالباً ما نأخذ

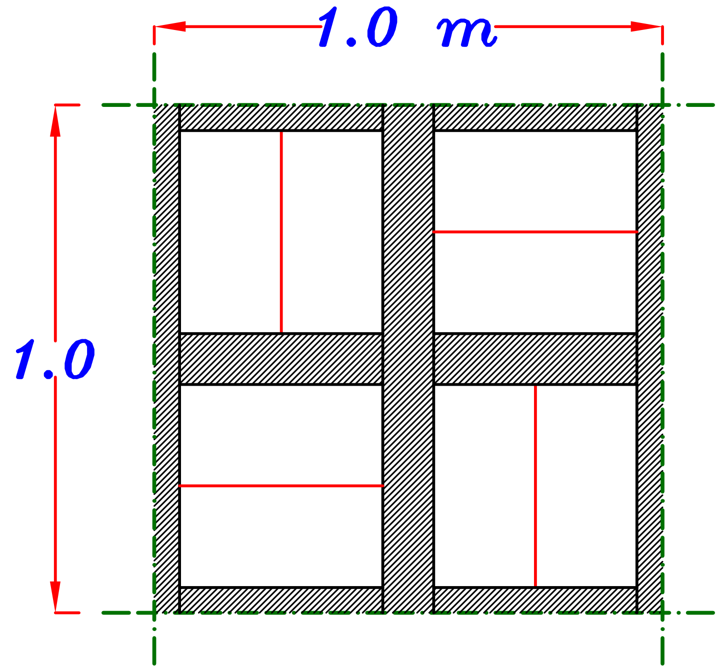
$t = 200$ mm ($t_s = 50$ mm , $h = 150$ mm).

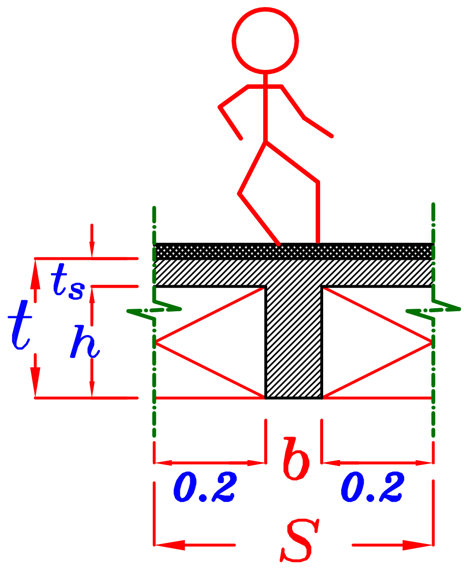
$t = 250$ mm ($t_s = 50$ mm , $h = 200$ mm). ----- الأكثر أستخداماً

$t = 300$ mm ($t_s = 50$ mm , $h = 250$ mm).

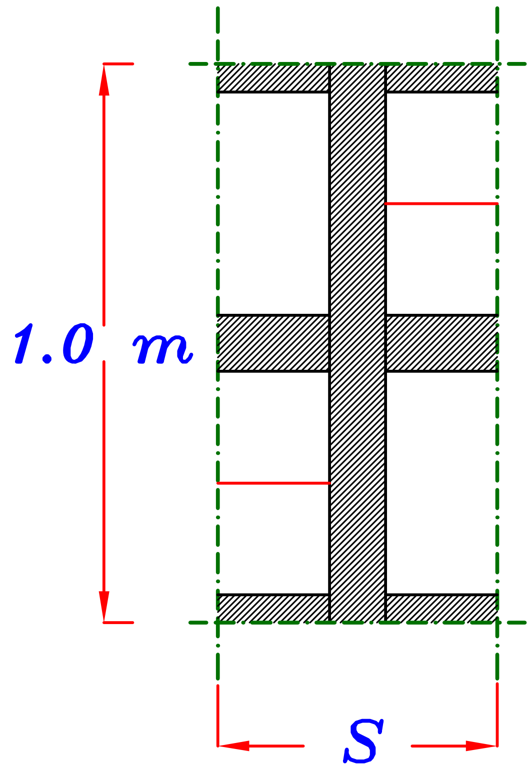
و فى هذه الحالة المفروض !!! أن نعمل Check deflection .

② Get the Loads on the Slab. (w_{rib}) $(kN \backslash (1.0 * S)\, m^2)$.





$$S = e + b = 0.4 + 0.1 = 0.5 \ m$$



$$(w_{rib})_{U.L.} = \left[1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)\right] S$$

$$+ 1.4\,(b\,h * 1.8 * \gamma_c) + 1.4\left[4\left(\text{Weight of One Block}\right)\right]$$

$$= \checkmark \ (kN \backslash (1.0 * S\ m^2))$$

③ Calculate the Load Factors. α , β

r = Degree of rectangularity

$$r = \frac{m\,L}{\grave{m}\,L_s}$$

the strip			
m OR $\grave{m}$	1.0	0.87	0.76

Then Calculate α , β

ⓐ IF L.L. $\leqslant$ 5.0 $kN \backslash m^2$

Use Marcus

Use Code Page **6-10** Table **6-2**

ليس لة معادلات

Note: $\alpha + \beta \simeq 0.8$

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

ⓑ IF L.L. $>$ 5.0 $kN \backslash m^2$ Use Grashoff

Grashoff — - —— - —

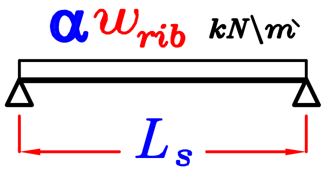
$$\alpha = \frac{r^4}{1+r^4}$$

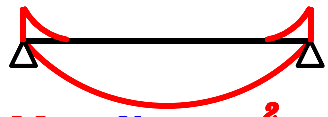
$$\beta = \frac{1}{1+r^4}$$

Note: $\alpha + \beta = 1.0$

④ Take strip at the Load direction, and Get B.M. $(kN.m\backslash rib)$

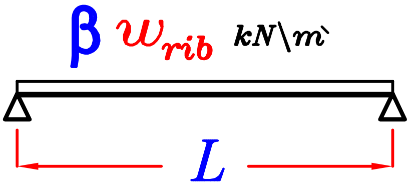
α نأخذ شريحه فى إتجاه عرضها $(S = 0.5\, m)$

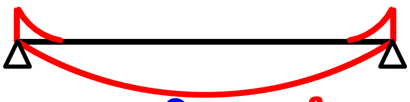




$$M_1 = \frac{\alpha\, w_{rib}\, L_s^2}{8}$$

β و نأخذ شريحه فى إتجاه عرضها $(S = 0.5\, m)$



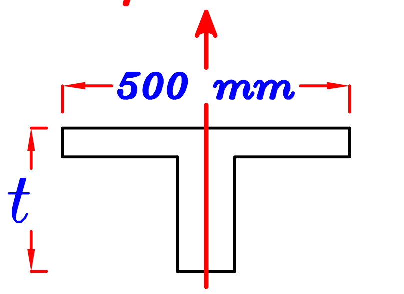


$$M_2 = \frac{\beta\, w_{rib}\, L^2}{8}$$

⑤ Design the Ribs. (Dimensions & RFT.)

ⓐ Short Direction. (α Direction)

$M_1 = ✓\ kN.m\backslash rib$



Get $M_1 = ✓\ kN.m\backslash rib$

$\because t = ✓\ mm$

$\therefore d_1 = t - 30\ mm\ (Cover) = ✓\ mm$

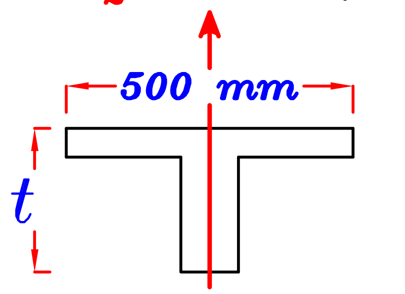
$\because d_1 = C_1 \sqrt{\dfrac{M_{1\,(kN.m\backslash rib)}}{F_{cu}\ B}}$, $B = 500\ mm$

Get $C_1 = ✓ \longrightarrow J = ✓$

$$A_{s\alpha} = \frac{M_1}{J\, F_y\, d} = ✓\ mm^2\backslash rib = 2\,\phi\, ✓\ \backslash rib$$

ⓑ Long Direction. (β Direction)

$M_2 = ✓\ kN.m\backslash rib$



Get $M_2 = ✓\ kN.m\backslash rib$

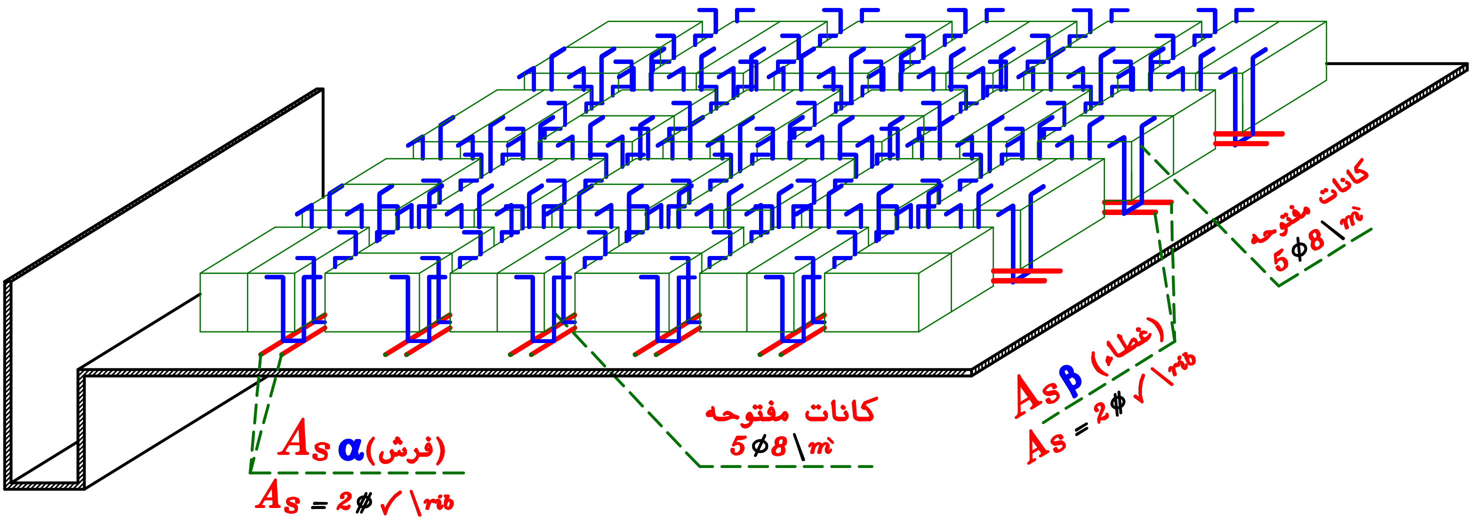
$\because t = ✓\ mm$

$\therefore d_2 = t - 40\ mm\ (Cover) = ✓\ mm$

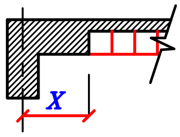
$\because d_2 = C_1 \sqrt{\dfrac{M_{2\,(kN.m\backslash rib)}}{F_{cu}\ B}}$, $B = 500\ mm$

Get $C_1 = ✓ \longrightarrow J = ✓$

$$A_{s\beta} = \frac{M_2}{J\, F_y\, d} = ✓\ mm^2\backslash rib = 2\,\phi\, ✓\ \backslash rib$$

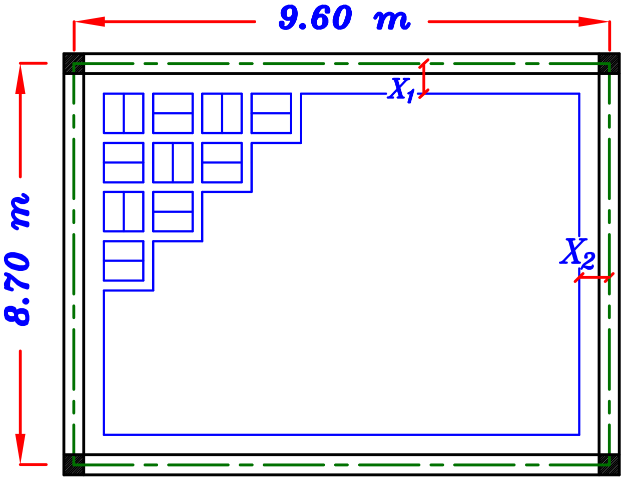


RFT. of the Ribs
For The Two Way Hollow Blocks Slab



ممكن حساب X من ال $C.L.$ كما هو مبين

و في هذه الحاله تكون قيمه $X_{min} = 250$ mm



Example.

Arrange the Blocks and get the dimensions of the Solid Part.

1_ Short Direction.

$L_s = 2\,(X_1) + (n_1)(0.4) + (n_1 - 1)(0.1)$ --- (X_1, n_1) Unknowns

Take $X_1 = 0.25$ m.

$8.7 = 2\,(0.25) + (n_1)(0.4) + (n_1 - 1)(0.1) \xrightarrow{Get} n_1 = 16.6$ → **$n_1 = 16$ Block**

$8.7 = 2\,(X_1) + (16)(0.4) + (16 - 1)(0.1) \xrightarrow{Get} X_1 = 0.40$ → **$X_1 = 0.40$ m.**

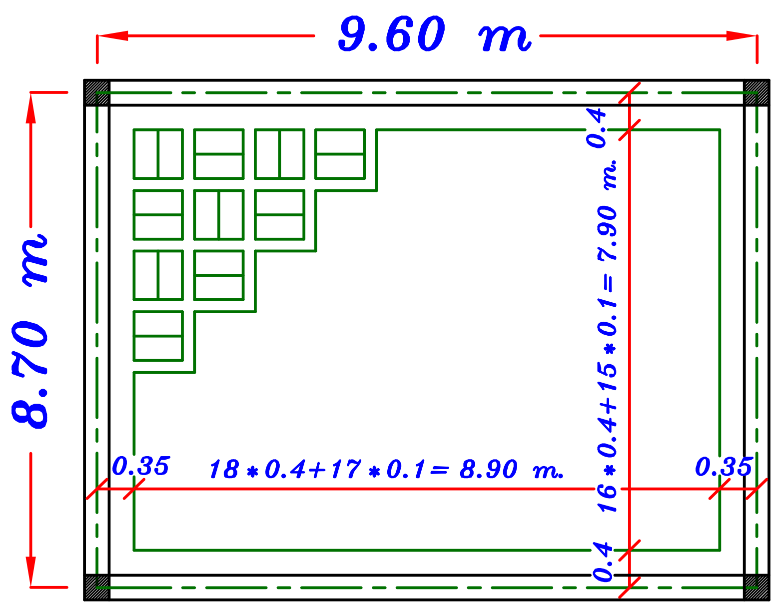
2_ Long Direction.

$L = 2\,(X_2) + (n_2)(0.4) + (n_2 - 1)(0.1)$ --- (X_2, n_2) Unknowns

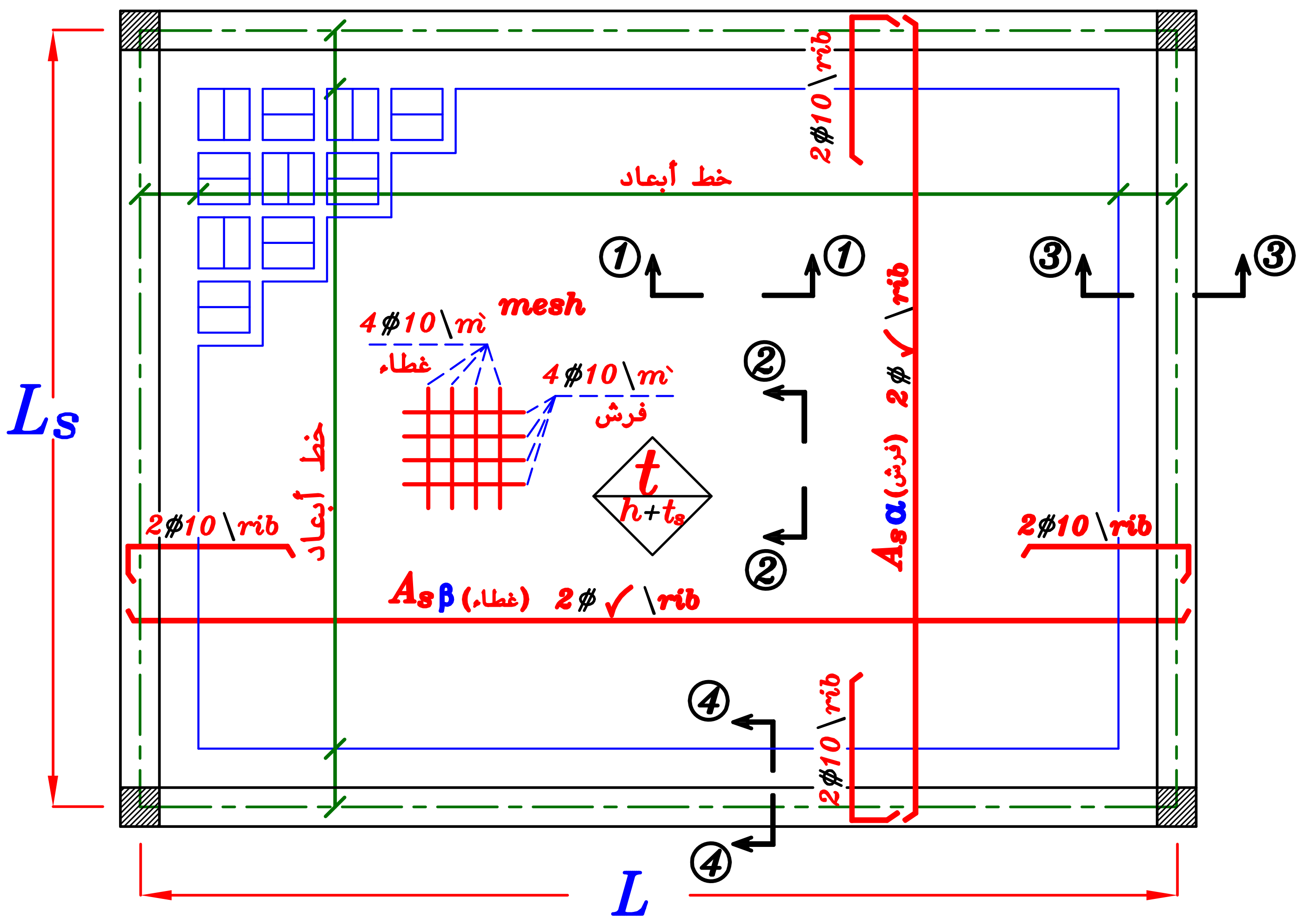
Take $X_2 = 0.25$ m.

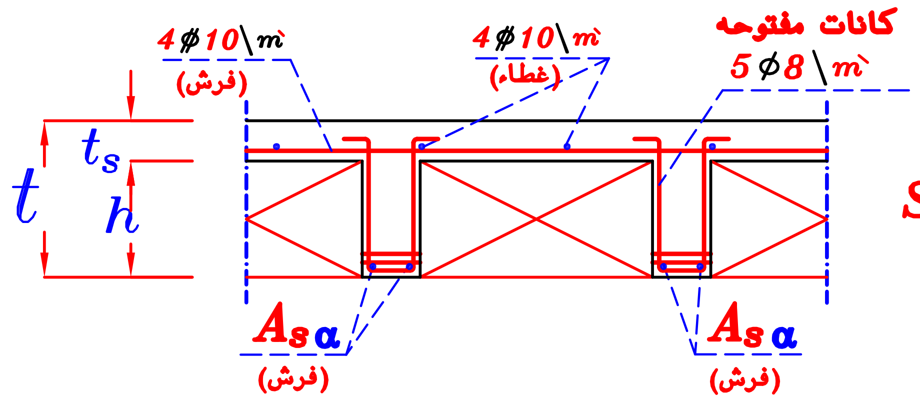
$9.6 = 2\,(0.25) + (n_2)(0.4) + (n_2 - 1)(0.1) \xrightarrow{Get} n_2 = 18.4$ → **$n_2 = 18$ Block**

$9.6 = 2\,(X_2) + (18)(0.4) + (18 - 1)(0.1) \xrightarrow{Get} X_2 = 0.35$ → **$X_2 = 0.35$ m.**

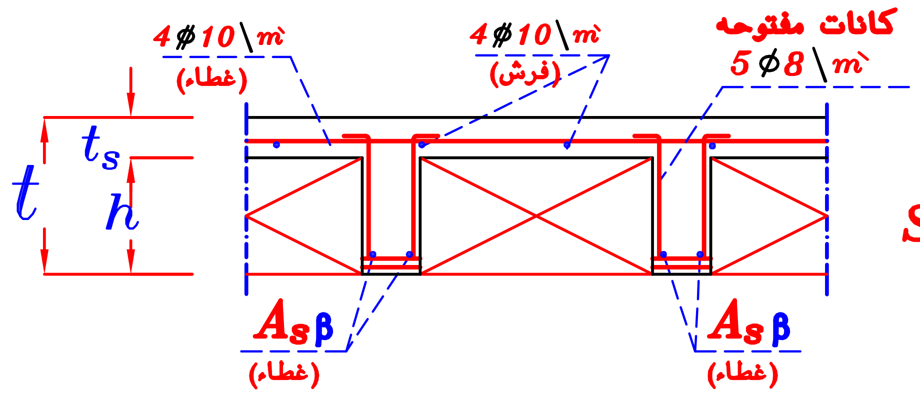


⑥ Drawing the RFT. [Plan & Cross-Sections].

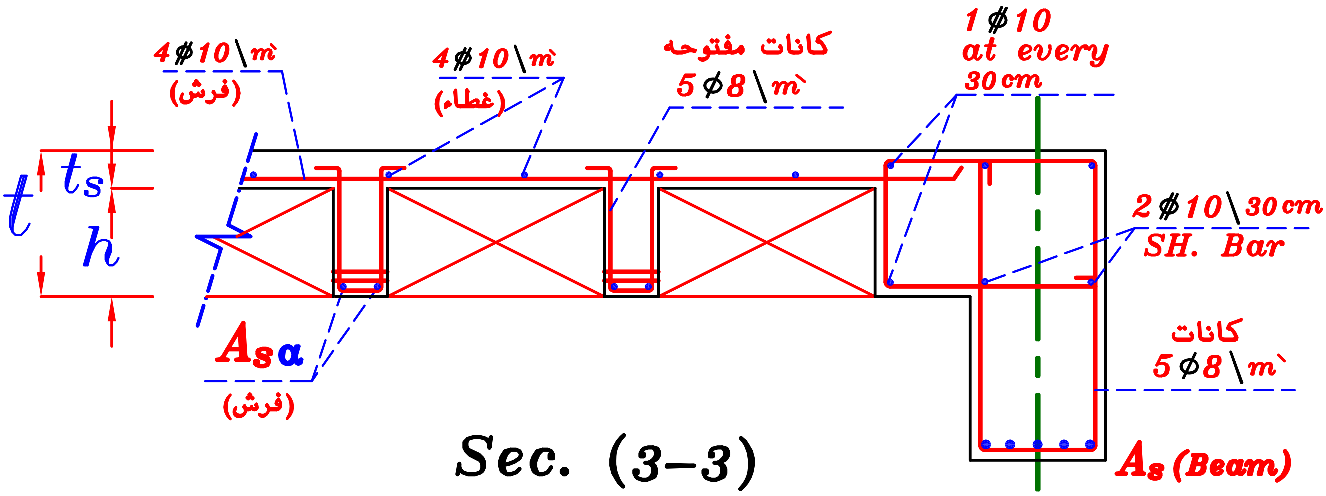




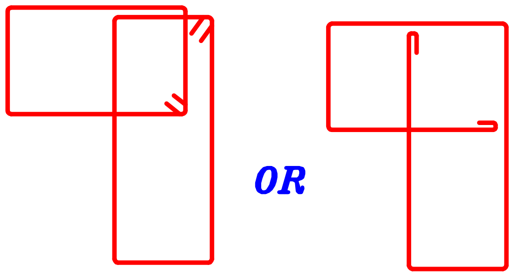
Sec. (1–1)

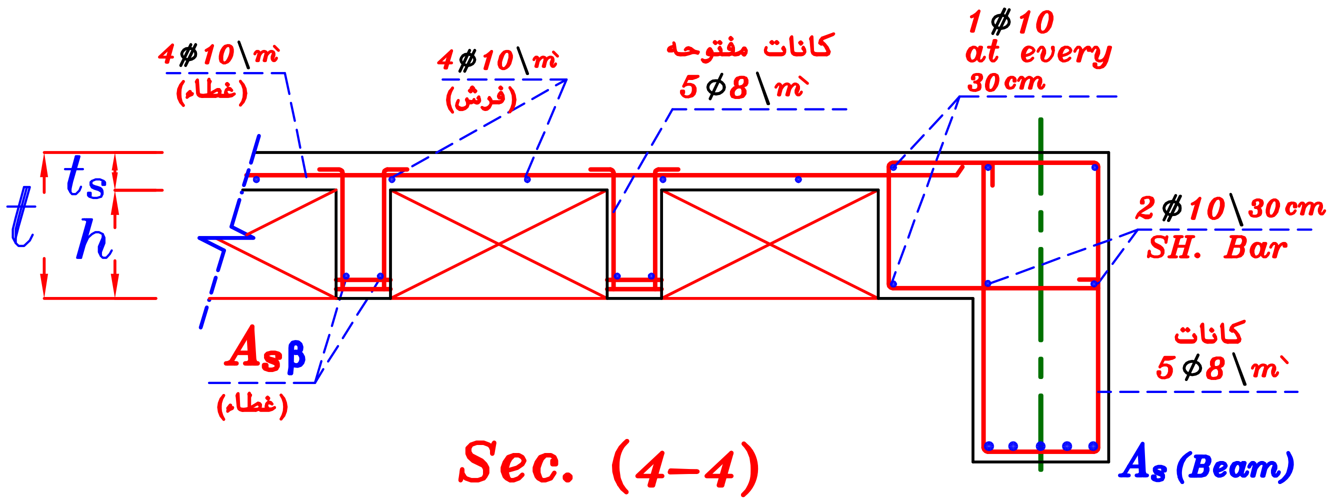


Sec. (2–2)


4 ϕ10 \ m`
(فرش)
4 ϕ10 \ m`
(غطاء)
كانات مفتوحه
5 ϕ8 \ m`
1 ϕ10
at every
30 cm
t
ts
h
2 ϕ10 \ 30 cm
SH. Bar
كانات
5 ϕ8 \ m`
Asα
(فرش)
As (Beam)

Sec. (3-3)


OR


4 ϕ10 \ m`
(غطاء)
4 ϕ10 \ m`
(فرش)
كانات مفتوحه
5 ϕ8 \ m`
1 ϕ10
at every
30 cm
t
ts
h
2 ϕ10 \ 30 cm
SH. Bar
كانات
5 ϕ8 \ m`
Asβ
(غطاء)
As (Beam)

Sec. (4-4)

Example.

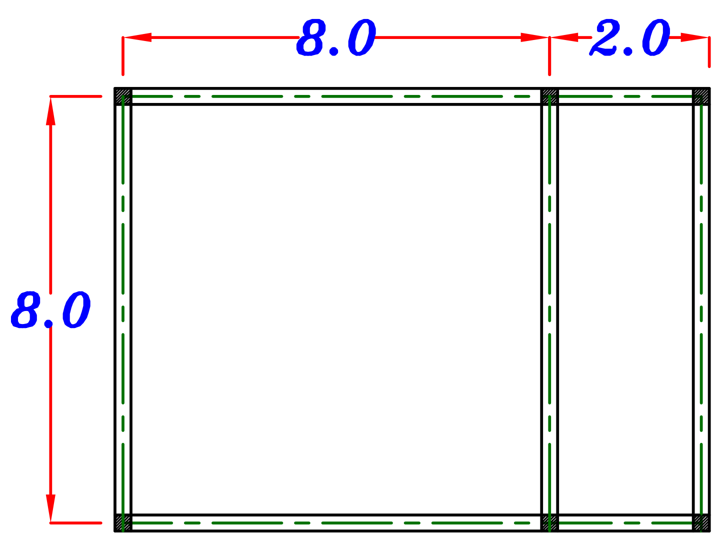
Data.

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

$F_y = 360 \ N\backslash mm^2$

$F.C. = 1.50 \ kN\backslash m^2$

$L.L. = 2.0 \ kN\backslash m^2$



Req.

Design the Slab & Draw Details of RFT.

Solution.

The Slab is (8.0 m. * 8.0 m.) $L_s = 8.0$ m
$\because L_s > 5.0$ m $\longrightarrow$ Use H.B. Slab
$\because L_s > 7.0$ m $\longrightarrow$ Use Two way H.B. Slab

① For H.B. Slab.

Take: $t = 250$ mm $t_s = 50$ mm $h = 200$ mm

$S = e + b = 0.4 + 0.1 = 0.5 \ m$

$(w_{rib})_{U.L.} = [1.4 \, (t_s \, \gamma_c + F.C.) + 1.6 \, (L.L.)] \, S$
$+ 1.4 \, (b \, h * 1.8 * \gamma_c) + 1.4 \, [4 \, (\text{Weight of One Block})]$

$\therefore (w_{rib})_{U.L.} = [1.4 \, (0.05 * 25 + 1.50) + 1.6 \, (2.0)] \, (0.50)$
$+ 1.4 \, (0.1 * 0.20 * 1.8 * 25) + 1.4 \, [4 \, (\frac{160}{1000})] = 5.68$
$(kN \backslash (1.0 * 0.5 m^2))$

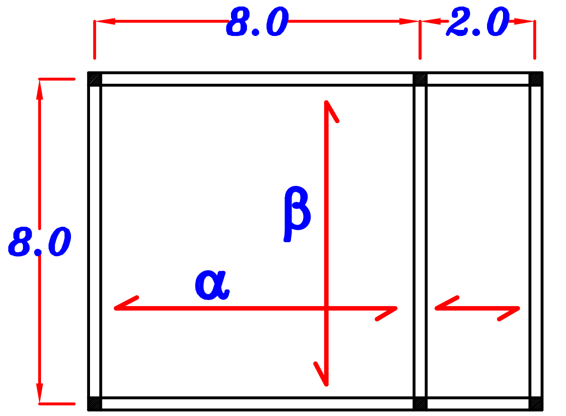
② For Solid Slab.

$t_s = \frac{L_s}{30} = \frac{2000}{30} = 66.6 \ mm$ $t_s = 100$ mm

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

$(w_s)_{S.S.} = 1.4 \, (0.10 * 25 + 1.50) + 1.6 \, (2.0) = 8.80 \ kN\backslash m^2$

Calculate the Load Factors. α , β For the H.B. Slab.



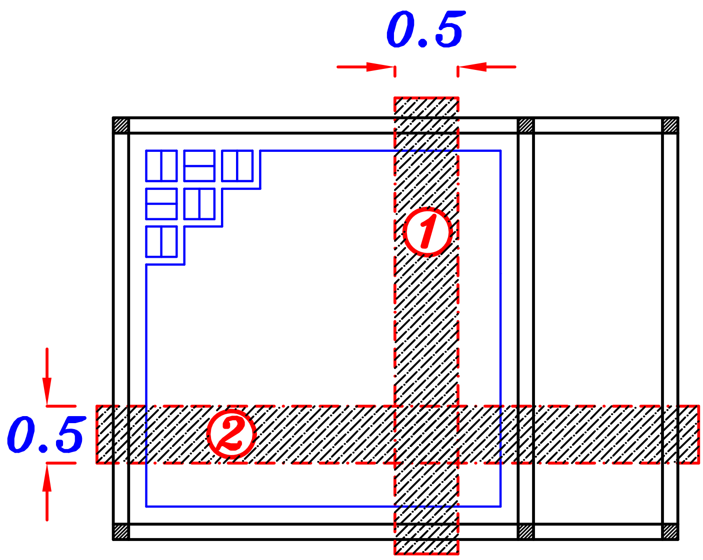
$$r = \frac{m\,L}{m'\,L_s} = \frac{1.0\,(8)}{0.87\,(8)} = 1.15$$

$\because$ L.L. < 5.0 kN\m^2

Use Marcus

$$\alpha = 0.52$$

$$\beta = 0.28$$



Strip ① β Direction.

$M = 12.7$ kN.m\rib

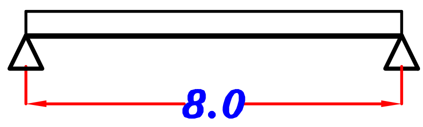
$d = t - 40\ mm = 250 - 40 = 210\ mm$

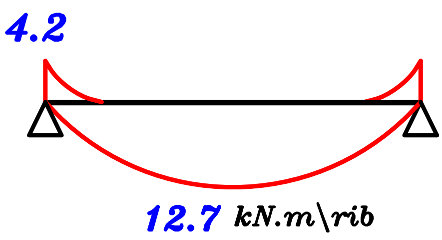
$$\because\ d = C_1 \sqrt{\frac{M\ (mt\backslash rib)}{F_{cu}\ B}}$$

$$\therefore\ 210 = C_1 \sqrt{\frac{12.7 * 10^6}{25 * 500}}$$

$\rightarrow C_1 = 6.588 \quad \rightarrow J = 0.826$

β $w_s = 0.28\,(5.68) = 1.59$ kN\m'





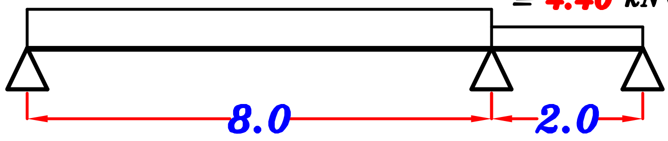
$$A_s = \frac{M}{J\,F_y\,d} = \frac{12.7 * 10^6}{0.826 * 360 * 210} = 203.3\ mm^2\backslash rib$$

2 ϕ12\rib

Strip ② α Direction.

α $w_{rib} = 0.52\,(5.68) = 2.95$ kN\m`

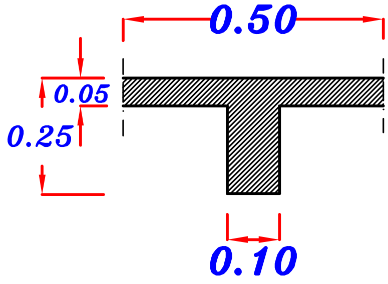
$8.80 * 0.5 = 4.40$ kN\m`



$I_1 = 2.453 * 10^{-4}\ m^4$

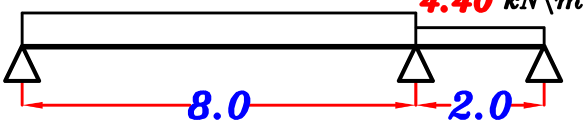
$$I_2 = \frac{0.5\,(t_s)^3}{12} = \frac{0.5\,(0.10)^3}{12}$$

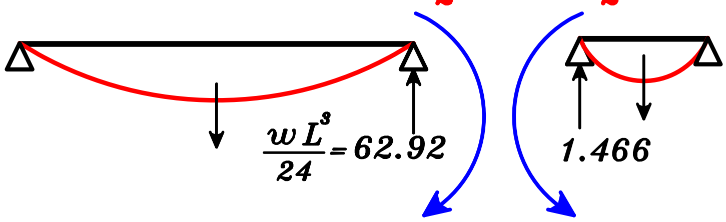
$$= 4.16 * 10^{-5}\ m^4$$



$$\therefore\ \frac{I_1}{I_2} = \frac{2.453 * 10^{-4}}{4.16 * 10^{-5}} = 5.89$$

$$\therefore\ \boxed{I_1 = 5.89\ I_2}$$



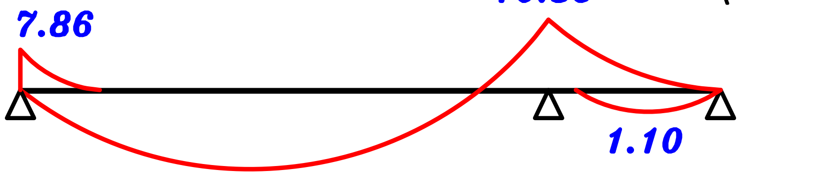


Use 3 Moment Equation.

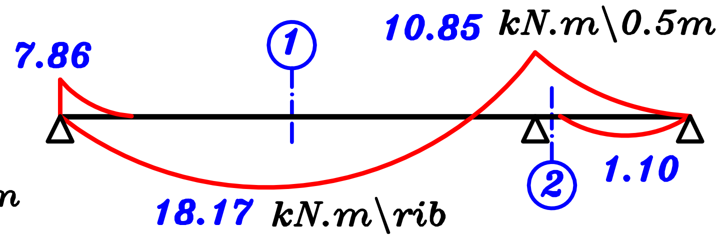
$$M_1\left(\frac{L_1}{I_1}\right) + 2\,M_2\left(\frac{L_1}{I_1} + \frac{L_2}{I_2}\right) + M_3\left(\frac{L_2}{I_2}\right) = -6\left(\frac{r_1}{I_1} + \frac{r_2}{I_2}\right)$$

$$0.0 + 2\,M_2\left(\frac{8.0}{5.89} + \frac{2.0}{1.0}\right) + 0.0 = -6\left(\frac{62.92}{5.89} + \frac{1.466}{1.0}\right)$$

$$\boxed{M_2 = -\,10.85\ kN.m\backslash 0.5m}$$



Sec. ①



$M = 18.17 \quad kN.m\backslash rib$

$d = t - 30\ mm = 250 - 30 = 220\ mm$

$$220 = C_1 \sqrt{\frac{18.17 * 10^6}{25 * 500}} \rightarrow C_1 = 5.77 \rightarrow J = 0.826$$

$$A_s = \frac{M}{J\, F_y\, d} = \frac{18.17 * 10^6}{0.826 * 360 * 220} = 277.7\ mm^2\backslash rib$$

$1\phi12 + 1\phi16 \backslash rib$

Sec. ②

$M_{U.L.} = 10.85 \quad kN.m\backslash 0.5m$

$, t_s = 100\ mm \ , \ d = 100 - 20 = 80\ mm$

$$80 = C_1 \sqrt{\frac{10.85 * 10^6}{25 * 500}} \longrightarrow C_1 = 2.715 < 2.78 \longrightarrow \therefore \text{Unsafe}$$

$\therefore$ we have to increase dimensions

$\therefore$ Take **$t_s = 120\ mm$**

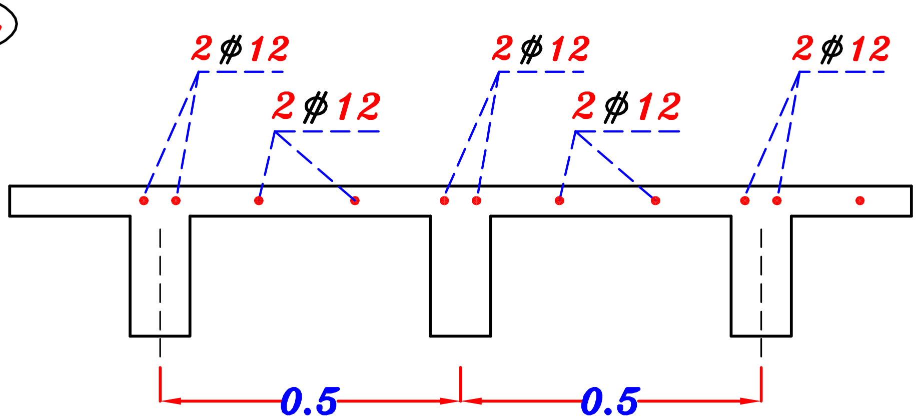
$t_s = 120\ mm \ , \ d = 120 - 20 = 100\ mm$

$$100 = C_1 \sqrt{\frac{10.85 * 10^6}{25 * 500}} \longrightarrow C_1 = 3.39 \longrightarrow J = 0.773$$

$$As = \frac{10.85 * 10^6}{0.773 * 360 * 100} = 390\ mm^2/0.5m$$

$4\phi12\backslash 0.5m$

$As =$ **$8\phi12\backslash m$**



Check The Solid Part.

$$M_R = \left[R_{max} \frac{F_{cu}}{\delta_c} b\, d^2\right] = \left[0.194 \left(\frac{25}{1.5}\right)(100)(220)^2\right] = 15649300 \text{ N.mm}$$

$\because M_R = 15.64$ kN.m $> M = 10.85$ kN.m

$\therefore$ Use min. Solid Part $X_{min.} = 0.25$ m.

Arrangement of Blocks.

Short direction = Long Direction. = 8.0 m.

$L = 2(X) + (n)(0.4) + (n-1)(0.1)$

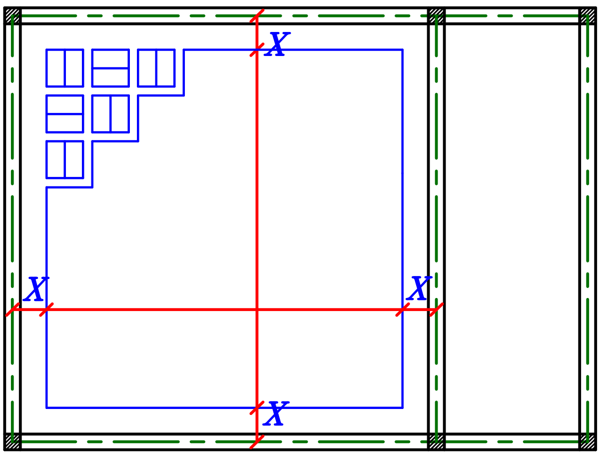
Take $X = 0.25$ m.

$8.0 = 2(0.25) + (n)(0.4) + (n-1)(0.1)$

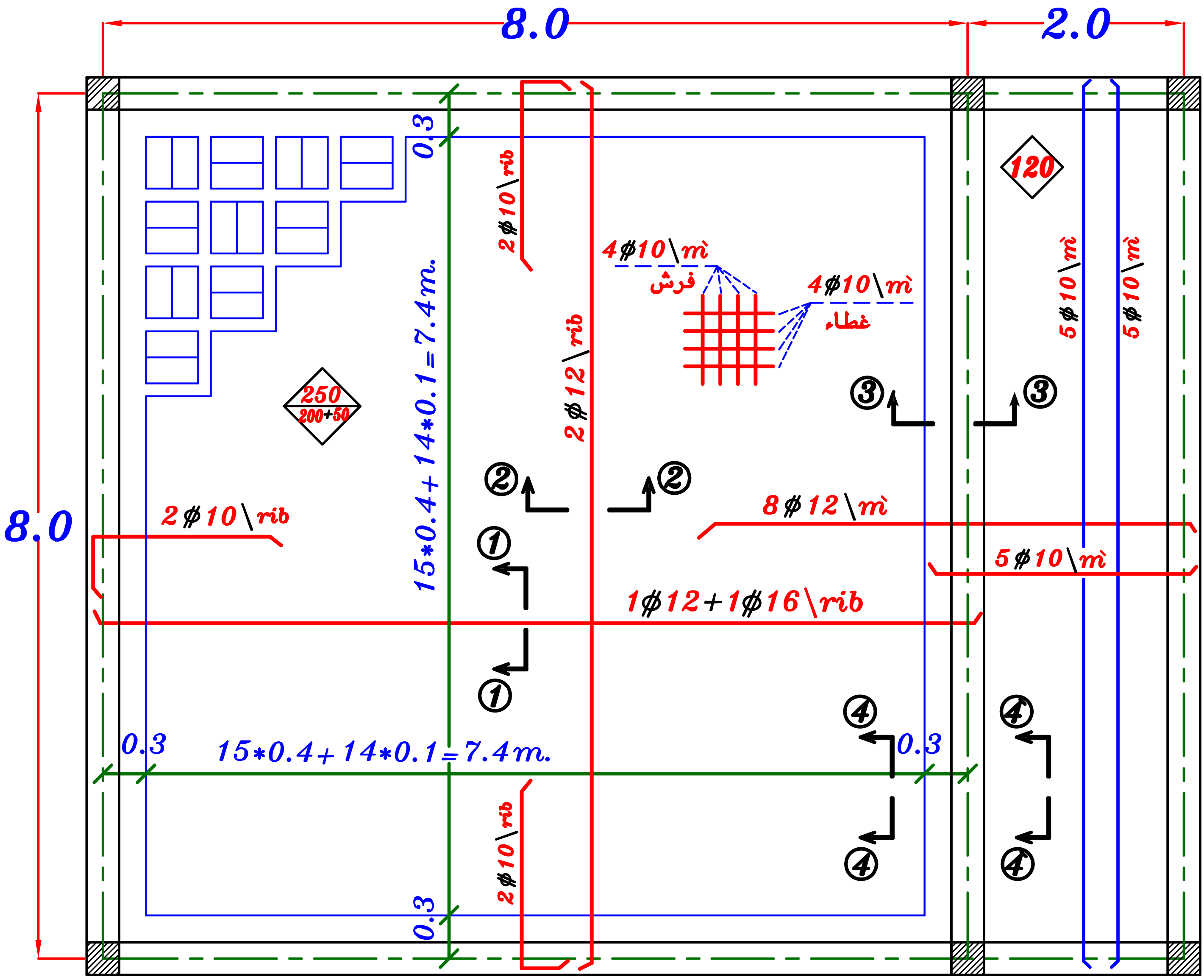
$\xrightarrow{Get} n = 15.2$ $n = 15$ Block

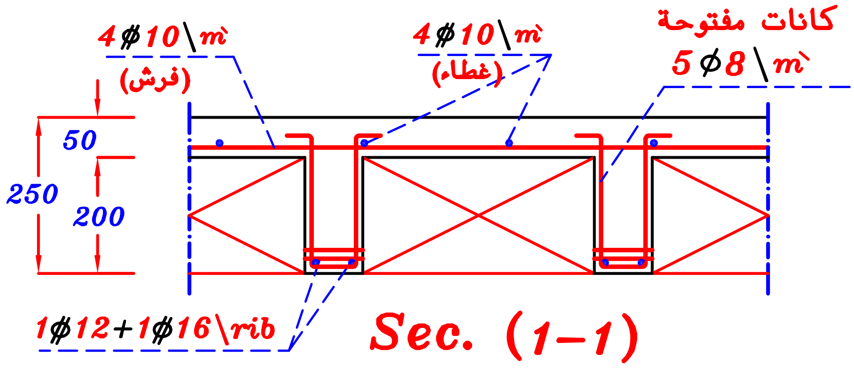
$6.0 = 2(X) + (15)(0.4) + (15-1)(0.1)$

$\xrightarrow{Get} X = 0.30$ $X = 0.30$ m.

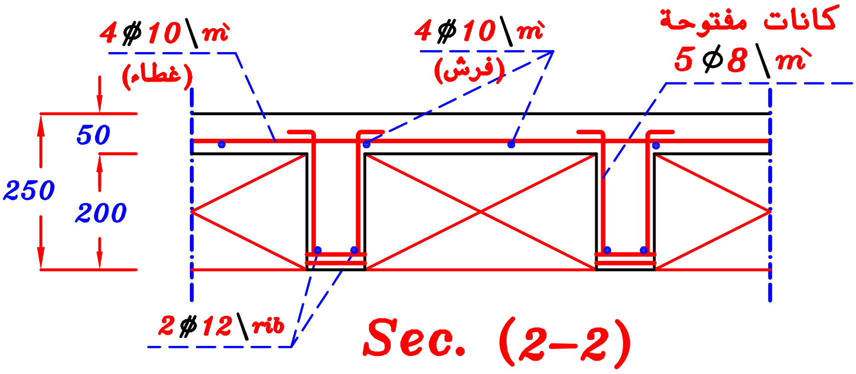


RFT. of the slab in plan.

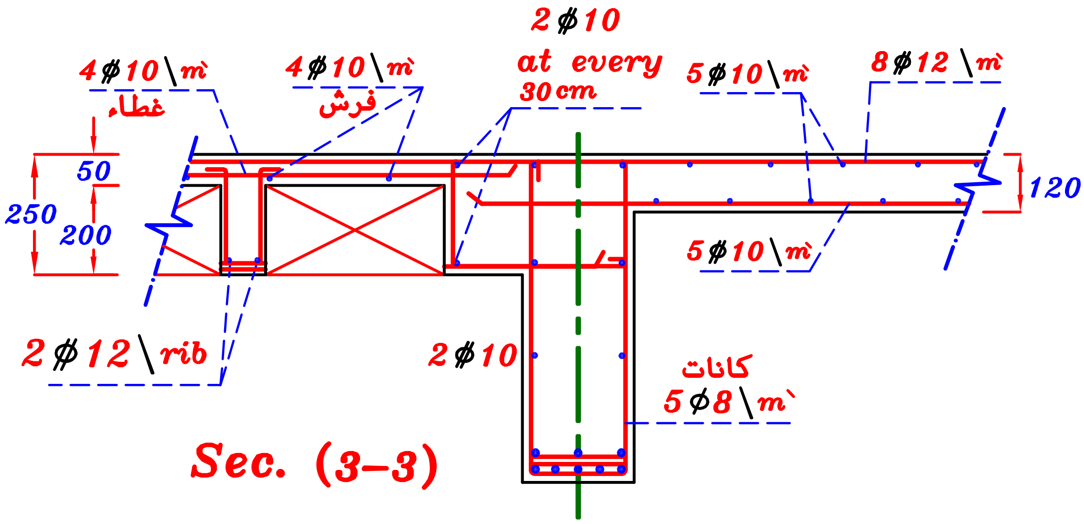




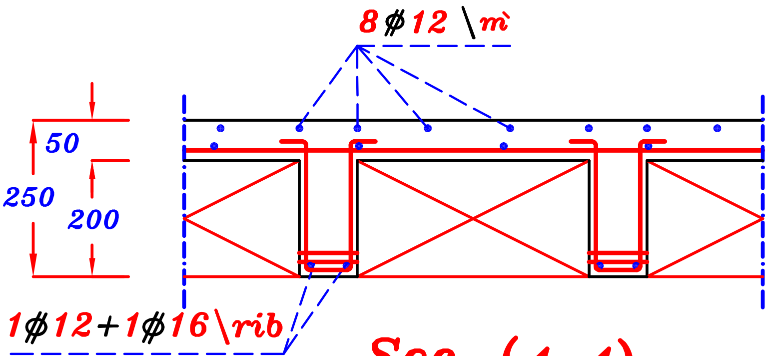
Sec. (1–1)



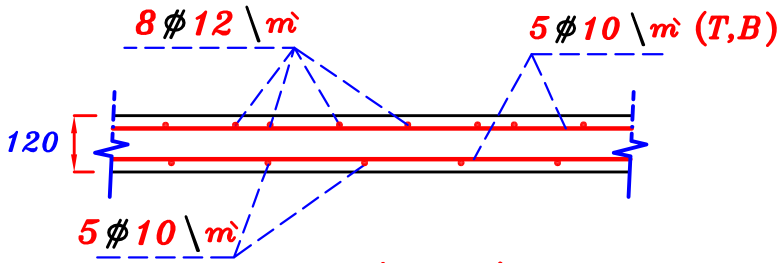
Sec. (2–2)



Sec. (3–3)



Sec. (4–4)



Sec. (4`–4`)

Load Distribution on Beams.

لا ن قيمه (w_{rib}) هو وزن مساحه من البلاطه تساوى ($1.0 * S\ m^2$)

و لاننا نحتاج فى الـ Load Distribution الى حساب وزن ($1.0\ m^2$) من البلاطه .

لذا نقسم قيمه (w_{rib}) على العرض (S)ليكون وزن ($1.0\ m^2$) .

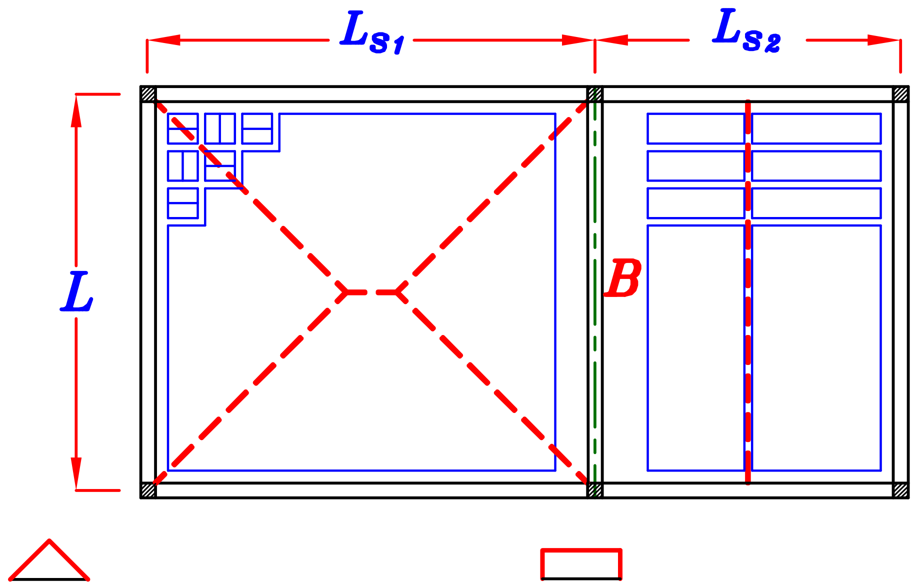
Example.

For Two way H.B.

, Calculate $w_{rib\,1}$

For One way H.B.

, Calculate $w_{rib\,2}$



$$w_b = o.w. + C_a \left(\frac{w_{rib\,1}}{S}\right) * \frac{L_{S1}}{2} + \left(\frac{w_{rib\,2}}{S}\right) * \frac{L_{S2}}{2}$$

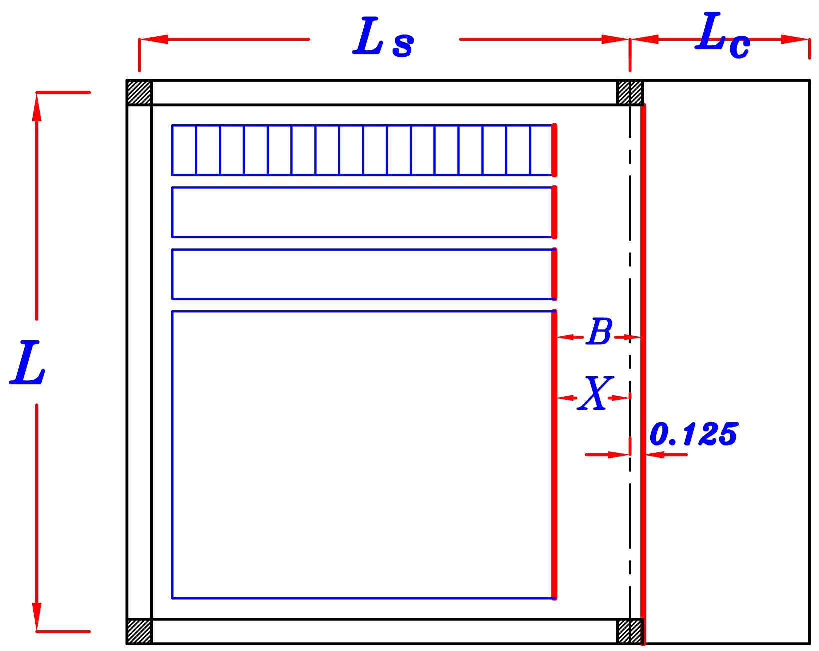
Example.

For One way H.B.

, Calculate w_{rib}

For Cantilever Slab.

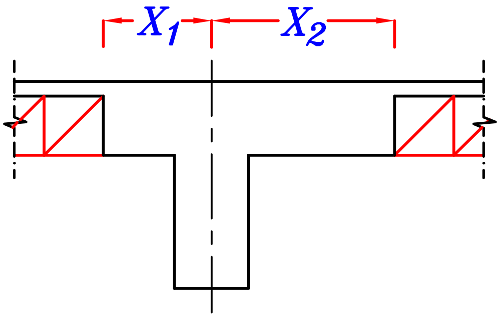
, Calculate w_s

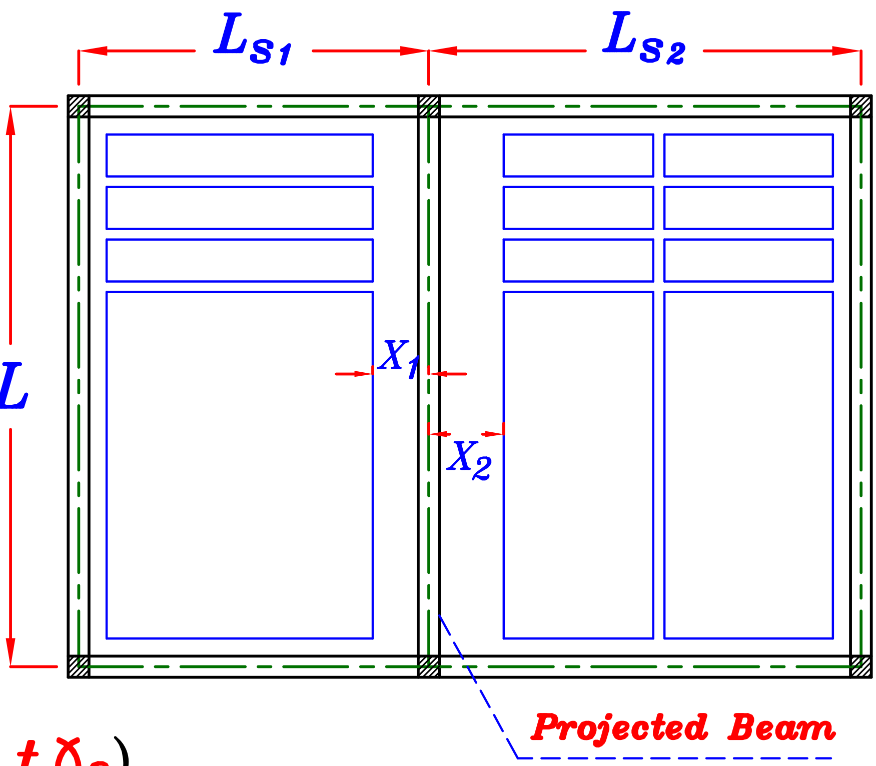


$$w_b = o.w. + \left(\frac{w_{rib}}{S}\right) * \frac{L_s}{2} + w_s * L_c$$

Design of the Beams.

1- Projected Beam. كـمره سـاقطه



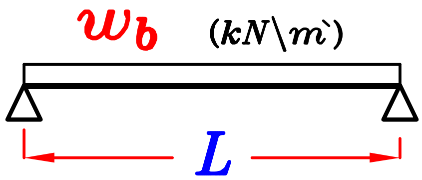


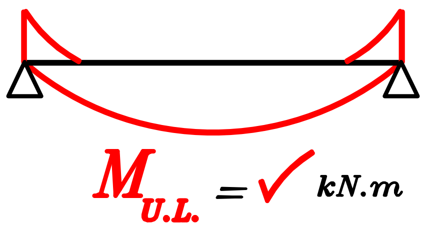
Take $t \simeq \frac{L}{10}$

$O.W.(Beam) = 1.4\,(b\,t\,\gamma_c)$

Loads on the Beam.

$$w_b = O.W.(Beam) + Walls + \left(\frac{w_{rib}}{S}\right)\left(\frac{L_{s1}}{2} + \frac{L_{s2}}{2}\right)$$

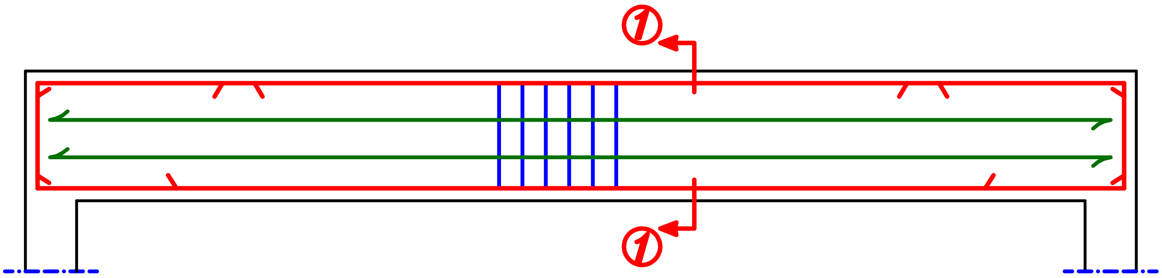


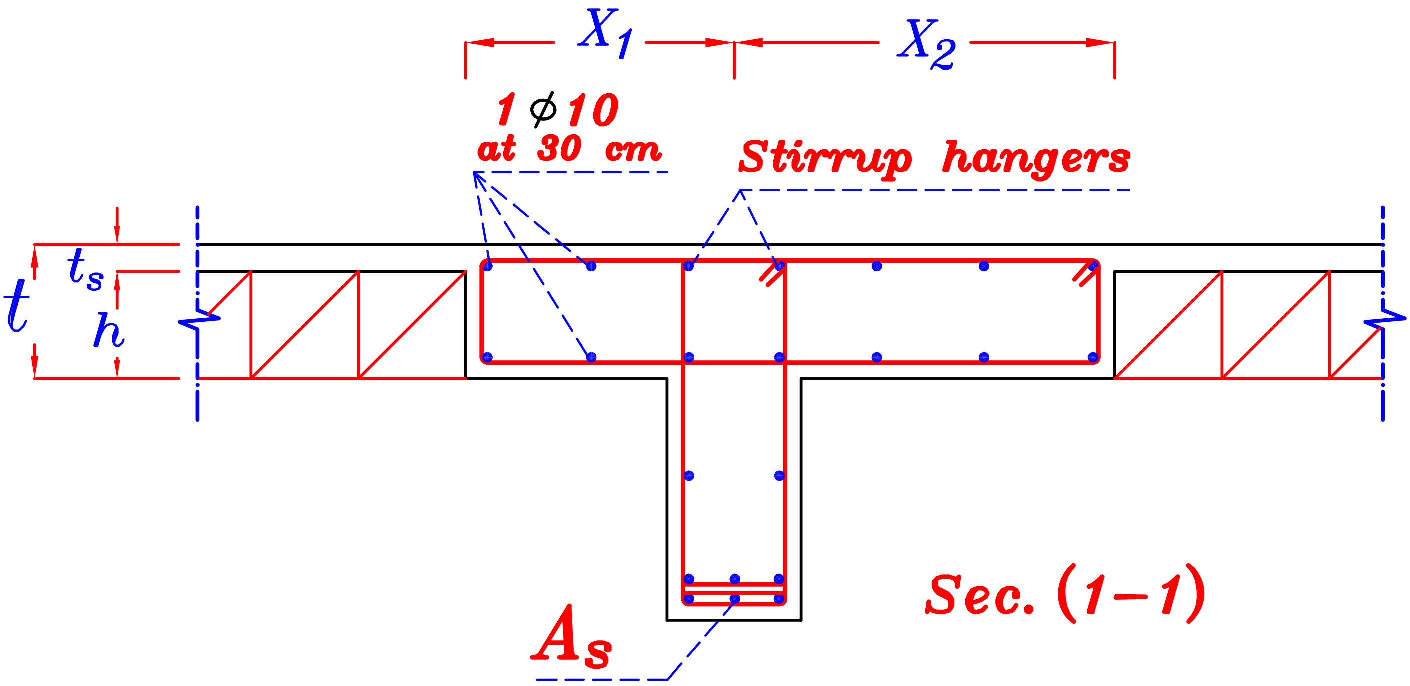


$\because \; d = t - 50\ mm$

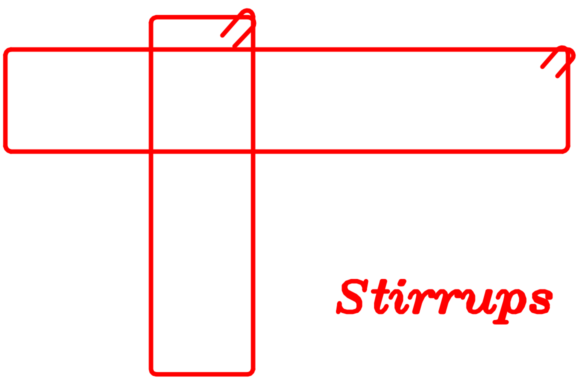
$$d = C_1 \sqrt{\frac{M_{U.L.}}{F_{cu}\ B}} \quad , \quad B = (X_1 + X_2)$$

$$\text{Get} \quad C_1 = \checkmark \longrightarrow J = \checkmark \longrightarrow A_s = \frac{M_{U.L.}}{J\,F_y\,d} = \checkmark\ mm^2$$





Sec. (1-1)



Stirrups

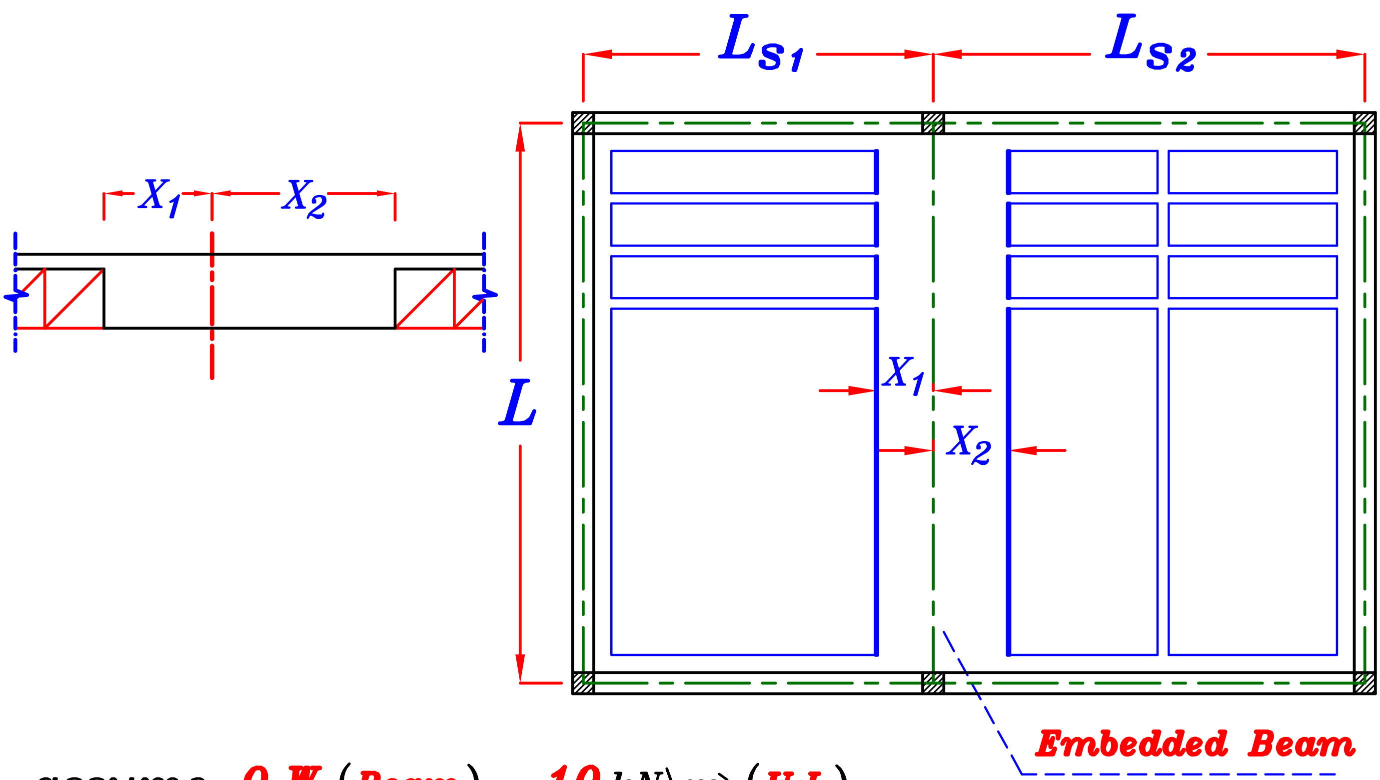
2- Embedded Beam. كمره مدفونه

لتصميم الكمرات المدفونه توجد حالتان :

١- عندما تكون الكمره بين بلاطتين $H.B.$

٢- عندما تكون الكمره بين بلاطه $S.S.$ و بلاطه $H.B.$

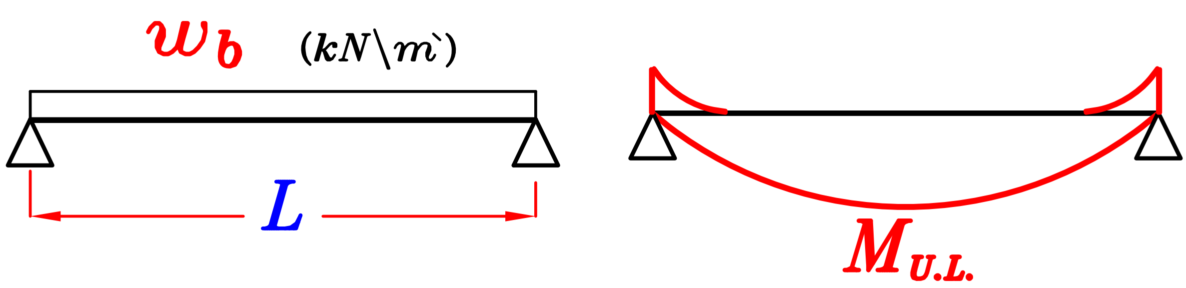
١- الكمره الـ Embedded بين بلاطتين H.B.



assume $O.W.(Beam) = 10\ kN\backslash m'\ (U.L.)$

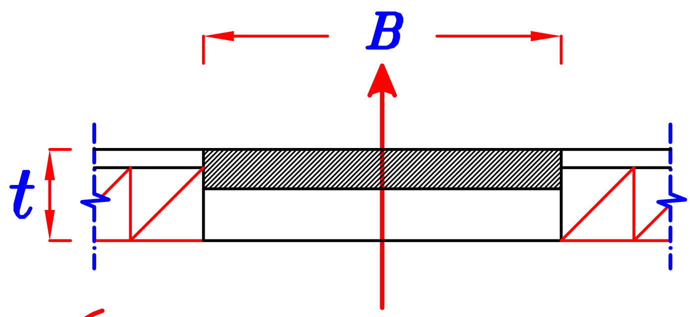
Loads on the Beam.

$$w_b = O.W.(Beam) + Walls + \left(\frac{w_{rib}}{S}\right)\left(\frac{L_{S1}}{2} + \frac{L_{S2}}{2}\right)$$



١- نحسب M_R ثم نحسب أقل $X_1 \& X_2$ بدون رص البلوكات (أى قبل التقريب)

٢- نحسب قيمه B بعد أخذ قيمه $C_1 = 3.0$



$$d = t - 30mm$$

$$= C_1 \sqrt{\frac{M_{U.L.}}{F_{cu} * B}} \longrightarrow B = \checkmark$$

($C_1 = 3.0$)

٣- نقارن بين B و مجموع $X_1 + X_2$ فتكون احدى الحالتين

٣-أ- $IF \; B < X_1 + X_2$

نبدأ فى رص البلوكات و تحديد القيمه الجديده ل X_2 و X_1 (أى بعد التقريب)

ثم نعيد تصميم الكمره مره أخرى مع أخذ قيمه $B = X_1 + X_2$ (بعد التقريب)

و تحديد قيمه C_1 , J و التسليح

$$d = t - 30mm = C_1 \sqrt{\frac{M_{U.L.}}{F_{cu} * B}} \longrightarrow C_1 \longrightarrow J \longrightarrow A_s$$

($B = X_1 + X_2$)

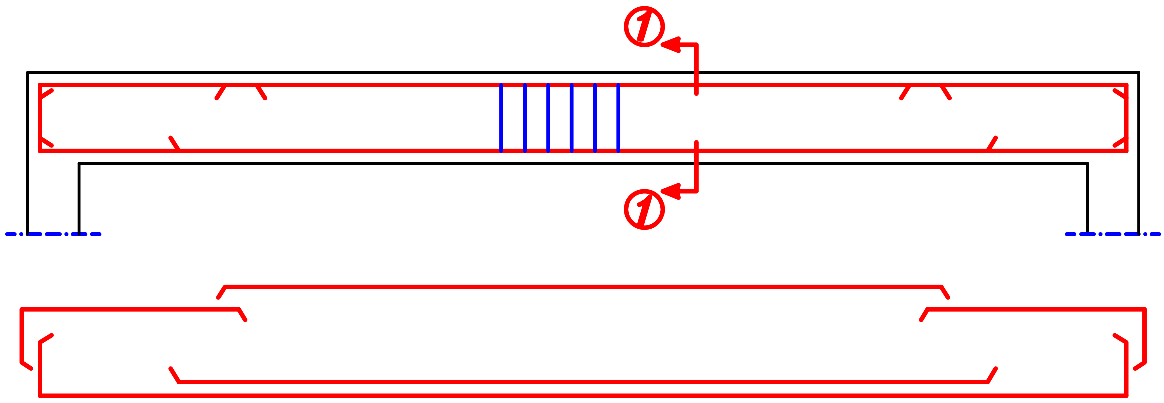
٣-ب - $IF \; B > X_1 + X_2$

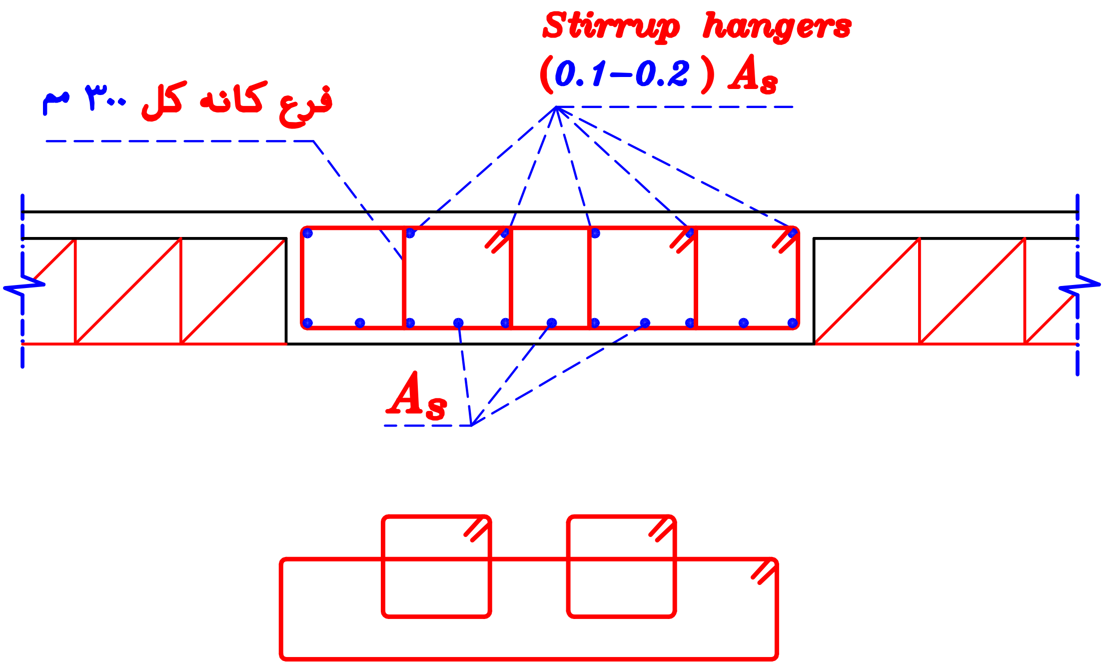
نزيد من قيمه كلا من $X_1 \& X_2$ بحيث $X_1 + X_2 = B$

نبدأ فى رص البلوكات و تحديد القيمه الجديده ل X_2 و X_1 (أى بعد التقريب)

ثم نعيد تصميم الكمره مره أخرى مع أخذ قيمه $B = X_1 + X_2$ (بعد التقريب)

و تحديد قيمه C_1 , J و التسليح

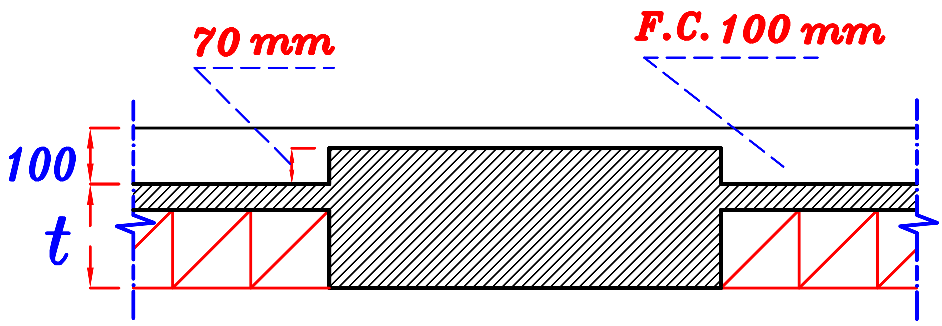




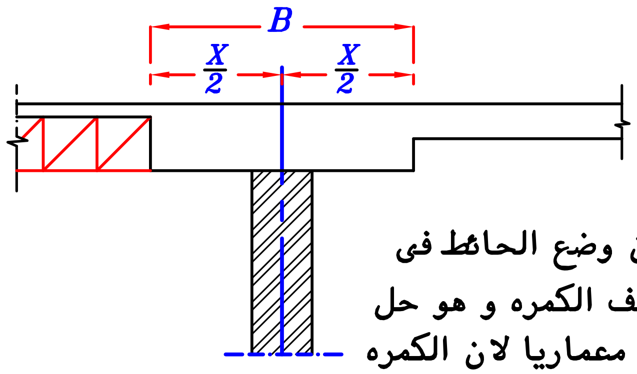
Sec. (1−1)

عاده فى التنفيذ نزيد من تخانه الكمره المدفونه

قيمة –٧٠ مم من أعلى و تكون تحت الـ F.C.

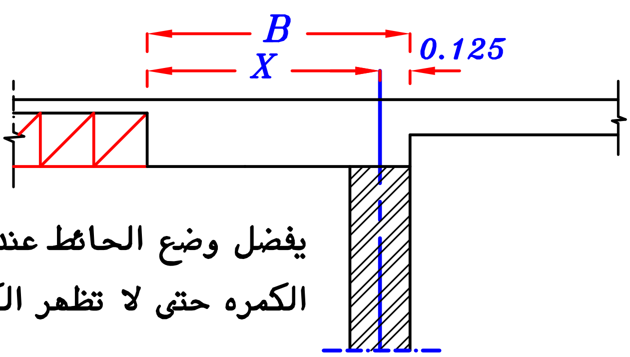


٢- الكمره ال Embedded بين بلاطه .S.S و بلاطه .H.B.



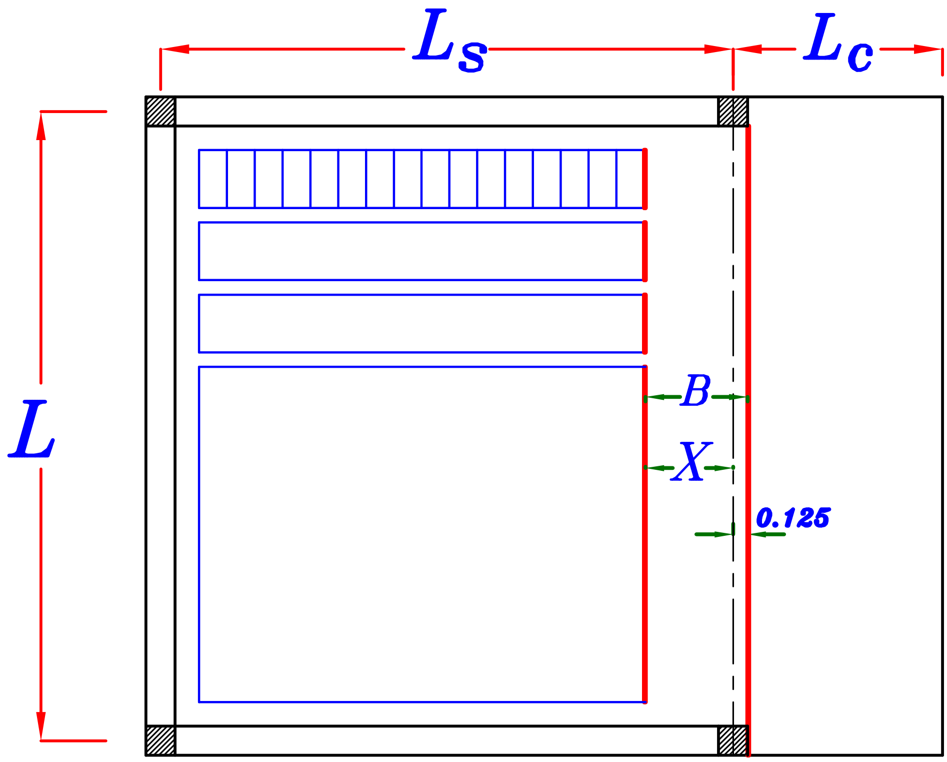
ممكن وضع الحائط فى
منتصف الكمره و هو حل
سيئ معماريا لان الكمره
سوف تظهر من جهه ال .S.S

$$B = X$$

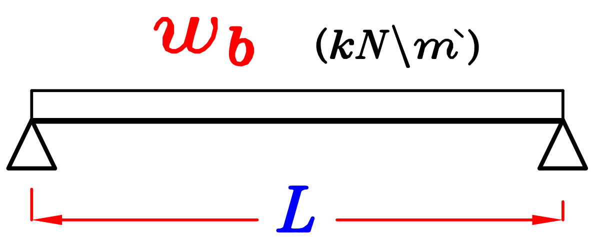


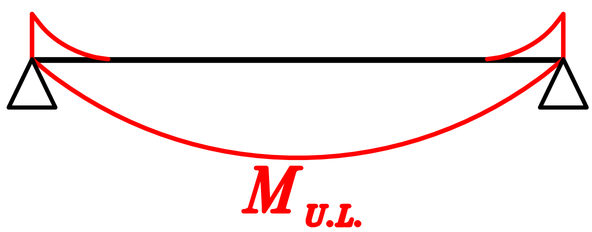
يفضل وضع الحائط عند طرف
الكمره حتى لا تظهر الكمره

$$B = X + 0.125$$



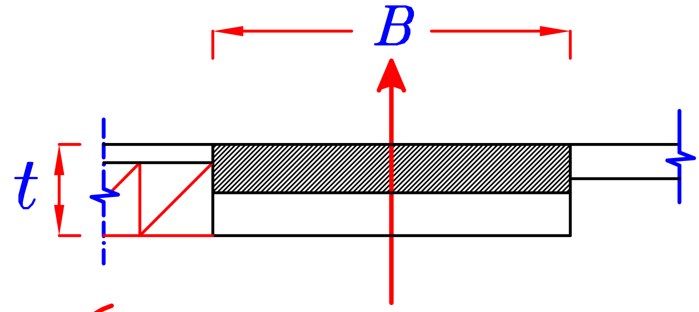
$$w_b = o.w. + \left(\frac{w_{rib}}{S}\right) * \frac{L_s}{2} + w_s * L_c$$





١- نحسب M_R ثم نحسب أقل X بدون رص البلوكات (أى قبل التقريب)

٢- نحسب قيمه B بعد أخذ قيمه $C_1 = 3.0$



$$d = t - 30mm = \underset{3.0}{C_1} \sqrt{\frac{M_{U.L.}}{F_{cu} * B}} \longrightarrow B = \checkmark$$

٣- نقارن بين B و مجموع $X + 0.125$ فتكون احدى الحالتين

٣-أ- $IF \ B < X + 0.125$

نبدأ فى رص البلوكات و تحديد القيمه الجديده لـ X (أى بعد التقريب)

ثم نعيد تصميم الكمره مره أخرى مع أخذ قيمه $B = X + 0.125$ (بعد التقريب)

و تحديد قيمه C_1 , J و التسليح

$$d = t - 30mm = C_1 \sqrt{\frac{M_{U.L.}}{F_{cu} * \underset{X+0.125}{B}}} \longrightarrow C_1 \longrightarrow J \longrightarrow A_s$$

٣-ب- $IF \ B > X + 0.125$

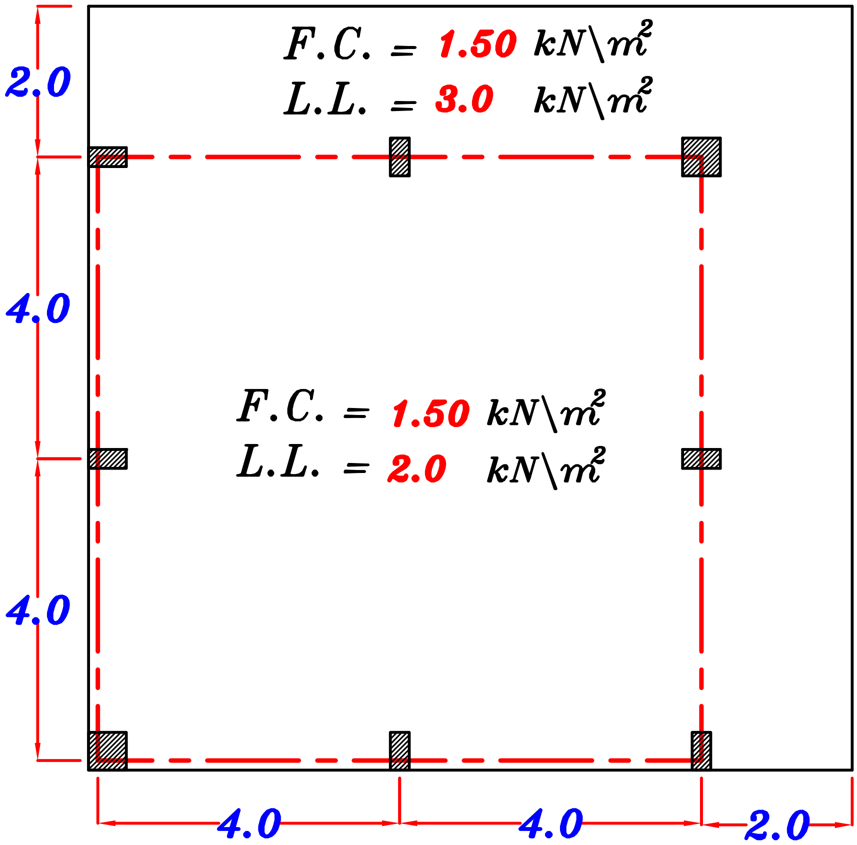
نزيد من قيمه X بحيث $X + 0.125 = B$

نبدأ فى رص البلوكات و تحديد القيمه الجديده لـ X (أى بعد التقريب)

ثم نعيد تصميم الكمره مره أخرى مع أخذ قيمه $B = X + 0.125$ (بعد التقريب)

و تحديد قيمه C_1 , J و التسليح

Example.

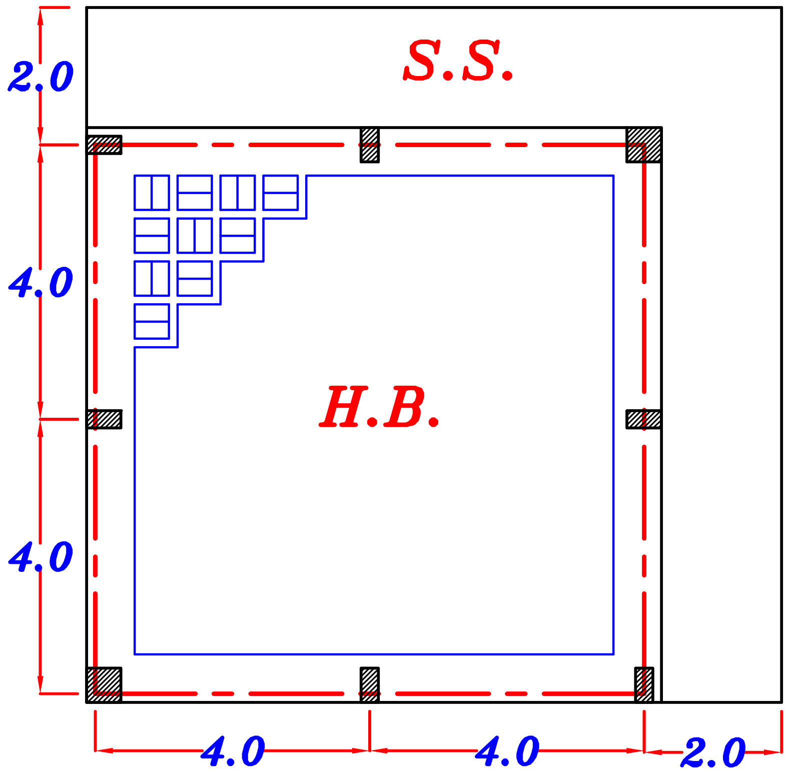


F_{cu} = 25 N\mm² F_y = 360 N\mm²

1- Design all slabs.

2- Design all Beams as embeded beams.

3- Draw details of RFT. in plan ,elevation and cross-sec.



① For H.B. Slab.

$$t = \frac{L_s}{35} = \frac{8000}{35} = 228.5\ mm$$

Take: $\boxed{t = 250\ mm}$, $\boxed{t_s = 50\ mm}$, $\boxed{h = 200\ mm}$

$$S = e + b = 0.4 + 0.1 = 0.5\ m$$

$$\therefore (w_{rib})_{U.L.} = \left[1.4\,(0.05 * 25 + 1.50) + 1.6\,(3.0)\right](0.50)$$

$$+ 1.4\,(0.1 * 0.20 * 1.8 * 25) + 1.4\left[4\left(\frac{160}{1000}\right)\right] = 6.48$$

$(kN \backslash (1.0 * 0.5\,m^2))$

② For Solid Slab.

$$t_s = \frac{L_c}{10} = \frac{2000}{10} = 200\ mm \quad \text{Take} \quad \boxed{t_s = 160\ mm}$$

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

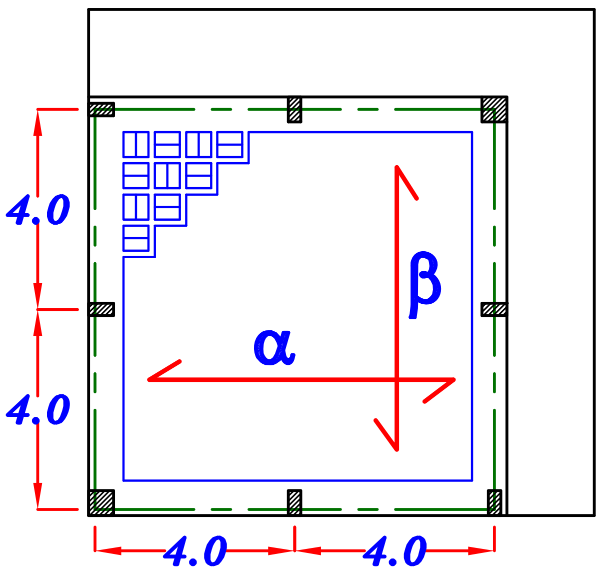
$$(w_s)_{S.S.} = 1.4\,(0.16 * 25 + 1.50) + 1.6\,(2.0) = 10.9\ kN \backslash m^2$$

Calculate the Load Factors. α , β For the H.B. Slab.

$$r = \frac{m\ L}{m'\ L_s} = \frac{0.87\,(8)}{0.87\,(8)} = 1.0$$

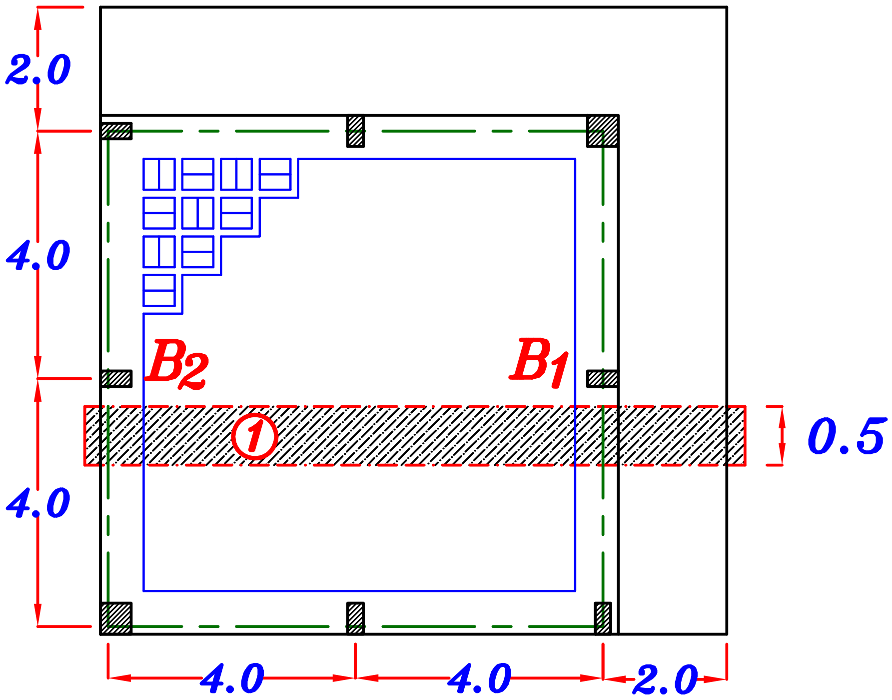
$$\because \quad L.L. < 5.0\ kN \backslash m^2$$

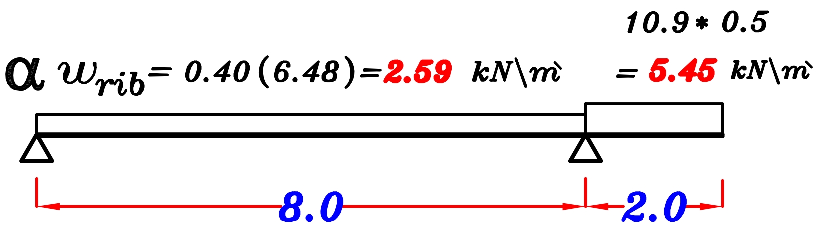
Use Marcus

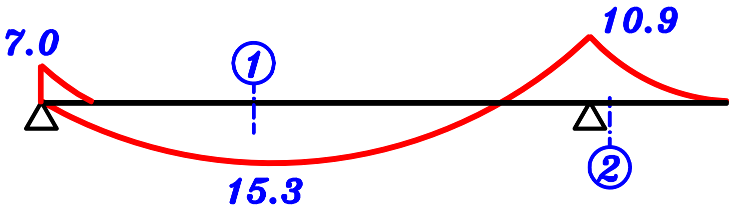


$$\alpha = 0.40$$

$$\beta = 0.40$$







Sec. ①

$M = 15.3$ kN.m\rib

$d = 250 - 30 = 220$ mm

$$220 = C_1 \sqrt{\frac{15.3 * 10^6}{25 * 500}} \rightarrow C_1 = 6.35 \rightarrow J = 0.826$$

$$A_s = \frac{M}{J F_y d} = \frac{15.3 * 10^6}{0.826 * 360 * 220} = 233 \ mm^2 \backslash rib$$

2 ϕ 12 \ rib

Sec. ②

$M_{U.L.} = 10.9$ kN.m\0.5m

, $t_s = 160$ mm , $d = 160 - 20 = 140$ mm

$$140 = C_1 \sqrt{\frac{10.9 * 10^6}{25 * 500}} \rightarrow C_1 = 4.74 \rightarrow J = 0.823$$

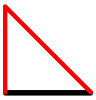
$$A_s = \frac{10.9 * 10^6}{0.823 * 360 * 140} = 262 \ mm^2/0.5m$$

4 ϕ 10 \ 0.5m

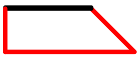
8 ϕ 10 \ m

Design of Beams. B_1 & B_2

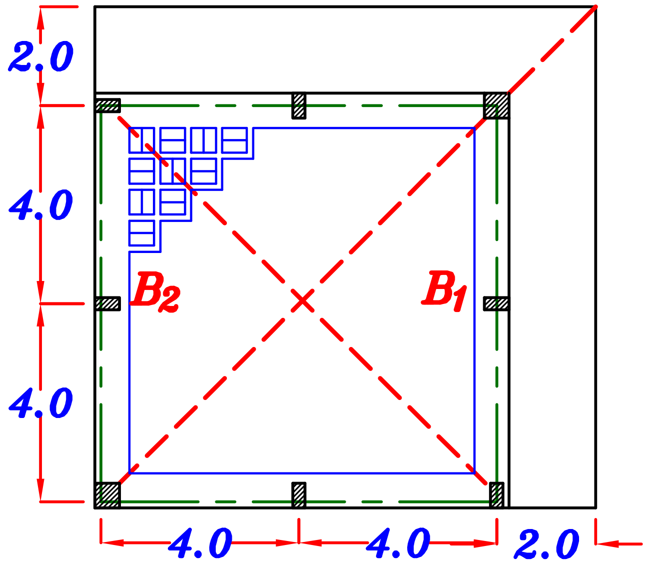
B_1



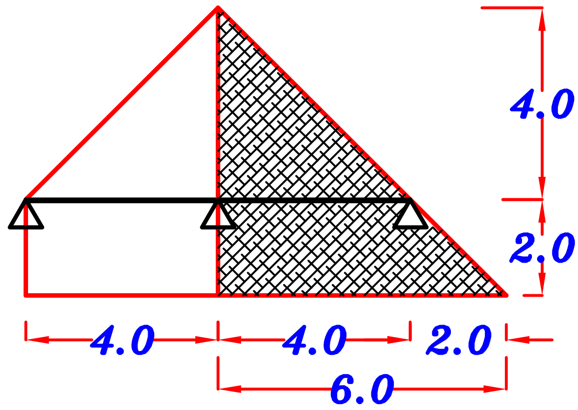
$$\frac{\sum area}{span} = \frac{\left(\frac{1}{2}(4)(4)\right)}{4} = 2.0$$

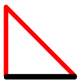


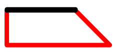
$$\frac{\sum area}{span} = \frac{\left(\frac{(4+6)}{2} * 2\right)}{4} = 2.50$$



للتسهيل سنفترض أن الحمل متساوى على الباكيتين .

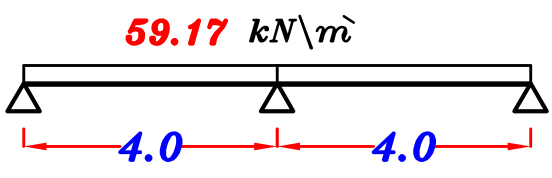


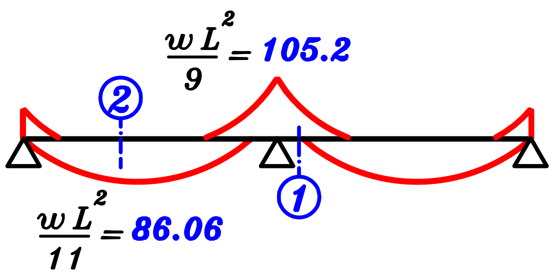




$$w_a = w_e = o.w. + \frac{\sum area}{span} * (2\, w_{rib}) + \frac{\sum area}{span} * (w_s)$$

$$= 6.0 + 2.0(2 * 6.48) + 2.50(10.9) = 59.17 \ kN\backslash m'$$





Sec. ①

$M = 105.2\ kN.m\ ,\ t = 250\ mm\ ,\ d = 250 - 30 = 220\ mm$

Take $C_1 = 3.0 \longrightarrow J = 0.743$

$$220 = 3.0\sqrt{\frac{105.2 * 10^6}{25 * B}} \longrightarrow B = 782.5\ mm$$

$$A_s = \frac{M}{J\ F_y\ d} = \frac{105.2 * 10^6}{0.743 * 360 * 220} = 1787.7\ mm^2$$

9 ϕ16

Sec. ②

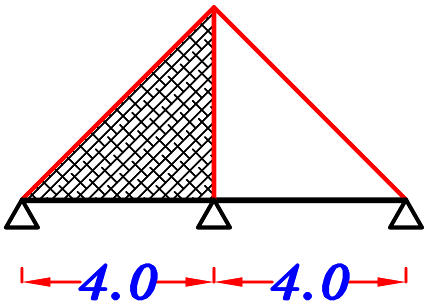
$M = 86.06\ kN.m\ ,\ d = 220\ mm\ ,\ B = 782\ mm$

$$220 = C_1\sqrt{\frac{86.06 * 10^6}{25 * 782}} \longrightarrow C_1 = 3.31 \longrightarrow J = 0.769$$

$$A_s = \frac{M}{J\ F_y\ d} = \frac{86.06 * 10^6}{0.769 * 360 * 220} = 1413\ mm^2$$

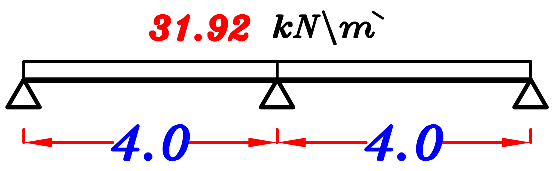
7 ϕ16

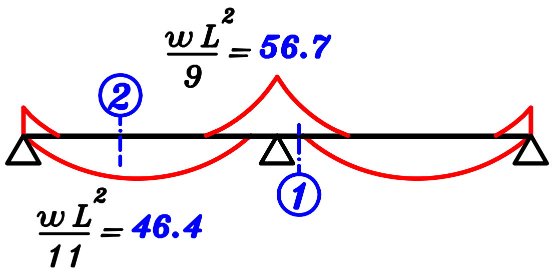
B2



$$w_a = w_e = o.w. + \frac{\sum area}{span} * (2\ w_{rib})$$

$$= 6.0 + 2.0(2 * 6.48) = 31.92\ kN\backslash m`$$





Sec. ①

$M = 56.7\ kN.m\ ,\ t = 250\ mm\ ,\ d = 250 - 30 = 220\ mm$

Take $C_1 = 3.0 \longrightarrow J = 0.743$

$$220 = 3.0 \sqrt{\frac{56.7 * 10^6}{25 * B}} \longrightarrow B = 421\ mm$$

$$A_s = \frac{M}{J\,F_y\,d} = \frac{56.7 * 10^6}{0.743 * 360 * 220} = 963\ mm^2$$

5 ϕ 16

Sec. ②

$M = 46.4\ kN.m\ ,\ d = 220\ mm\ ,\ B = 421\ mm$

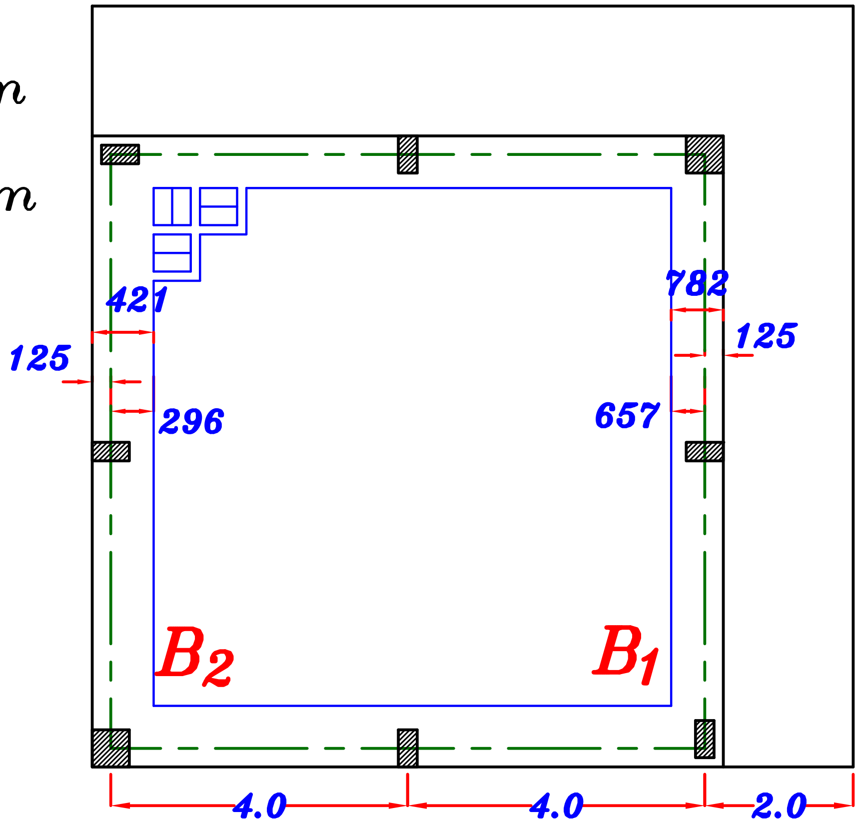
$$220 = C_1 \sqrt{\frac{46.4 * 10^6}{25 * 421}} \longrightarrow C_1 = 3.31 \longrightarrow J = 0.769$$

$$A_s = \frac{M}{J\,F_y\,d} = \frac{46.4 * 10^6}{0.769 * 360 * 220} = 761\ mm^2$$

4 ϕ 16

$X_1 = 657\ mm$

$X_2 = 296\ mm$

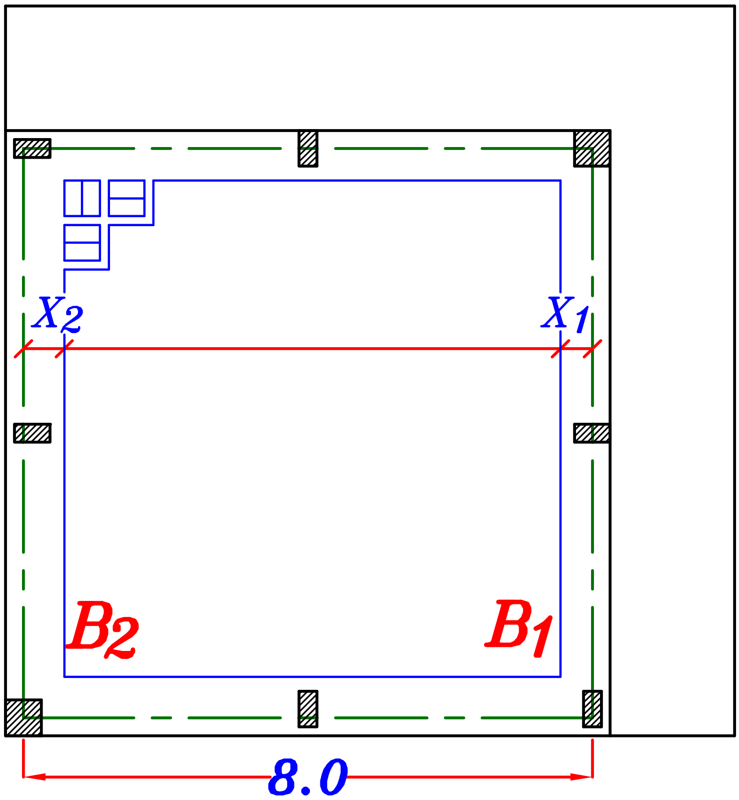


Check The Solid Part.

$$M_R = \left[R_{max} \frac{F_{cu}}{\gamma_c} b\, d^2\right] = \left[0.194 \left(\frac{25}{1.5}\right)(100)(220)^2\right] = 15649333 \text{ N.mm}$$

$\because M_R = 15.64$ kN.m $>$ $M = 10.9$ kN.m

$\therefore$ **Use min. Solid Part** $\boxed{X_{min} = 0.25 \text{ m.}}$



Arrangement of Blocks.

Short direction = Long Direction. = 8.0 m.

$$L = X_1 + X_2 + (n)(0.4) + (n - 1)(0.1)$$

Take $X_1 = 0.657$ m. , $X_2 = 0.296$ m.

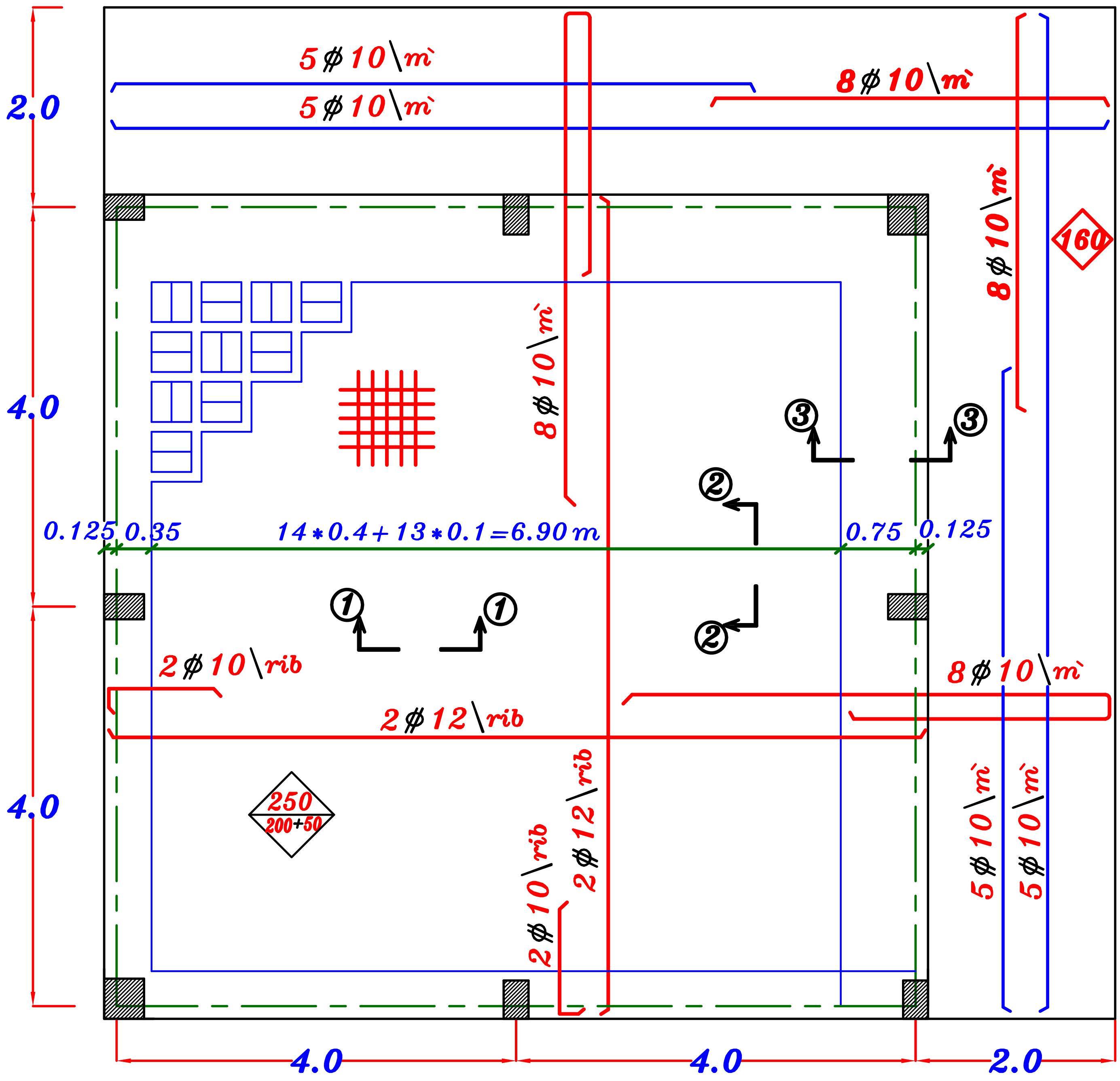
$$8.0 = 0.657 + 0.296 + (n)(0.4) + (n - 1)(0.1)$$

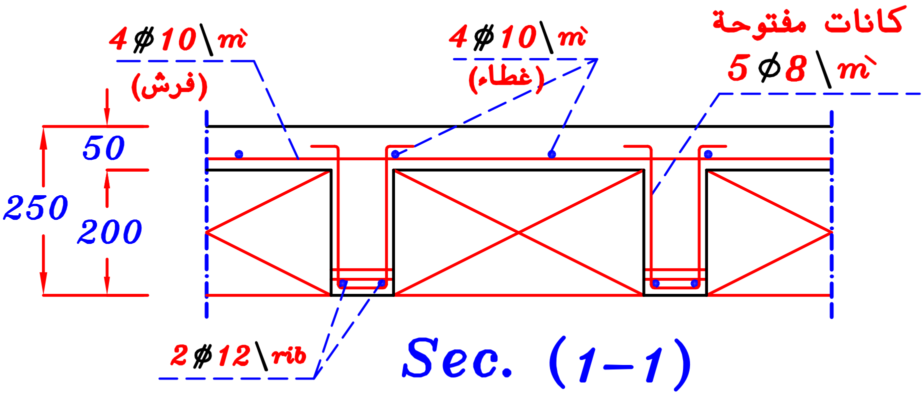
$\xrightarrow{Get}$ $n = 14.29$ $\boxed{n = 14 \text{ Block}}$

$$8.0 = X_1 + X_2 + (14)(0.4) + (14 - 1)(0.1)$$

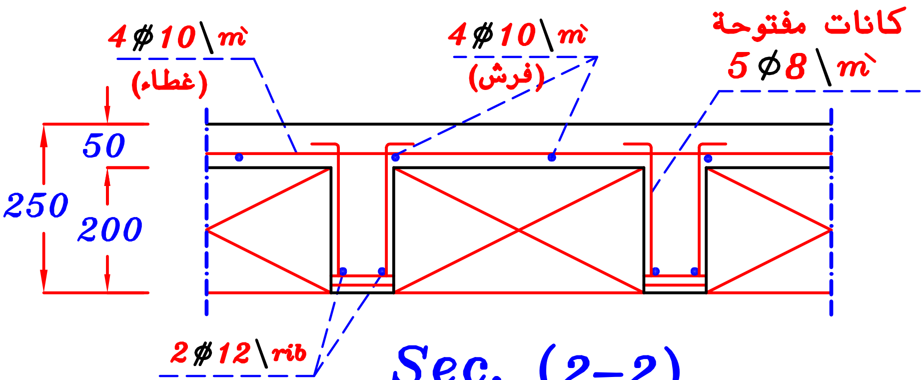
Take $X_1 = 0.75$ m. , $X_2 = 0.35$ m.

RFT. of the slab in plan.

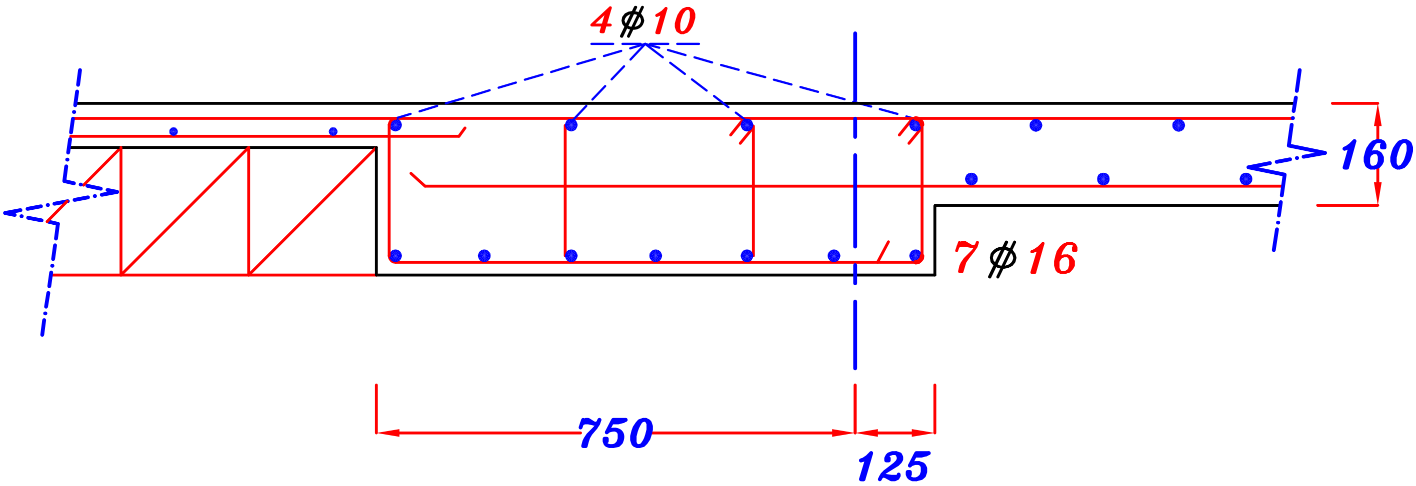




Sec. (1–1)



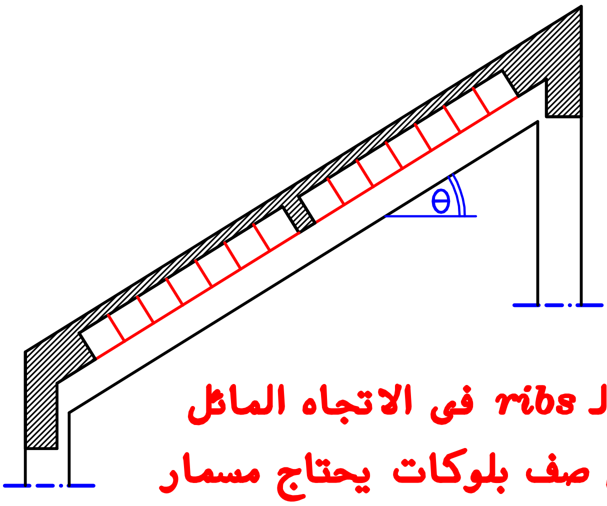
Sec. (2–2)

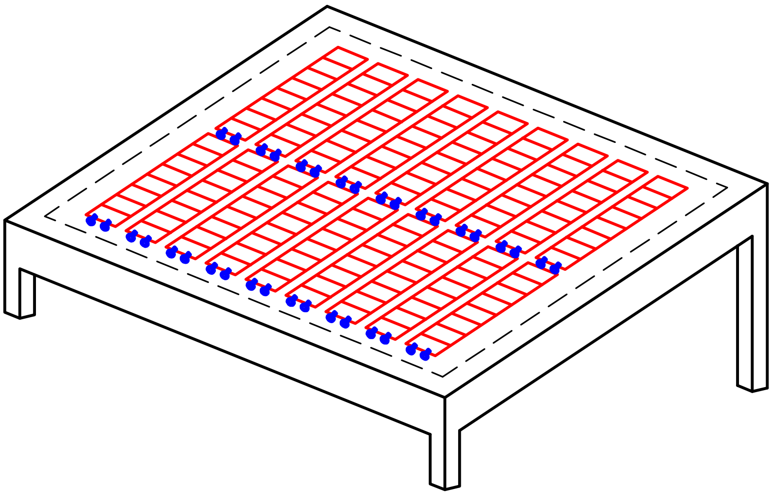


Sec. (3–3)

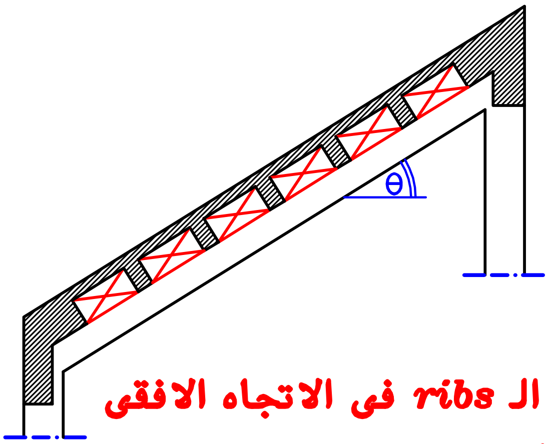
Inclined H.B. Slabs

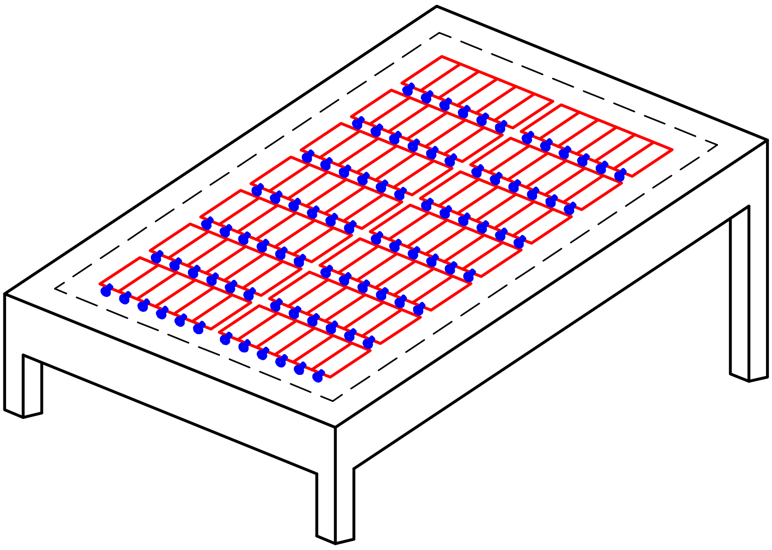
يفضل أن تكون البلاطات المائله **solid slab** حتى لو كانت $L_s > 5.0\ m$
لكن ممكن عمل البلاطات المائله **H.B.** فى حالات خاصه جدا .
البلاطات المائله الـ $H.B.$ يجب أن تكون **One Way** لان البلاطات الـ **Two way**
تكون صعبه جدا جدا فى التنفيذ .
و فى البلاطات الـ **One Way H.B.** يوجد طريقتين لوضع البلوكات .





الـ ribs فى الاتجاه المائل
كل صف بلوكات يحتاج مسمار





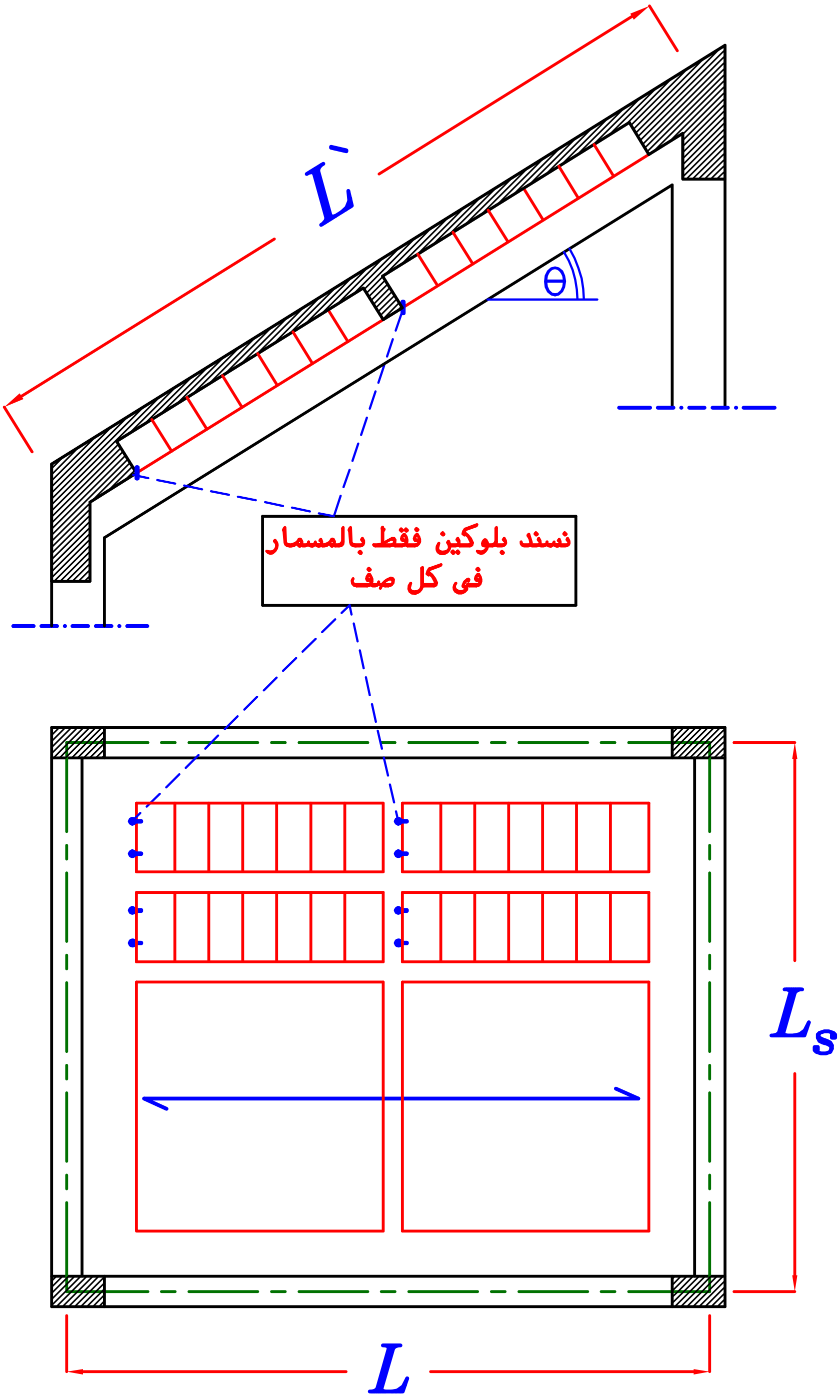
الـ ribs فى الاتجاه الافقى
كل بلوك يحتاج مسمار
أصعب فى التنفيذ

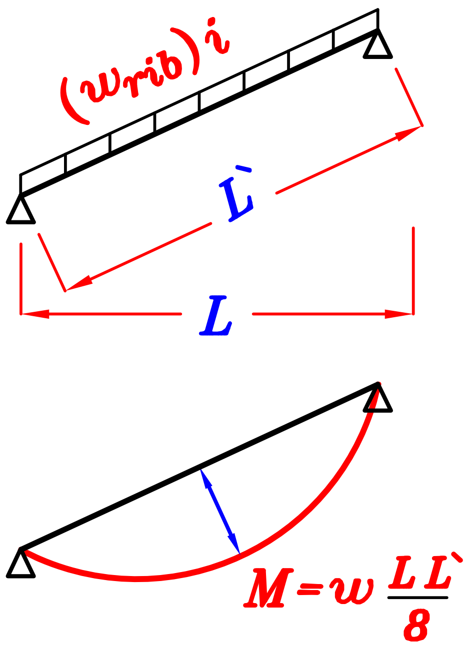
يفضل فى البلاطات الـ $H.B.$ أن تكون الـ $ribs$ مائله لانها أسهل فى التنفيذ
و لكن اذا كان ميل البلاطه قليل (**زاويه ميل البلاطه أقل من ٢٠°**)
ممكن وضع البلوكات بدون مسامير

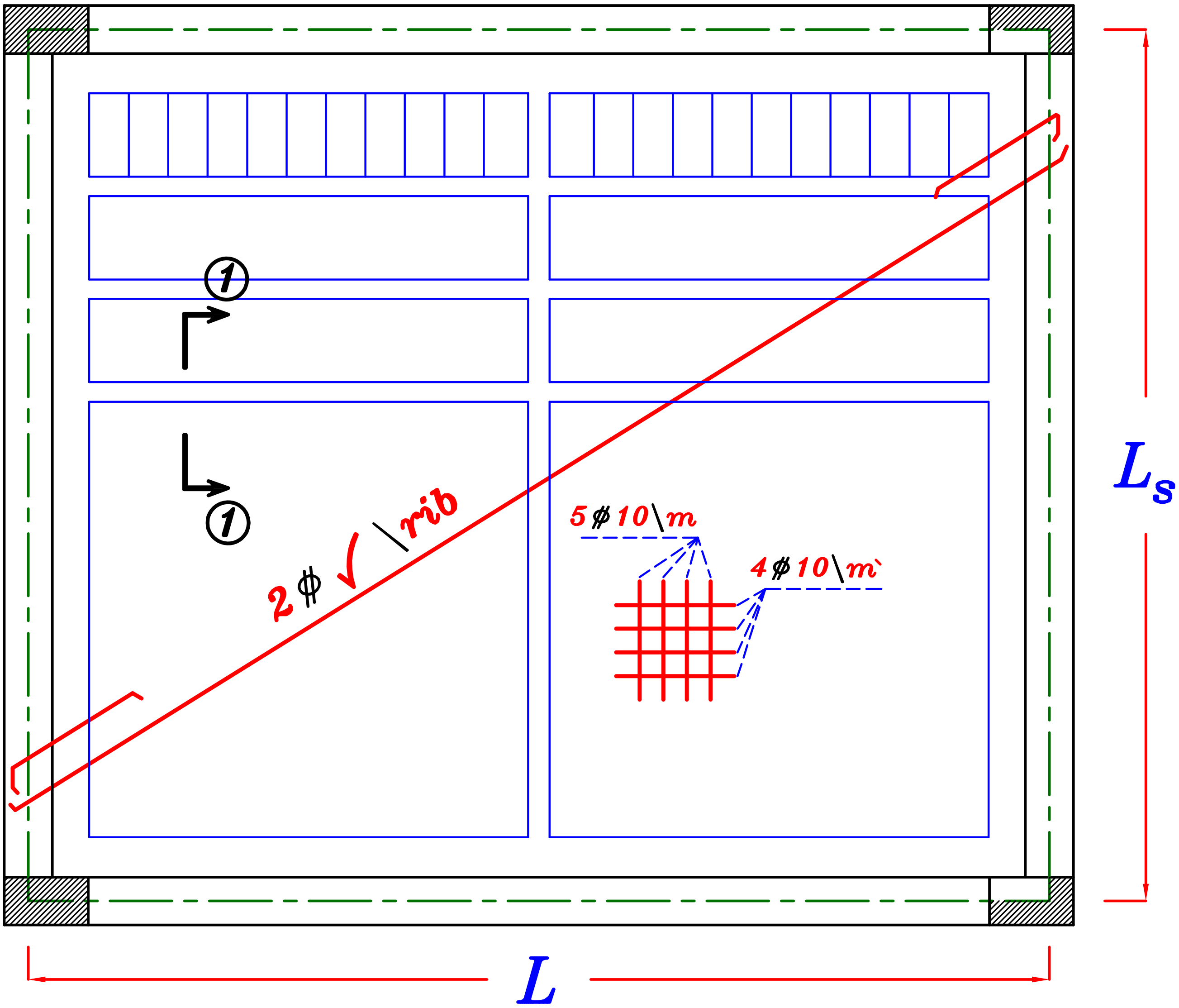
$$S = e + b = 0.4 + 0.1 = 0.5\ m$$

$$(w_{rib})_i = \left[1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L. * \cos\theta)\right] S + 1.4\,(b\,h * 1.0 * \gamma_c) + 1.4\,\left[5\,(\text{Weight of One Block})\right] = \checkmark\ (kN \backslash (1.0 * S\ m^2))$$

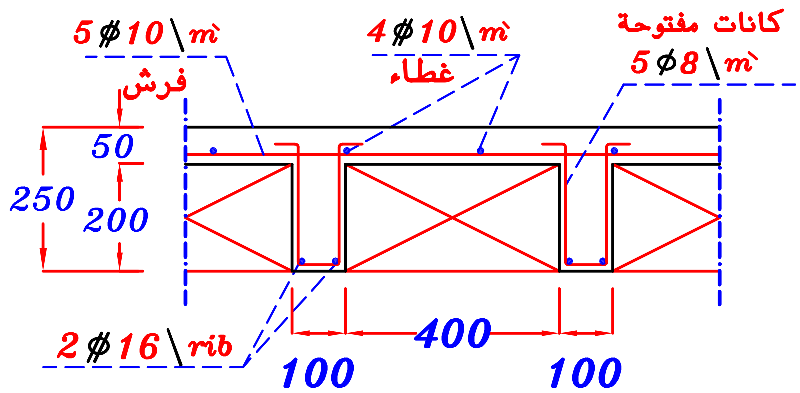
١ـ ال ribs مائلة.



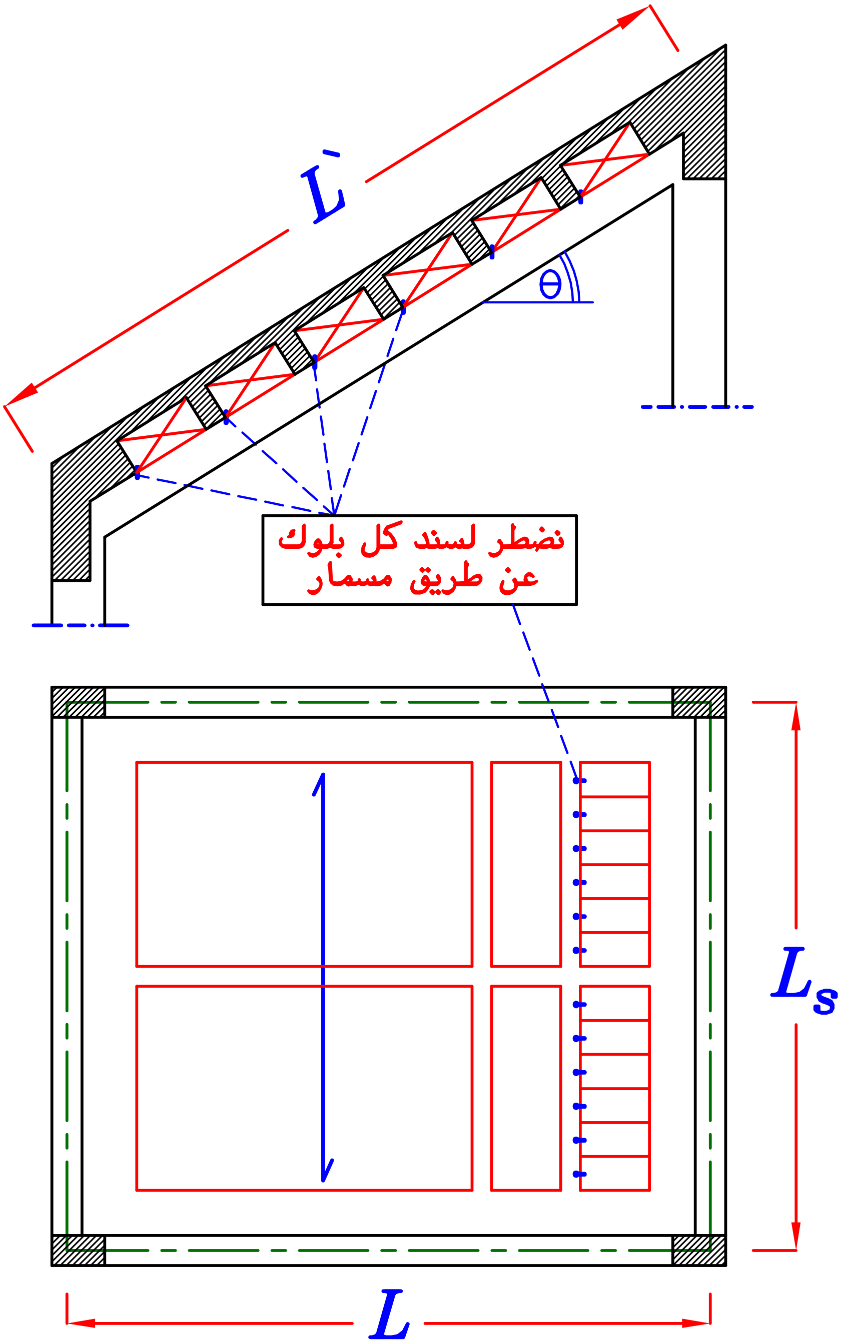


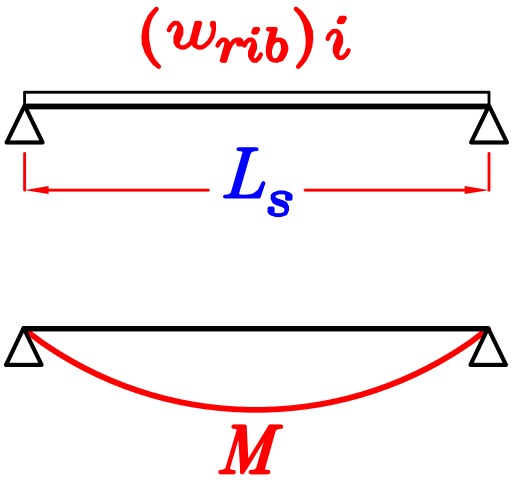

1
1
2ϕ √ \rib
5ϕ10\m
4ϕ10\m`
L_s
L

Sec. (1-1)


5ϕ10\m`
فرش
4ϕ10\m`
غطاء
كانات مفتوحة
5ϕ8\m`
50
250
200
2ϕ16\rib
400
100
100

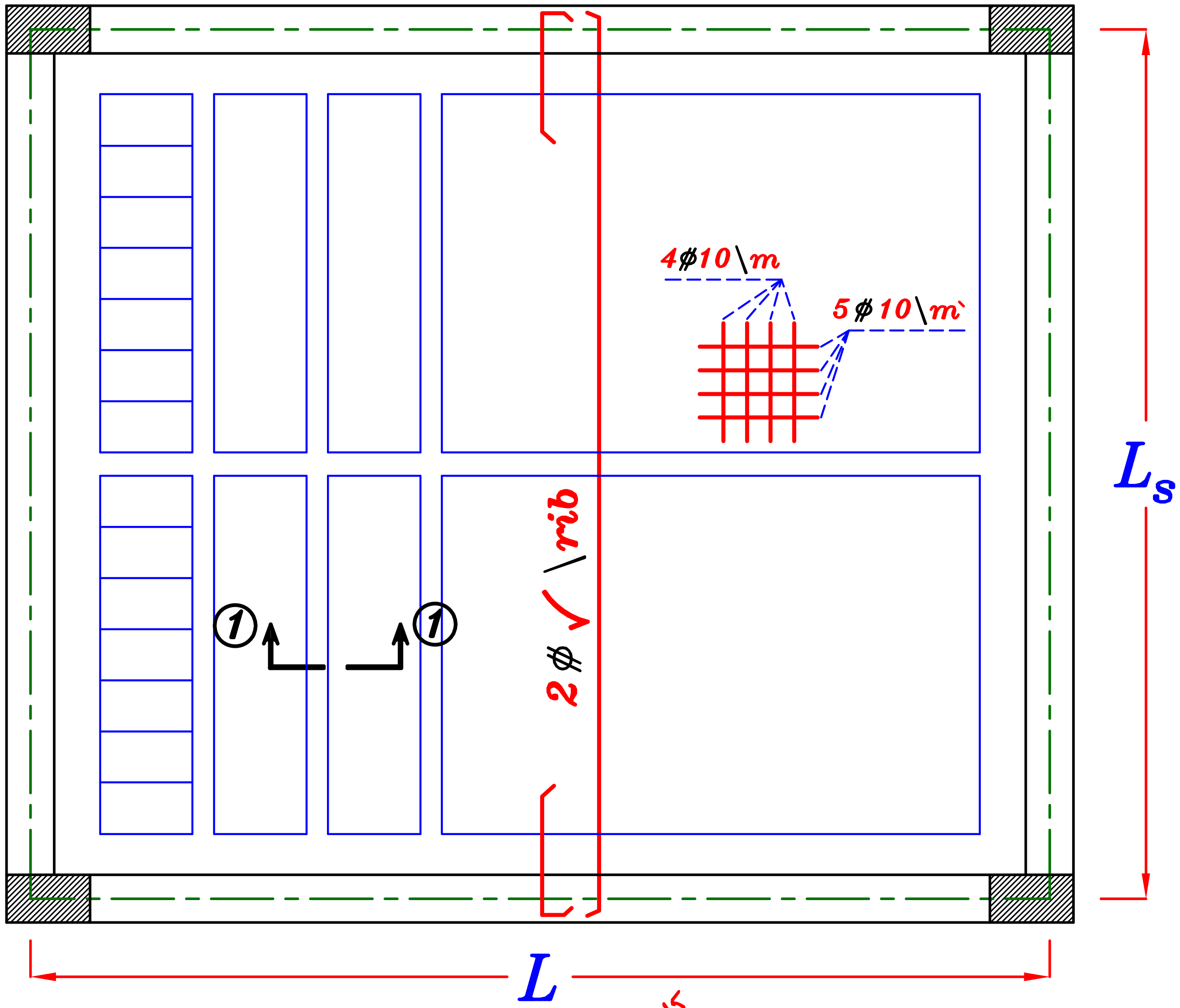
٢ـ ال ribs أفقيه.

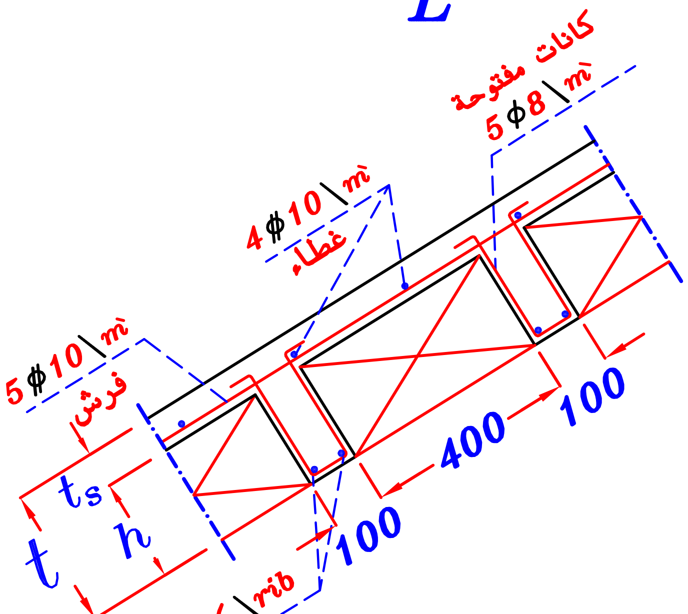




شريحه أفقيه فى بلاطة مائله

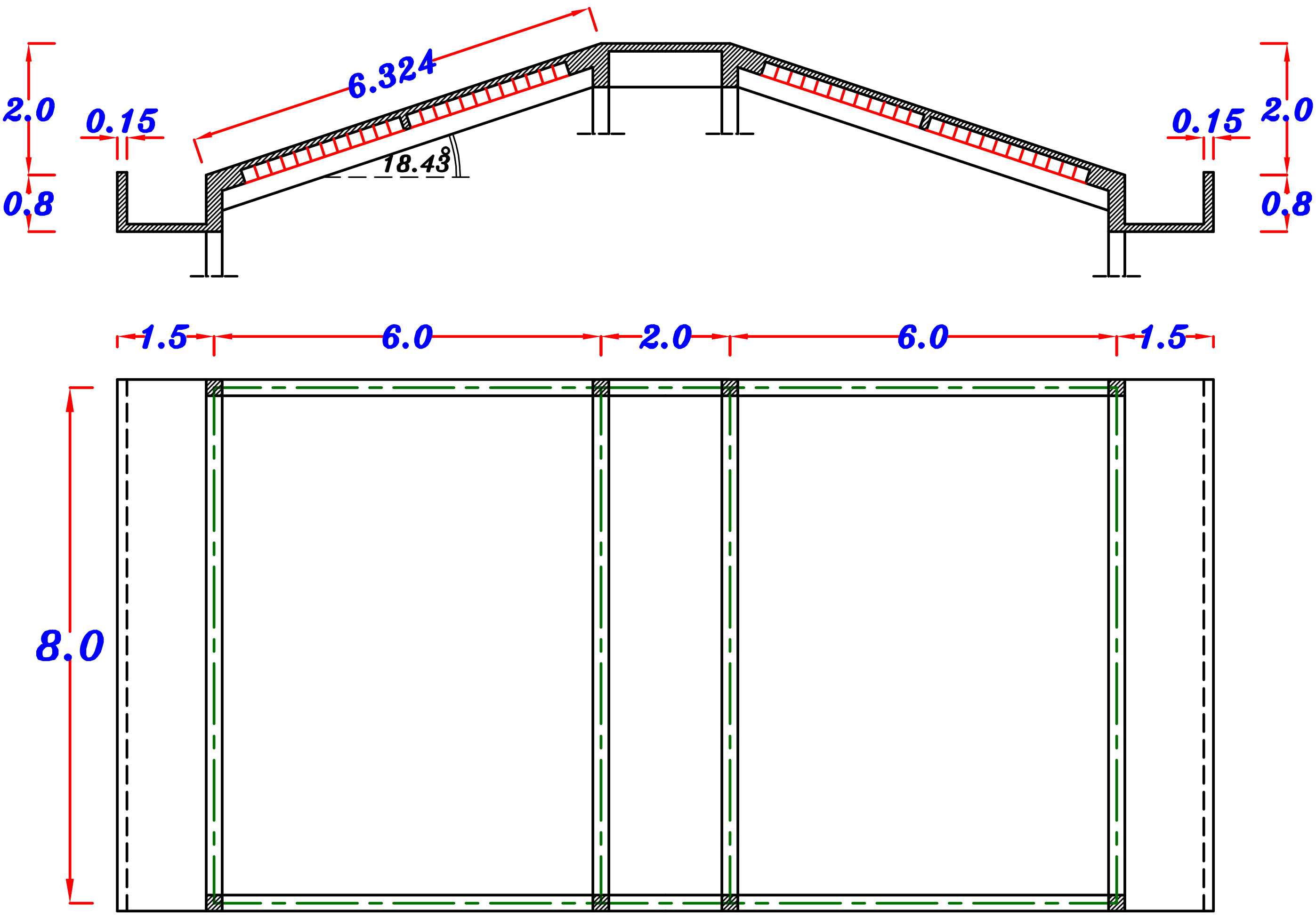
Designed at $M \cos \theta$


4ϕ10\m
5ϕ10\m`
2ϕ √ \rib
1
1
Ls
L


كانات مفتوحة
5ϕ8\m`
4ϕ10\m`
غطاء
5ϕ10\m`
فرش
ts
t
h
400
100
100
As = 2ϕ √ \rib

Sec. (1-1)

Example.



Data.

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

$F.C. = 1.50 \ kN\backslash m^2$ $\quad$ $L.L. = 3.0 \ kN\backslash m^2$

Use Blocks (200*200*400)

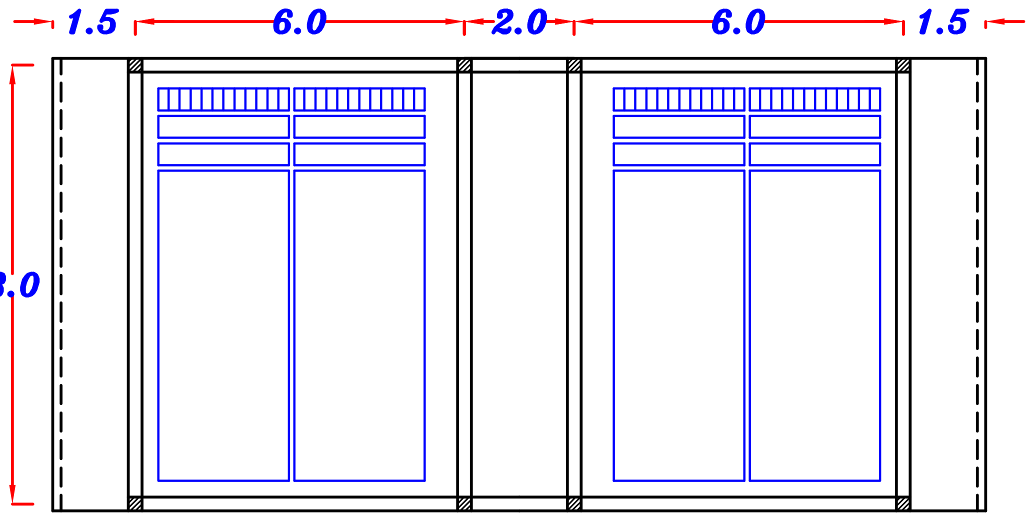
O.W. (Block) = 160 N\Block

Req.

1- Design all slabs to satisfy the given loads.

2- Draw details of RFT. in Plan & Cross-Sections.

Solution.



The Inclined Slab is (**6.0** m. * **8.0** m.)

∵ L_s > **5.0** m ⟶ **Use** H.B. Slab

∵ The slab is inclined ⟶ Use one way H.B. Slab

H.B. Slab.

Take: $t = 250$ mm $t_s = 50$ mm $h = 200$ mm

$$(w_{rib})_i = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.\cos\theta)]\,S$$

$$+1.4\,(b\,h * 1.0 * \gamma_c) + 1.4\,[5\,(\text{Weight of One Block})]$$

$$\therefore (w_{rib})_{U.L.} = [1.4\,(0.05 * 25 + 1.50) + 1.6\,(3.0)\cos 18.43^\circ]\,(0.50)$$

$$+1.4\,(0.1 * 0.2 * 25) + 1.4\left[5\left(\frac{160}{1000}\right)\right] = \mathbf{6.02}\ (kN\backslash(1.0 * 0.5\ m^2))$$

S.S. Slab.

$$t_s = \frac{L_s}{36} = \frac{2000}{36} = 55.55\ mm$$

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

$t_s = 150$ mm

$$(w_s)_{S.S.} = 1.4\,(0.15 * 25 + 1.50) + 1.6\,(3.0) = \mathbf{12.15}\ kN\backslash m^2$$

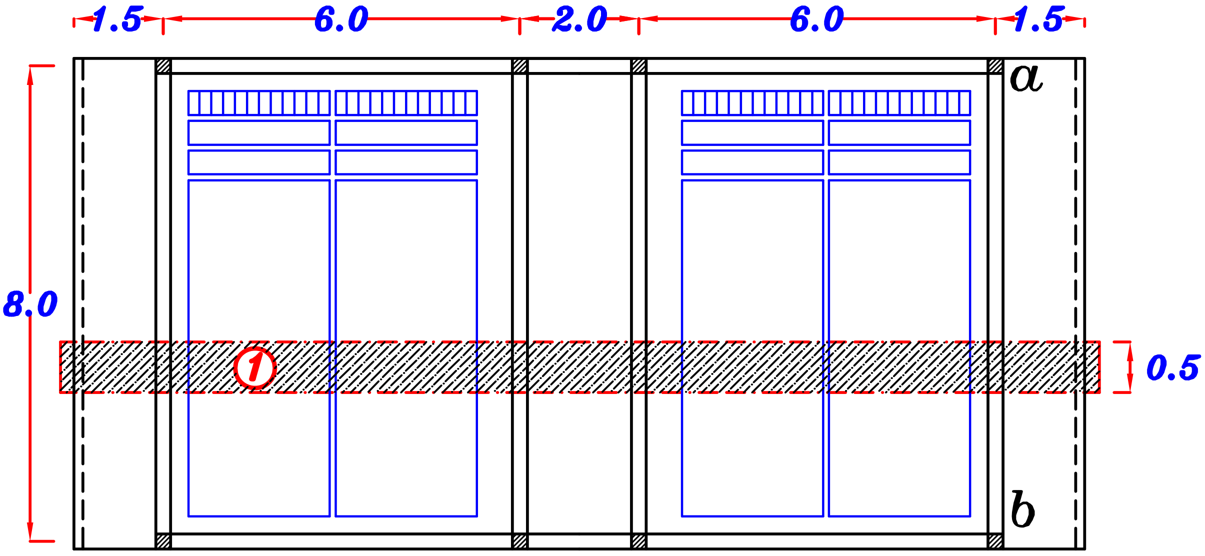
Weight of Parapet.

$$= 1.4\,(0.15 * 0.80 * 1.0 * 25) = \mathbf{4.20}\ kN\backslash m'$$

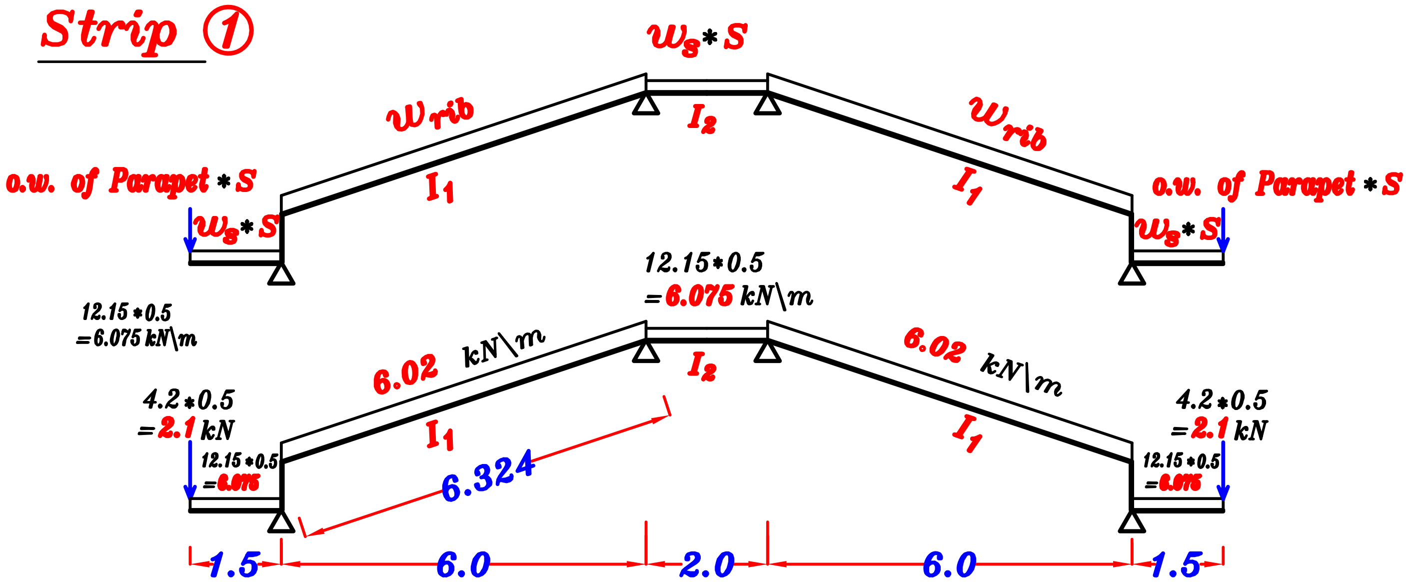
We have Two Solutions.

Solution ①.

Take one strip at all the slabs.
with NO Torsion on beam (a b)

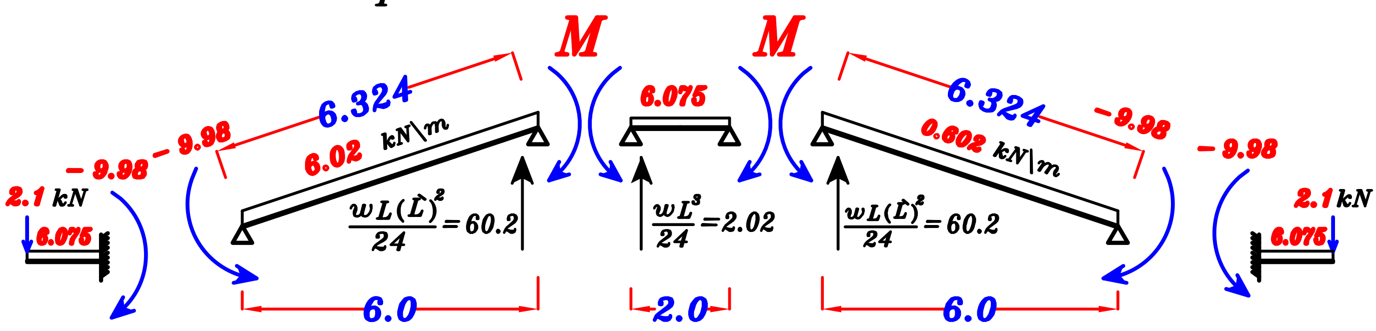


Strip ①



$\because\ t_{H.B.} = 250\ mm\ ,\ t_{S.S.} = 150\ mm\ \therefore\ \frac{I_{H.B.}}{I_{S.S.}} = 1.744$

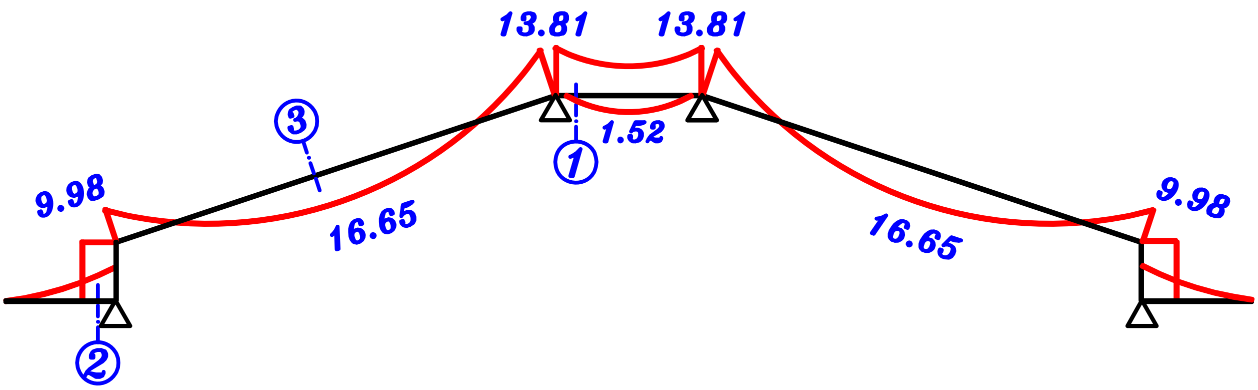
Use 3 Moment Equation.



$$M_1\left(\frac{L_1}{I_1}\right)+2M_2\left(\frac{L_1}{I_1}+\frac{L_2}{I_2}\right)+M_3\left(\frac{L_2}{I_2}\right)=-6\left(\frac{r_1}{I_1}+\frac{r_2}{I_2}\right)$$

$$-\ 9.98\left(\frac{6.324}{1.744}\right)+2M\left(\frac{6.324}{1.744}+\frac{2.0}{1.0}\right)+M\left(\frac{2.0}{1.0}\right)=-6\left(\frac{60.2}{1.744}+\frac{2.02}{1.0}\right)$$

$$\boxed{M=-13.81\ kN.m\backslash 0.5m}$$



Sec. ①

$M_{U.L.}=13.81\ kN.m\backslash 0.5m$

$, t_s=150\ mm\ ,\ d=150-20=130\ mm$

$$130=C_1\sqrt{\frac{13.81*10^6}{25*500}}\longrightarrow C_1=3.91\longrightarrow J=0.802$$

$$A_s=\frac{13.81*10^6}{0.802*360*130}=368\ mm^2/0.5m\quad \boxed{4\phi 12\backslash 0.5m}=\boxed{8\phi 12\backslash m}$$

Sec. ②

$M_{U.L.}=9.98\ kN.m\backslash 0.5m$

$, t_s=150\ mm\ ,\ d=150-20=130\ mm$

$$130=C_1\sqrt{\frac{9.98*10^6}{25*500}}\longrightarrow C_1=4.60\longrightarrow J=0.819$$

$$A_s=\frac{9.98*10^6}{0.819*360*130}=260.3\ cm^2/0.5m\quad \boxed{4\phi 10\backslash 0.5m}=\boxed{8\phi 10\backslash m}$$

Sec. ③

$M=16.65\ kN.m\backslash rib$

$, t=250\ mm\ ,\ d=250-30=220\ mm$

$$220=C_1\sqrt{\frac{16.65*10^6}{25*500}}\longrightarrow C_1=6.02\longrightarrow J=0.826$$

$$A_s=\frac{M}{J\,F_y\,d}=\frac{16.65*10^6}{0.826*360*220}=254.5\ cm^2\backslash rib$$

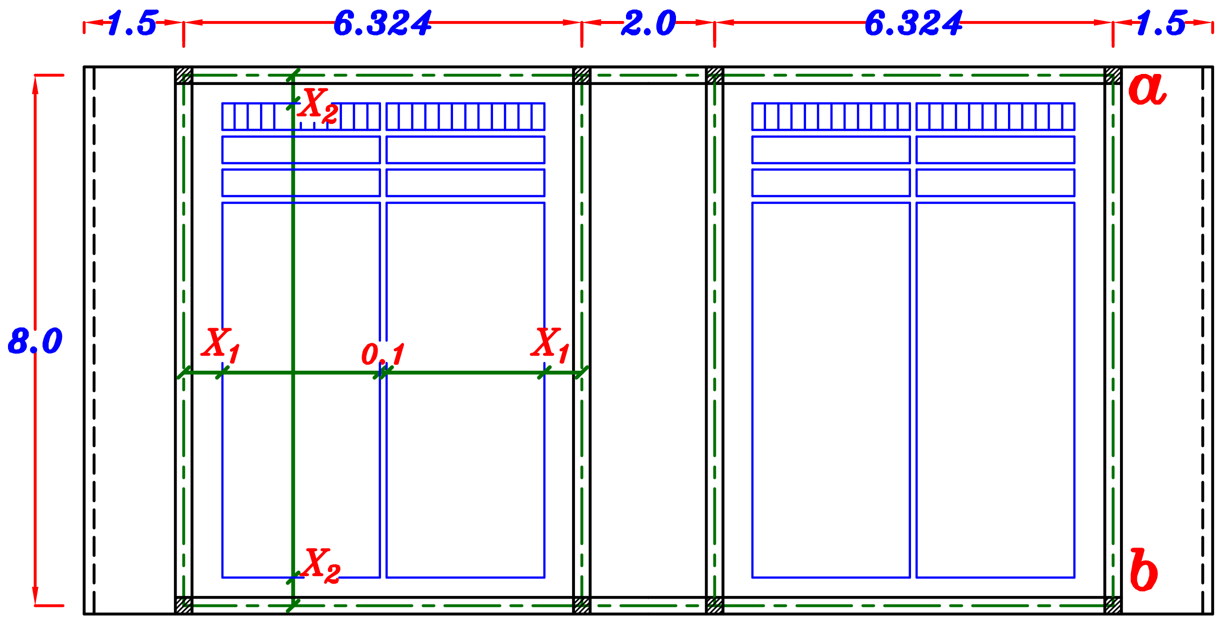
$$\boxed{1\phi 12+1\phi 16\backslash rib}$$

Check the dimensions of the Solid Part.

$$M_R = \left[R_{max}\frac{F_{cu}}{\delta_c}\, b\, d^2\right] = \left[0.194\left(\frac{25}{1.5}\right)(100)(220)^2\right] = 15649333 \text{ N.mm}$$

$\because M_R = 15.65$ kN.m $>$ $M = 13.81$ kN.m

$\therefore$ Use min. Solid Part $X_{min} = 0.25$ m.



Arrangement of Blocks.

1_ Short Direction.

$L_S = 2(X_1) + (n_1)(0.2) + (1)(0.10)$ Take $X_1 = X_{min} = 0.25$ m.

$6.324 = 2(0.25) + (n_1)(0.2) + (1)(0.10)$ $\xrightarrow{Get}$ $n_1 = 28.62$ **$n_1 = 28$ Block**

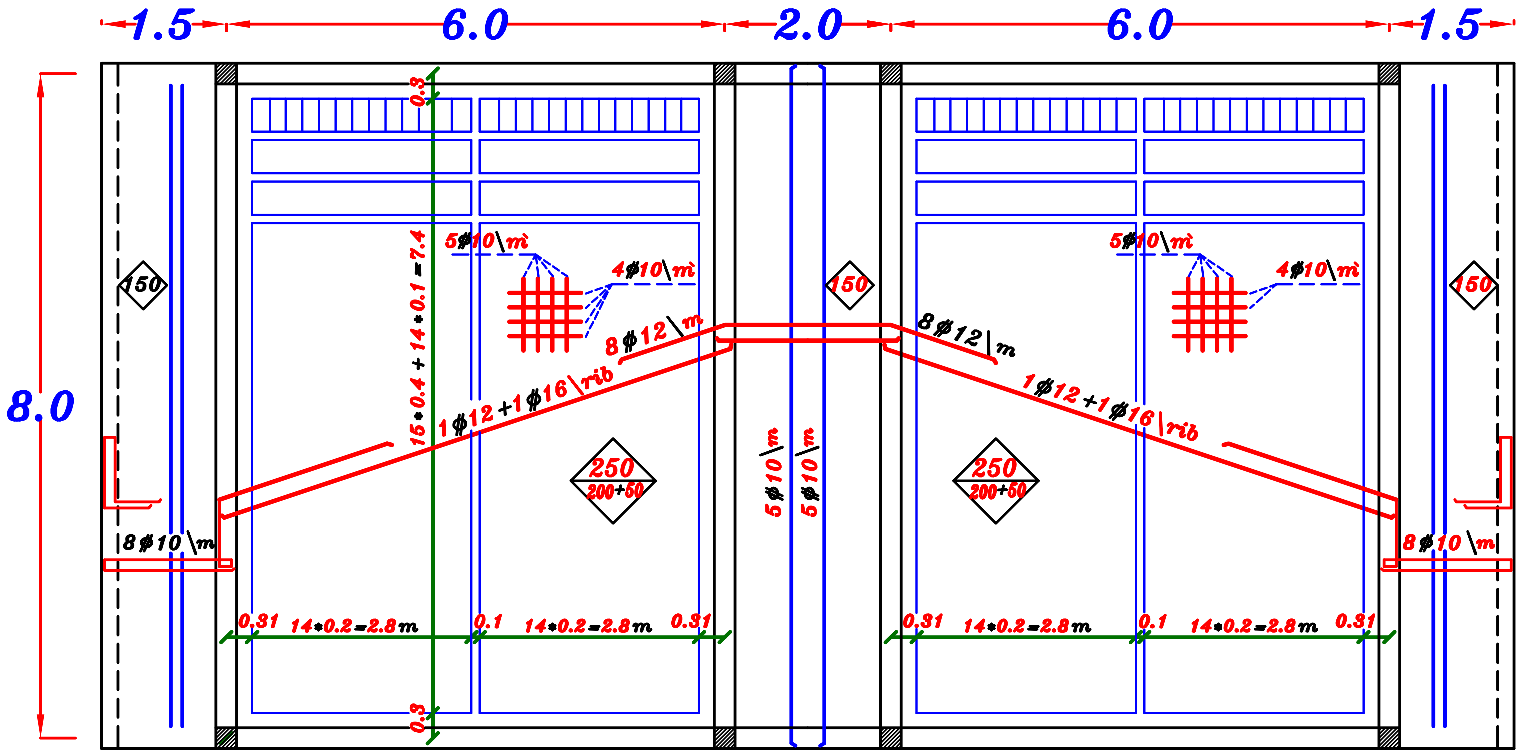
$6.324 = 2(X_1) + (28)(0.2) + (1)(0.10)$ $\xrightarrow{Get}$ $X_1 = 0.312$ **$X_1 = 0.31$ m.**

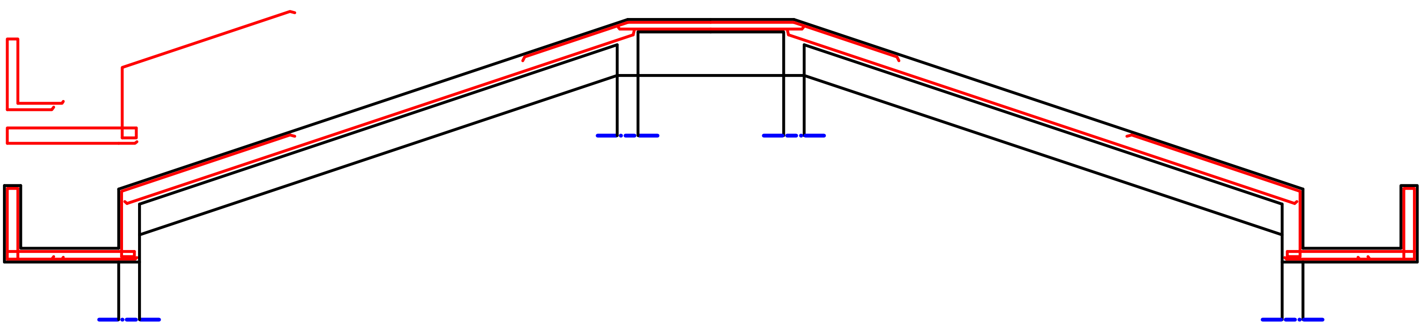
2_ Long Direction.

$L = 2(X_2) + (n_2)(0.4) + (n_2 - 1)(0.10)$ Take $X_2 = X_{min} = 0.25$ m.

$8.0 = 2(0.25) + (n_2)(0.4) + (n_2 - 1)(0.10)$ $\xrightarrow{Get}$ $n_2 = 15.2$ **$n_2 = 15$ Block**

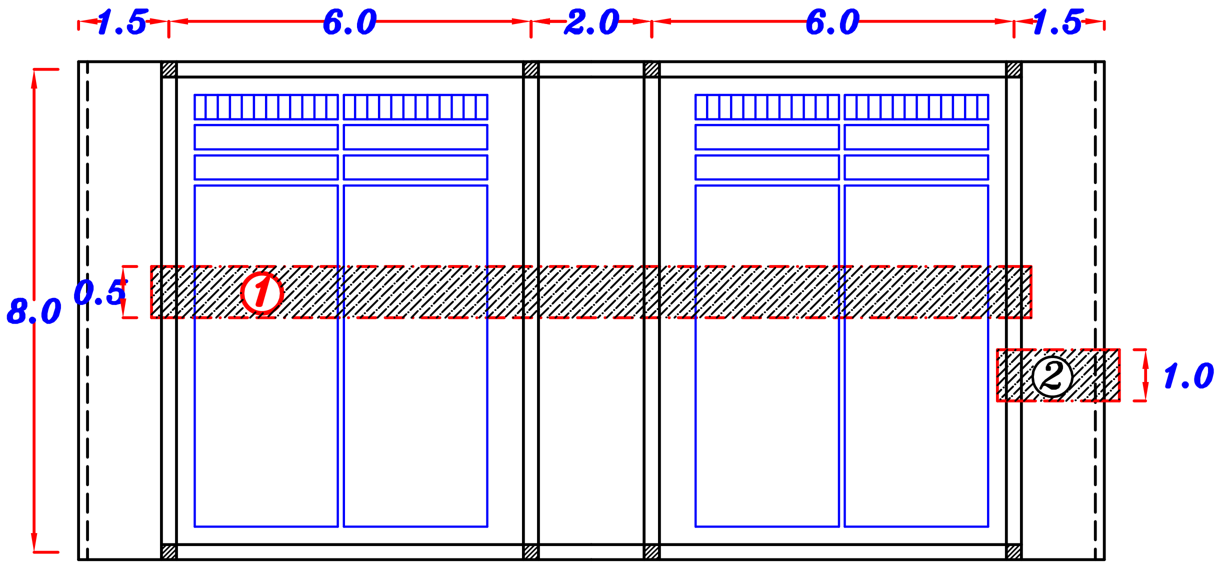
$8.0 = 2(X_2) + (15)(0.4) + (15 - 1)(0.10)$ $\xrightarrow{Get}$ $X_2 = 0.30$ **$X_2 = 0.30$ m.**


1.5
6.0
2.0
6.0
1.5
8.0
0.3
15*0.4 + 14*0.1 = 7.4
5ϕ10\m
4ϕ10\m
150
8ϕ12\m
1ϕ12+1ϕ16\rib
250
200+50
5ϕ10\m
8ϕ10\m
0.31
14*0.2=2.8m
0.1

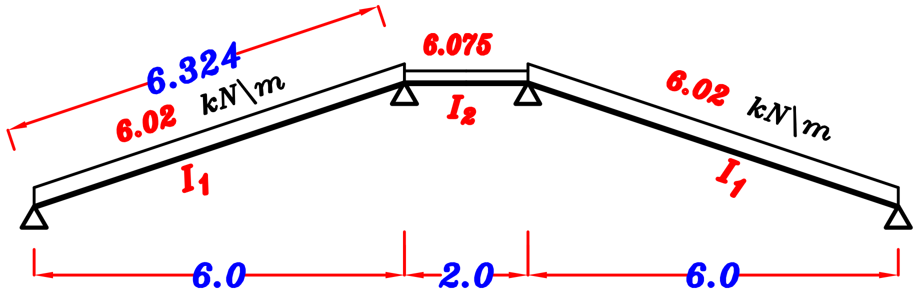


Solution ② .

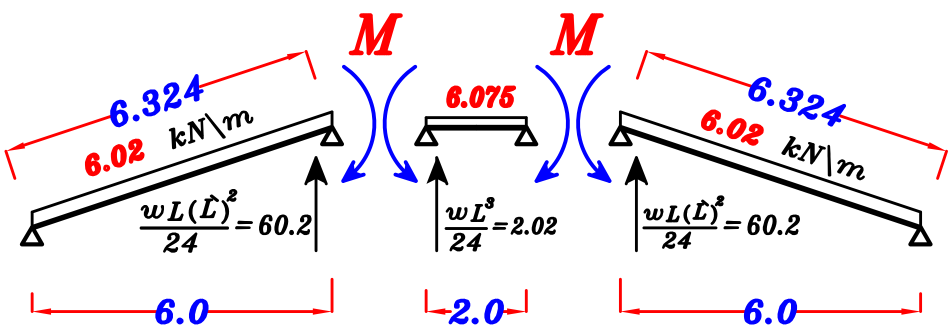
Take Two strips.
with Torsion on beam (a b)



Strip ①



$\because\ t_{H.B.} = 250\ mm\ ,\ t_{S.S.} = 150\ mm\ \therefore\ \frac{I_{H.B.}}{I_{S.S.}} = 1.744$

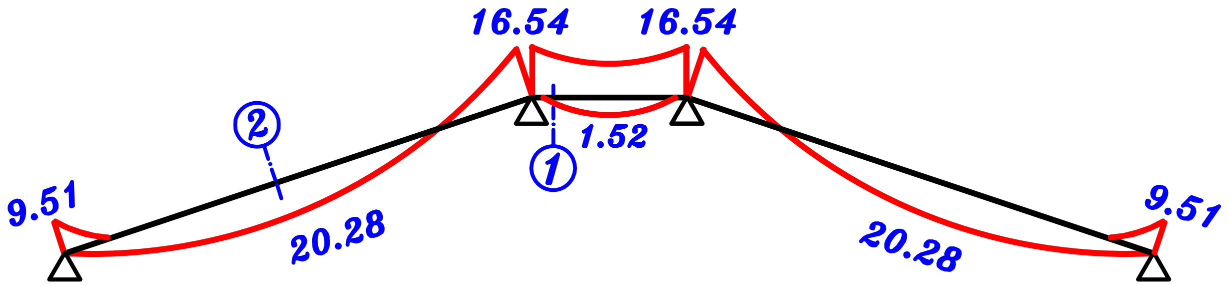


Use 3 Moment Equation.

$$M_1\left(\frac{L_1}{I_1}\right) + 2M_2\left(\frac{L_1}{I_1} + \frac{L_2}{I_2}\right) + M_3\left(\frac{L_2}{I_2}\right) = -6\left(\frac{\gamma_1}{I_1} + \frac{\gamma_2}{I_2}\right)$$

$$Zero + 2M\left(\frac{6.324}{1.744} + \frac{2.0}{1.0}\right) + M\left(\frac{2.0}{1.0}\right) = -6\left(\frac{60.2}{1.744} + \frac{2.02}{1.0}\right)$$

$$M = -\ 16.54\ \ kN.m\backslash 0.5m$$



Sec. ①

$M_{U.L.} = 16.54 \quad kN.m\backslash 0.5m$

$, t_s = 150\ mm \;, \; d = 150 - 20 = 130\ mm$

$$130 = C_1 \sqrt{\frac{16.54 * 10^6}{25 * 500}} \longrightarrow C_1 = 3.57 \longrightarrow J = 0.785$$

$$As = \frac{16.54 * 10^6}{0.785 * 360 * 130} = 450.2 \quad mm^2/0.5m$$

4 ϕ 12\0.5m = **8 ϕ 12\m**

Sec. ②

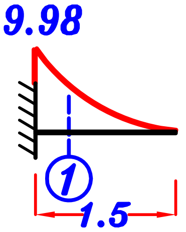
$M = 20.28 \quad kN.m\backslash rib \;, \quad t = 250\ mm \;, \; d = 250 - 30 = 220\ mm$

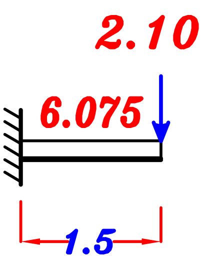
$$220 = C_1 \sqrt{\frac{20.28 * 10^6}{25 * 500}} \longrightarrow C_1 = 5.46 \longrightarrow J = 0.826$$

$$A_s = \frac{M}{J\, F_y\, d} = \frac{20.28 * 10^6}{0.826 * 360 * 220} = 310 \ mm^2\backslash rib$$

2 ϕ 16\rib

Strip ②





Sec. ①

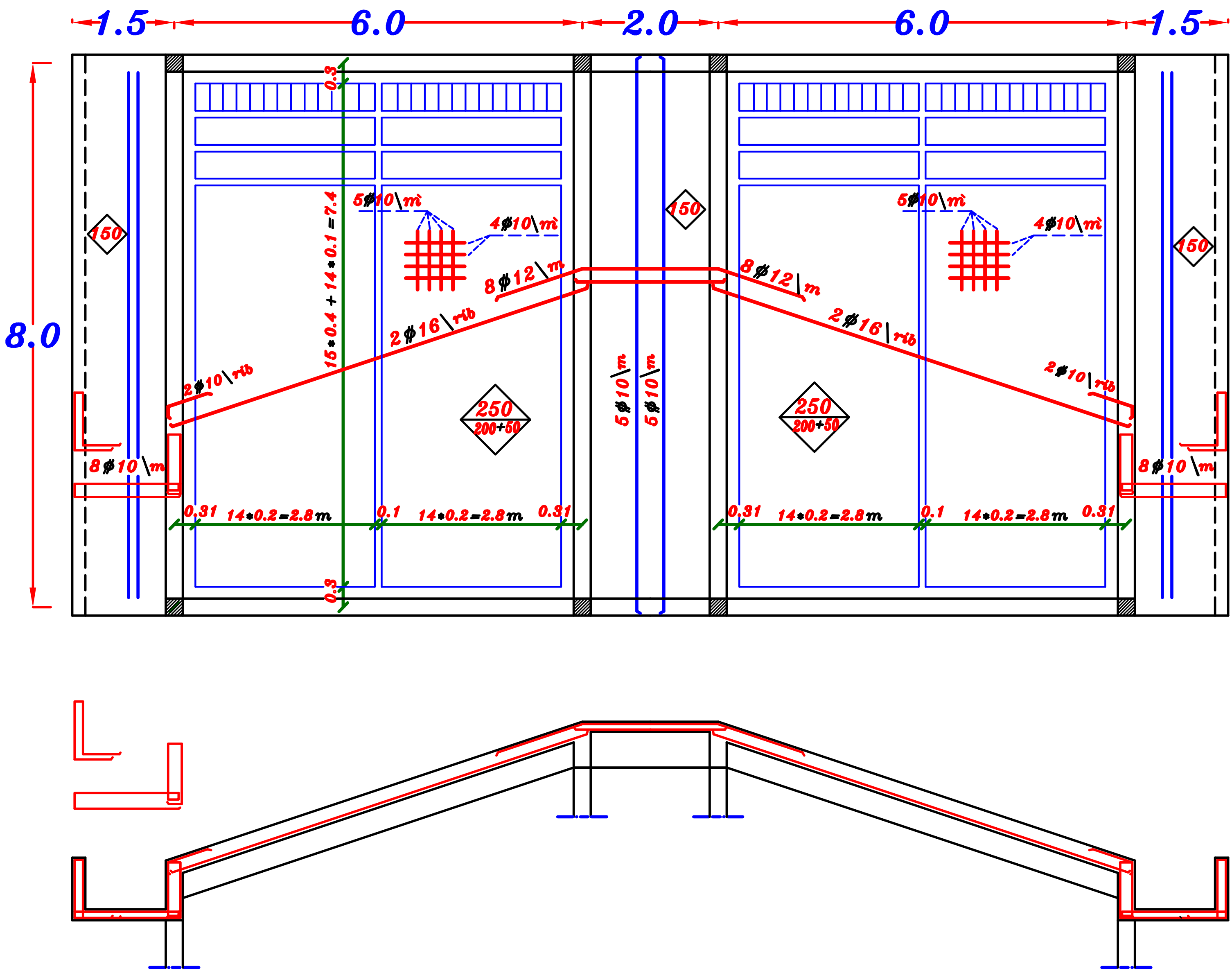
$M_{U.L.} = 9.98 \quad kN.m\backslash 0.5m$

$, t_s = 150\ mm \;, \; d = 150 - 20 = 130\ mm$

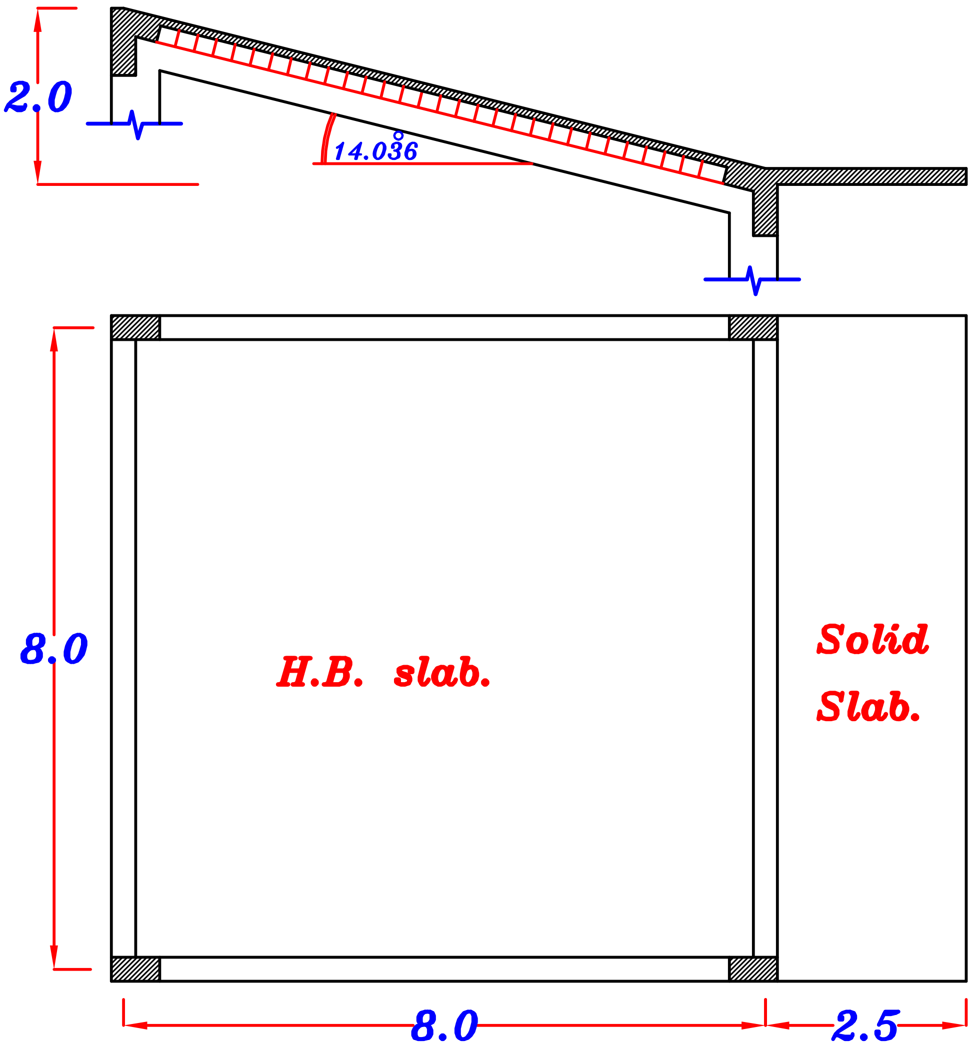
$$130 = C_1 \sqrt{\frac{9.98 * 10^6}{25 * 500}} \longrightarrow C_1 = 4.60 \longrightarrow J = 0.819$$

$$As = \frac{9.98 * 10^6}{0.819 * 360 * 130} = 260.4 \quad mm^2/0.5\ m$$

4 ϕ 10\0.5m = **8 ϕ 10\m**


1.5
6.0
2.0
6.0
1.5
8.0
0.3
15*0.4 + 14*0.1 = 7.4
5φ10\m
4φ10\m
8φ12\m
2φ16\rib
2φ10\rib
8φ10\m
150
250
200+50
5φ10\m
0.31
14*0.2=2.8m
0.1

Example.



Data.

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

$L.L. = 3.0 \; kN\backslash m^2$ $F.C. = 1.50 \; kN\backslash m^2$

Req.

1 – Design the H.B. slab & the Solid slab.

2 – Draw details of RFT. in plan to a scale 1:50

The Inclined Slab is (8.0 m. * 8.0 m.)

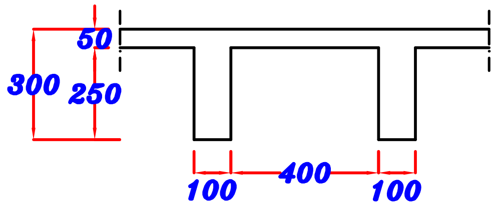
$\because L_s > 4.50 \; m$ ⟶ Use H.B. Slab

$\because$ The slab is inclined ⟶ Use one way H.B. Slab

$\because L_s > 7.0 \; m$ ⟶ Use 3 Cross ribs

H.B. Slab.

Use One Way H.B. Slab. أسهل فى التنفيذ



Take: $t = 300\ mm$ $t_s = 50\ mm$ $h = 250\ mm$

$$(w_{rib})_i = \left[1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.\ Cos\,\Theta)\right] S$$

$$+1.4\,(b\,h * 1.0 * \gamma_c) + 1.4\left[5\,(\text{Weight of One Block})\right]$$

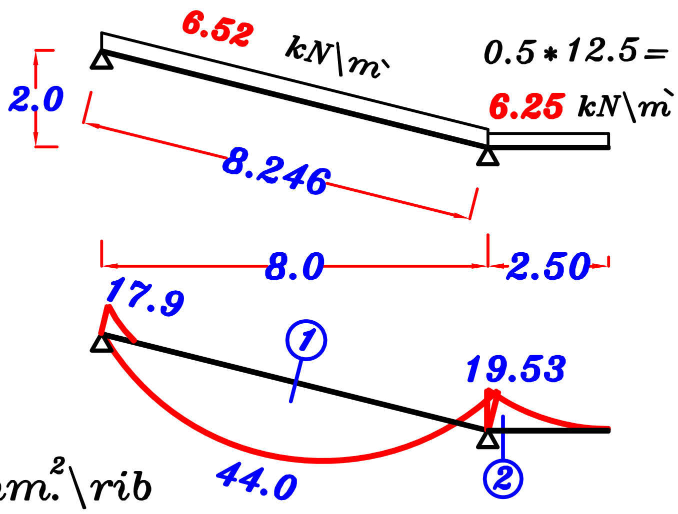
$$\therefore (w_{rib})_{U.L.} = \left[1.4\,(0.05 * 25 + 1.50) + 1.6\,(3.0)\ Cos\ 14.036^{\circ}\right](0.50)$$

$$+1.4\,(0.1 * 0.25 * 25) + 1.4\left[5\left(\frac{200}{1000}\right)\right] = 6.52 \quad (kN \backslash (1.0 * 0.5\ m^2))$$

S.S. Slab.

$$t_s = \frac{2500}{10} = 250\ mm \qquad t_s = 160\ mm$$

$$(w_s)_{U.L.} = 1.4\,(0.16 * 25 + 1.50) + 1.6\,(3.0) = 12.5\ kN\backslash m^2$$



Sec. ①

$M = 44.0\ kN.m\backslash rib$

$$270 = C_1 \sqrt{\frac{44.0 * 6^5}{25 * 500}}$$

$\rightarrow C_1 = 4.55 \quad \rightarrow J = 0.819$

$$A_s = \frac{44.0 * 10^6}{0.819 * 360 * 270} = 552\ mm^2\backslash rib$$

$2\phi 20\backslash rib$

Sec. ②

$M = 19.53\ kN.m\backslash 0.5m$

$$140 = C_1 \sqrt{\frac{19.53 * 10^5}{25 * 500}} \rightarrow C_1 = 3.54 \quad \rightarrow J = 0.78$$

$$A_s = \frac{19.53 * 10^5}{0.78 * 360 * 140} = 496\ mm^2\backslash rib \qquad 2\phi 20\backslash rib$$

Solid Ppart.

$$M_R = R_{max} \frac{F_{cu}}{\delta_c} b\, d^2 = 0.194 \left(\frac{25}{1.5}\right)(100)(270)^2 = 23571000 \text{ N.mm}$$

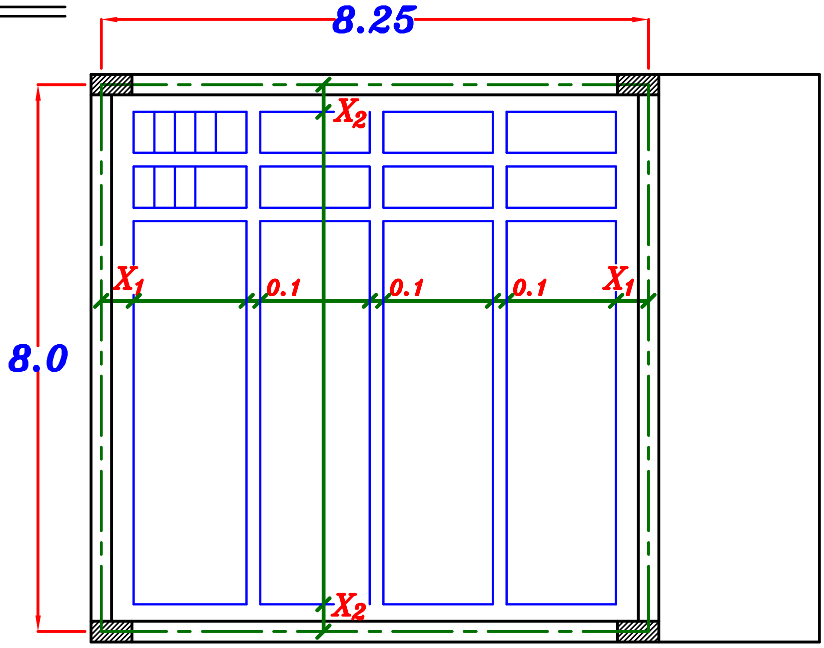
$M_R = 23.57$ kN.m $>$ $M = 19.53$ kN.m

$\therefore$ Use min. Solid Part. = 25 cm

Arrangement of blocks.

$\because L_s > 7.0$ m

$\therefore$ Use 3 X–ribs



1_ Long Direction.

$L = 2(X_1) + (n_1)(0.2) + (3)(0.1)$ Take $X_1 = X_{min.} = 0.25$ m.

$8.25 = 2(0.25) + (n_1)(0.2) + (3)(0.1)$ $\xrightarrow{Get}$ $n_1 = 37.25$ **$n_1 = 37$ Block**

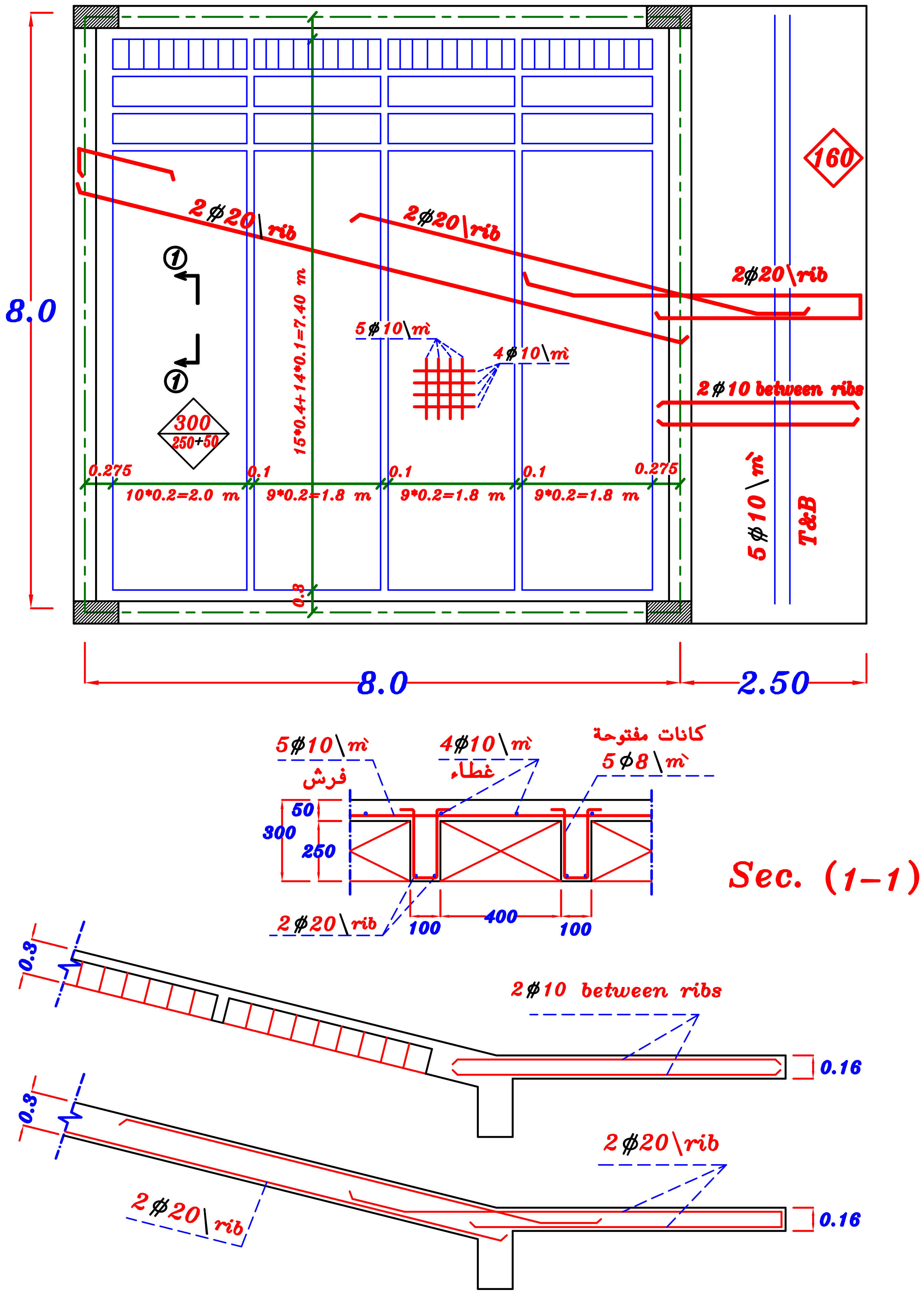
$8.25 = 2(X_1) + (37)(0.2) + (3)(0.1)$ $\xrightarrow{Get}$ $X_1 = 0.275$ **$X_1 = 0.275$ m.**

2_ Short Direction.

$L_S = 2(X_2) + (n_2)(0.4) + (n_2 - 1)(0.1)$ Take $X_2 = X_{min.} = 0.25$ m.

$8.0 = 2(0.25) + (n_2)(0.4) + (n_2 - 1)(0.1)$ $\xrightarrow{Get}$ $n_2 = 15.2$ **$n_2 = 15$ Block**

$8.0 = 2(X_2) + (15)(0.4) + (14)(0.1)$ $\xrightarrow{Get}$ $X_2 = 0.30$ **$X_2 = 0.30$ m.**


8.0
160
2φ20\rib
2φ20\rib
2φ20\rib
15*0.4+14*0.1=7.40 m
5φ10\m`
4φ10\m`
2φ10 between ribs
300
250+50
0.275
0.1
0.1
0.1
0.275
10*0.2=2.0 m
9*0.2=1.8 m
9*0.2=1.8 m
9*0.2=1.8 m
5φ10\m`
T&B
0.3
8.0
2.50
5φ10\m`
فرش
4φ10\m`
غطاء
كانات مفتوحة
5φ8\m`
50
300
250
2φ20\rib
100
400
100
Sec. (1-1)
0.3
2φ10 between ribs
0.16
0.3
2φ20\rib
2φ20\rib
0.16

Special Case.

Example.

Data.

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

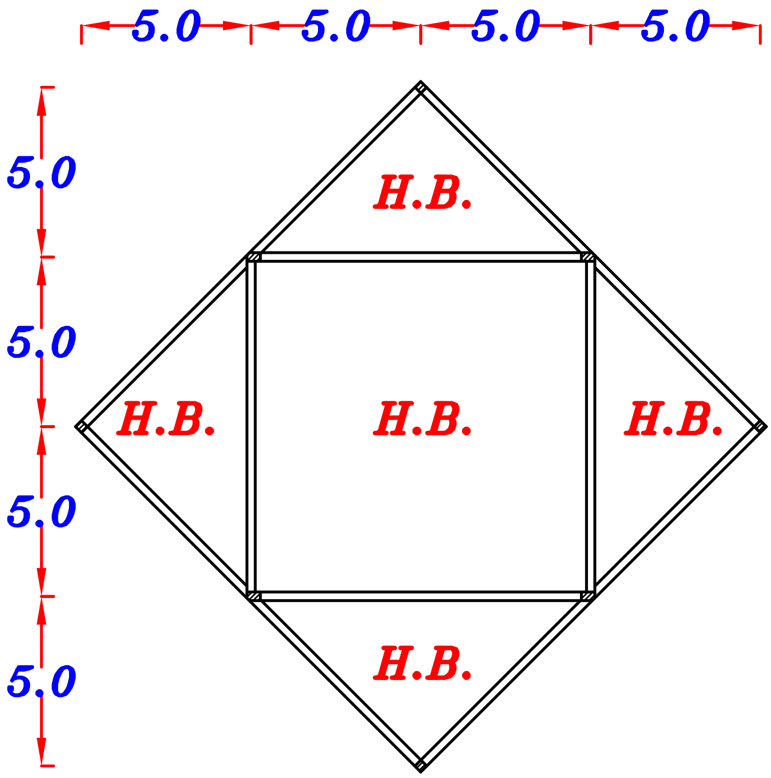
$F_y = 360$ N\mm^2

F.C. = 1.50 kN\m^2

L.L. = 3.0 kN\m^2

Use Blocks (200*200*400)

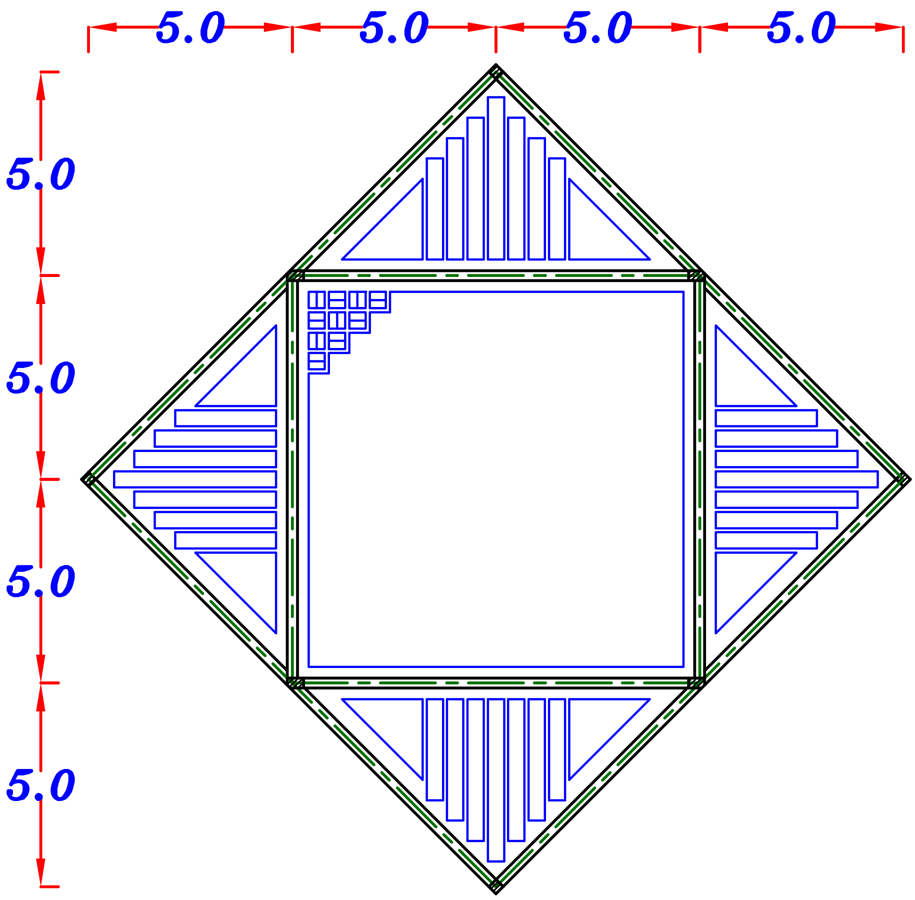
O.W. (Block) = 160 N\Block



Req.

1- Design all slabs to satisfy the given loads.

2- Draw details of RFT. in Plan & Cross-Sections.



For One Way H.B. Slab.

Take: $t = 250$ mm $t_s = 50$ mm $h = 200$ mm

$$(w_{rib})_{U.L.} = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)]\,S$$
$$+1.4\,(b\,h * 1.0 * \gamma_c) + 1.4\,[5\,(\text{Weight of One Block})]$$

$$\therefore (w_{rib1})_{U.L.} = [1.4\,(0.05 * 25 + 1.50) + 1.6\,(3.0)]\,(0.50)$$
$$+1.4\,(0.1 * 0.2 * 25) + 1.4\,[5\,(\frac{160}{1000})] = 6.15\ (kN\backslash(1.0 * 0.5\ m^2))$$

For Two Way H.B. Slab.

Take: $t = 250$ mm $t_s = 50$ mm $h = 200$ mm

$$(w_{rib})_{U.L.} = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)]\,S$$
$$+1.4\,(b\,h * 1.8 * \gamma_c) + 1.4\,[4\,(\text{Weight of One Block})]$$

$$\therefore (w_{rib2})_{U.L.} = [1.4\,(0.05 * 25 + 1.50) + 1.6\,(3.0)]\,(0.50)$$
$$+1.4\,(0.1 * 0.20 * 1.8 * 25) + 1.4\,[4\,(\frac{160}{1000})] = 6.48\ (kN\backslash(1.0 * 0.5\ m^2))$$

Calculate the Load Factors. α, β For the H.B. Slab.

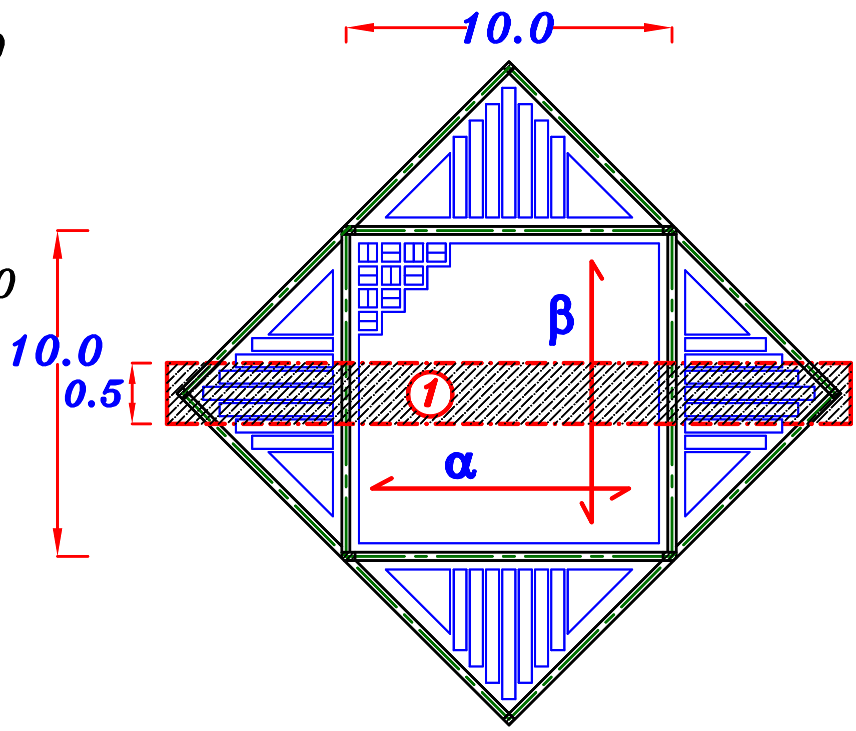
$$r = \frac{m\,L}{m'\,L_s} = \frac{0.76(10)}{0.76(10)} = 1.0$$

$\because$ $L.L. < 5.0$ $kN\backslash m^2$

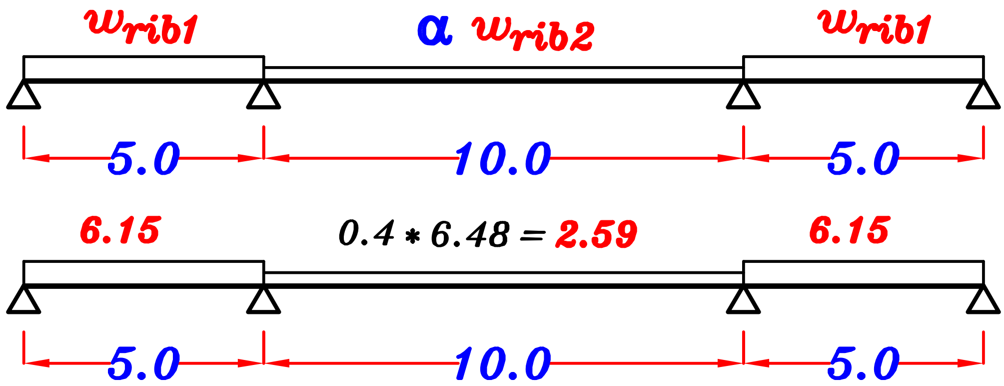
Use Marcus Tables Page 90

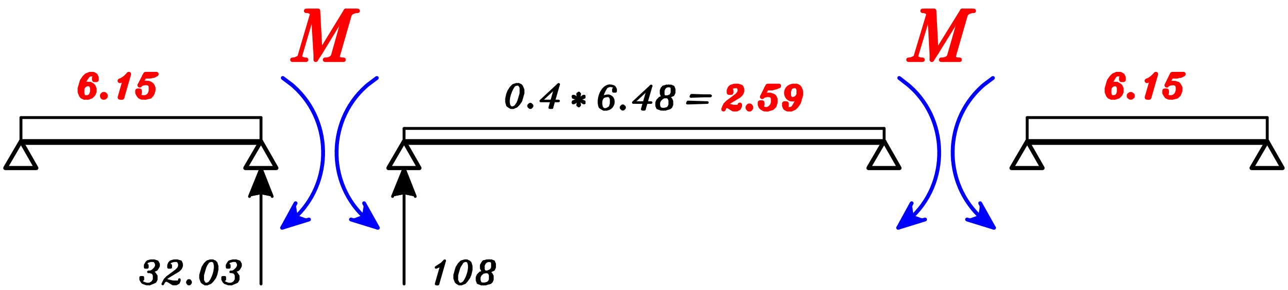
$\alpha = 0.40$

$\beta = 0.40$



Strip ①



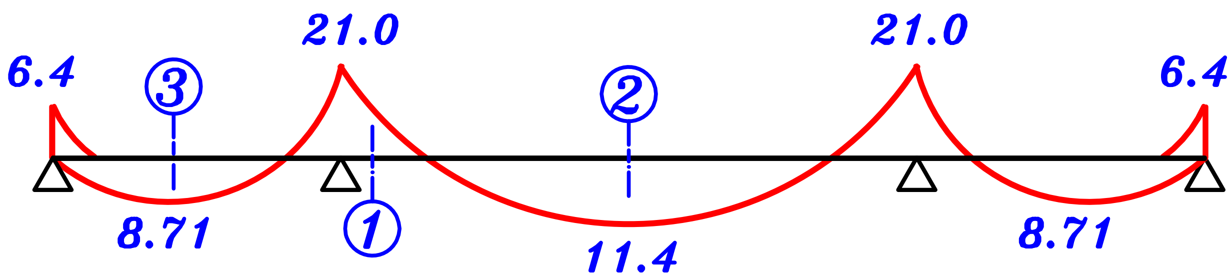


Use 3 Moment Equation.

$$M_1(L_1) + 2M_2(L_1 + L_2) + M_3(L_2) = -6\ (r_1 + r_2)$$

$$0.0 + 2M(5.0 + 10.0) + M(10.0) = -6\ (32.03 + 108)$$

$$M = -21.0\ kN.m\backslash m'$$



Sec. ① — 2ϕ16\rib

Sec. ② — 2ϕ12\rib

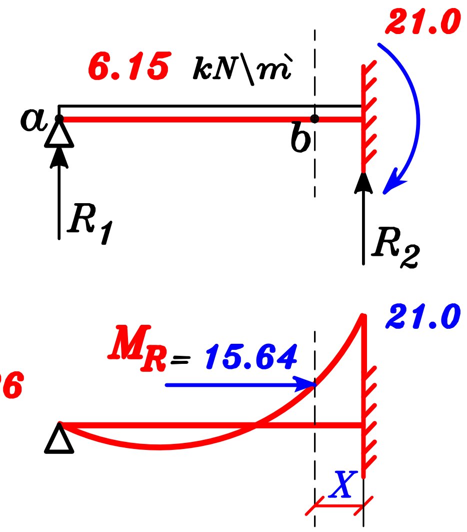
Sec. ③ — 2ϕ10\rib

Check the dimensions of the Solid Part.

$$^{2} = [\quad 94 \qquad 100)(220)^{2}] = 15649333 \ kg.cm.$$

$$< M = 21.0$$

For the one



$$2.5 - 5 R_2 =$$

$\longrightarrow$ $R_2 = 19.57 \ kN$

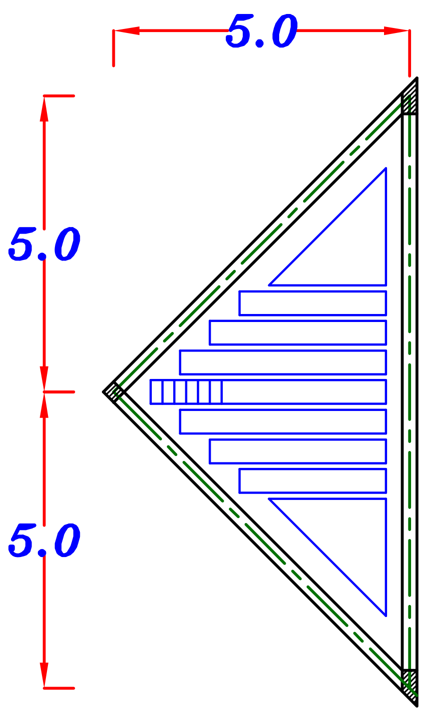
$$\therefore M_R = M_2 - R_2 (X) + w_s \frac{(X)^2}{2}$$

$$15.64 = 21.0 - 19.57 \ (X) + 6.15 \ \frac{(X)^2}{2} \longrightarrow X = 0.286$$

$\longrightarrow$ $X = 0.30 \ m.$

Arrangement of Blocks.

Short Direction.



$$L_s = 0.25 + (X_1) + (n_1)(0.2) + (1)\ (0.10)$$

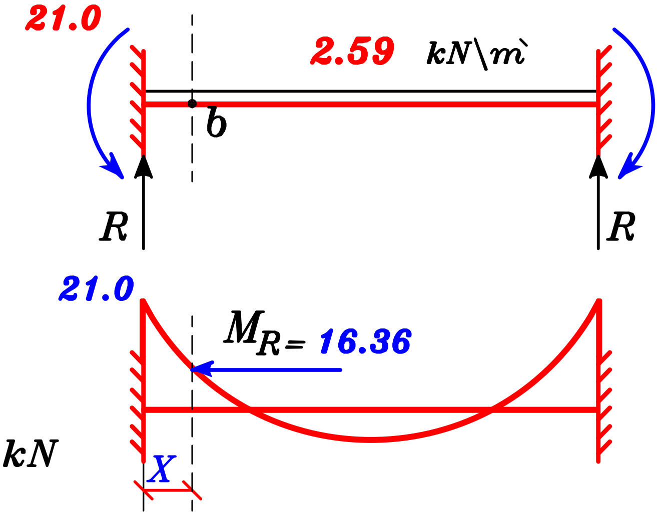
Take $X_1 = 0.30 \ m.$

$$5.0 = 0.25 + 0.30 + (n_1)(0.2)$$

$\xrightarrow{Get}$ $n_1 = 22.25$ $n_1 = 22 \ Block$

$$5.0 = 0.25 + X_1 + (22)(0.2)$$

$\xrightarrow{Get}$ $X_1 = 0.35$ $X_1 = 0.35 \ m.$



For the two way slab.

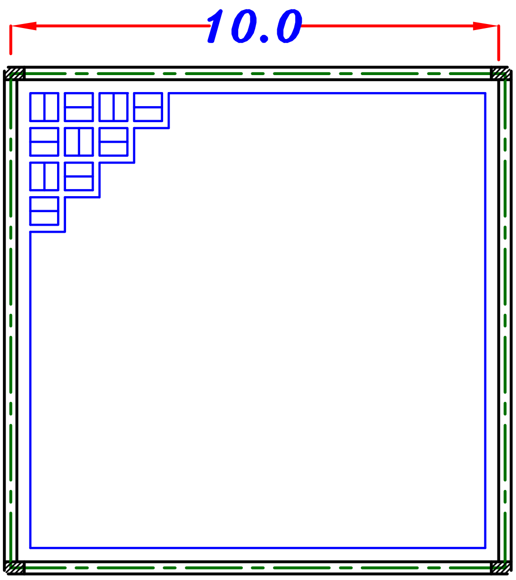
$$\because R = \frac{\sum Load}{2} = \frac{2.59 * 10}{2} = 12.95 \text{ kN}$$

$$\therefore M_R = M_2 - R\,(X) + w_s \frac{(X)^2}{2}$$

$$16.36 = 21.0 - 12.95\,(X) + 2.59\,\frac{(X)^2}{2} \longrightarrow X = 0.37$$

$$\longrightarrow \boxed{X_{min.} = 0.37 \text{ m.}}$$

Arrangement of Blocks.

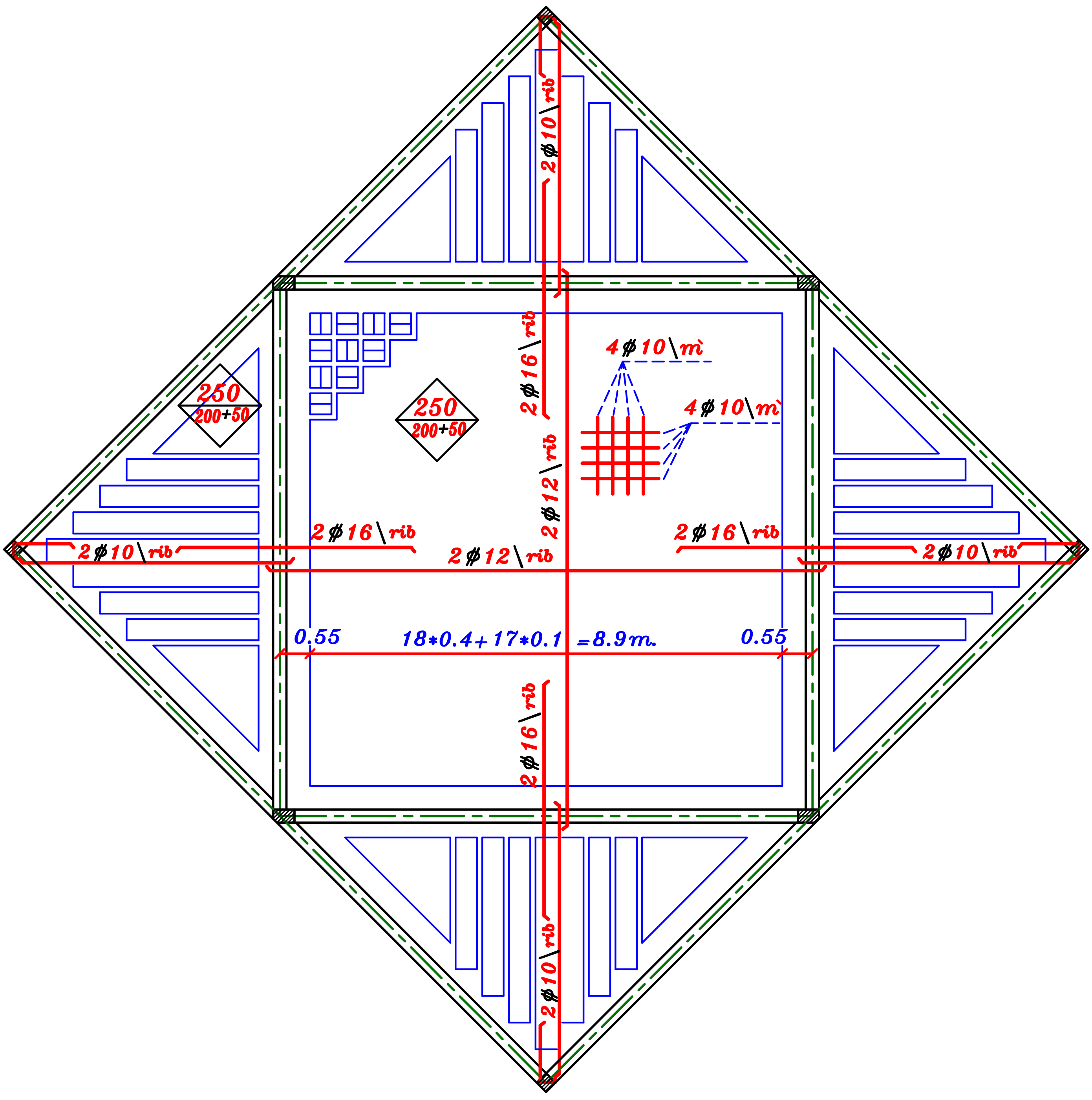


$$L = 2(X_2) + (n_2)(0.4) + (n_2 - 1)(0.10) \qquad \text{Take } X_2 = X_{min.} = 0.37 \text{ m.}$$

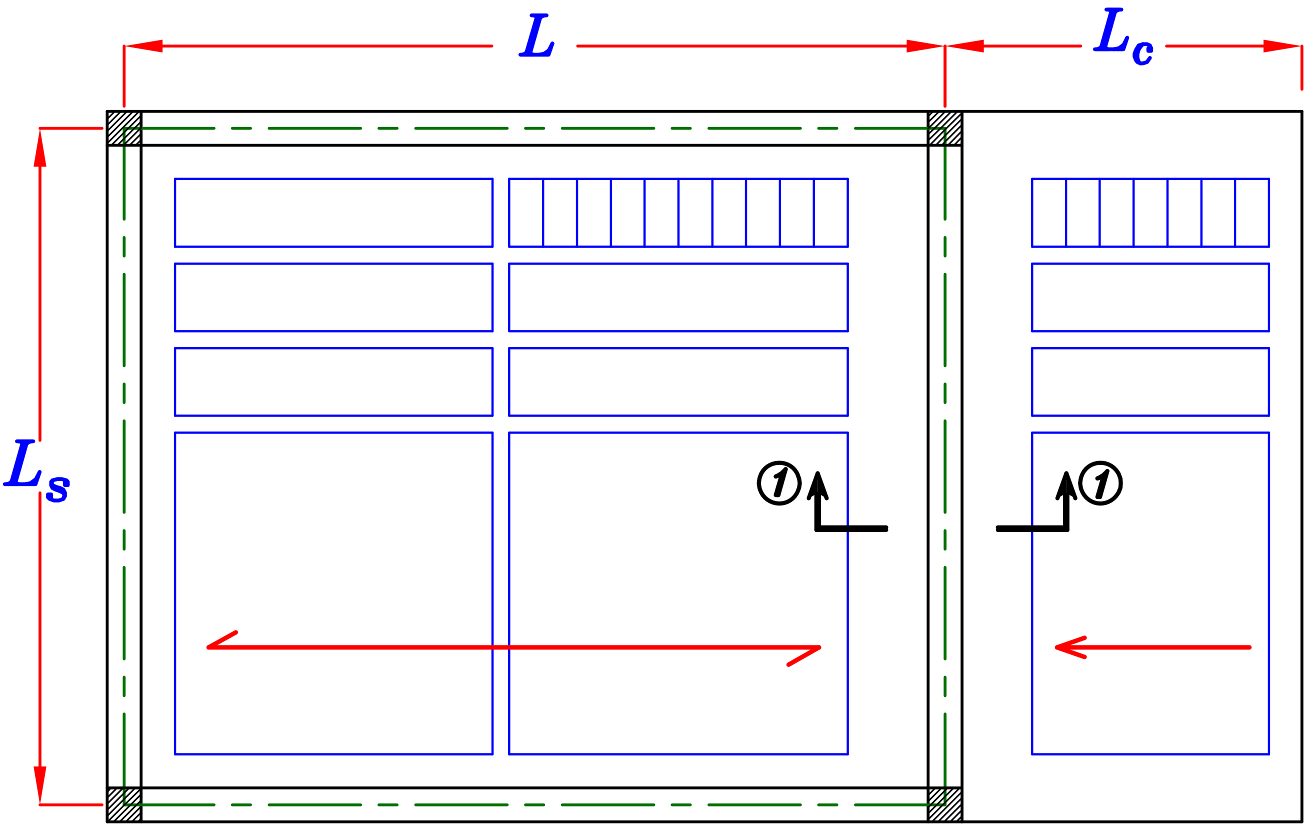
$$10.0 = 2(0.37) + (n_2)(0.4) + (n_2 - 1)(0.10) \xrightarrow{Get} n_2 = 18.72 \qquad \boxed{n_2 = 18 \text{ Block}}$$

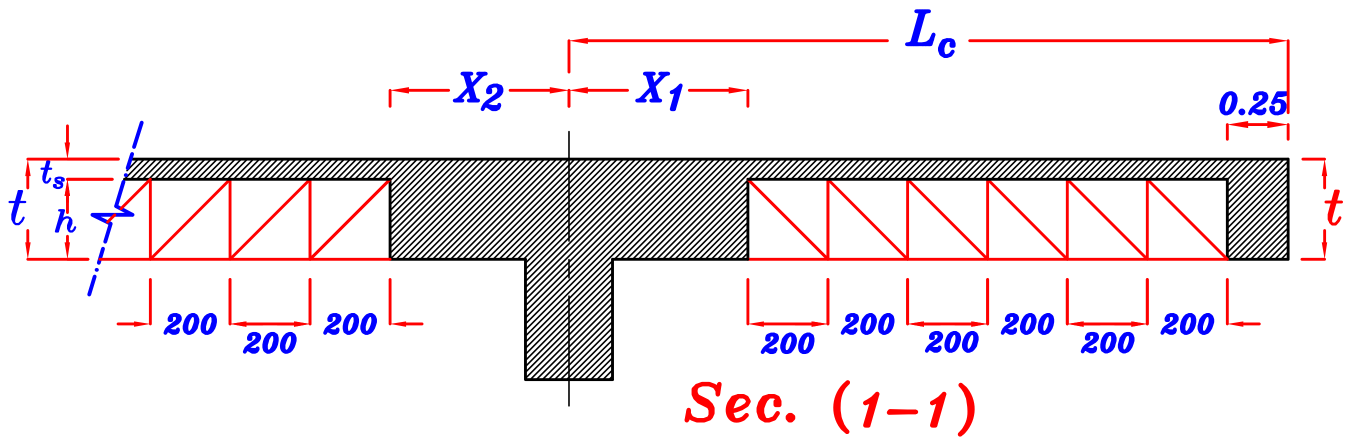
$$10.0 = 2(X_2) + (18)(0.4) + (18 - 1)(0.10) \xrightarrow{Get} X_2 = 0.55 \qquad \boxed{X_2 = 0.55 \text{ m.}}$$

RFT. of the slab in plan.



Cantilever Hollow Block Slab.





Sec. (1–1)

① Choose $t = t_s + h$

② Get the Loads on the Slab. (w_{rib}).

③ Take strip at the Load direction , and Get B.M. (kN.m\rib)

④ Design the Ribs. [Dimensions (b * h) & RFT. (2∅ ✓ \rib)].

⑤ Get the dimensions of the solid part & Arrangement of Blocks.

⑥ Draw the RFT. [Plan & Cross–Sections].

① Choose (t).

$$t = \frac{L_c}{8}$$

Check deflection قيمه (t) التى نأخذها لكى نتفادى عمل

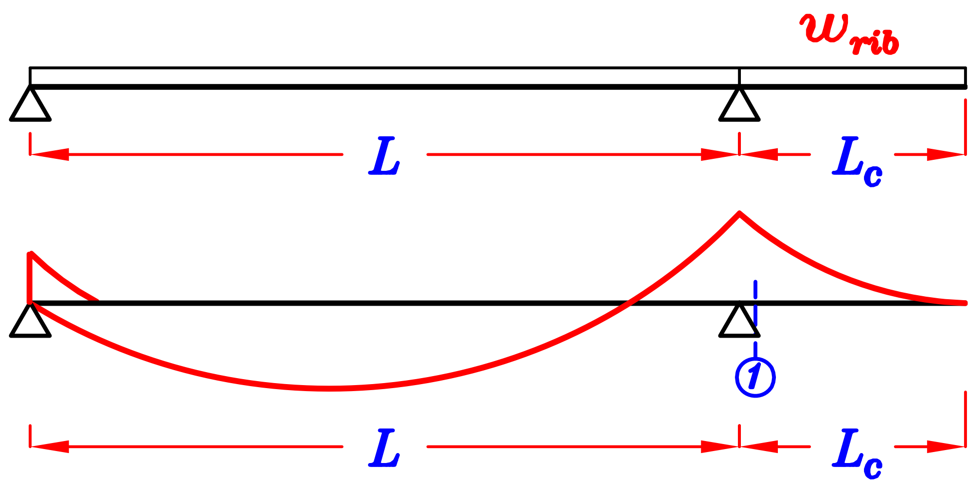
② Get the Loads on the Slab. (w_{rib}) $(kN\backslash(1.0*S)m^2)$.

$$S = e + b = 0.4+0.1 = 0.5 \ m$$

$$(w_{rib})_{U.L.} = [1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)]\,S$$

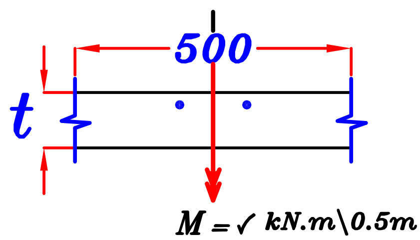
$$+1.4\,(b\,h*1.0*\gamma_c) + 1.4\,[5\,(\text{Weight of One Block})] = \checkmark\,(kN\backslash(1.0*S\ m^2))$$

③ Take strip at the Load direction , and Get B.M. $(kN.m\backslash rib)$



④ Design the Ribs. [Dimensions (b * h) & RFT. $(2\phi\checkmark\backslash rib)$].

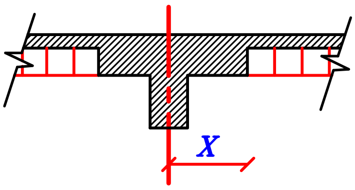
Sec. ①



$$d = t - 30\,mm = C_1\sqrt{\frac{M_{2\,(kN.m\backslash rib)}}{F_{cu}\ B}}\ , \quad B = 500\,mm \quad \text{Get } C_1 = \checkmark \longrightarrow J = \checkmark$$

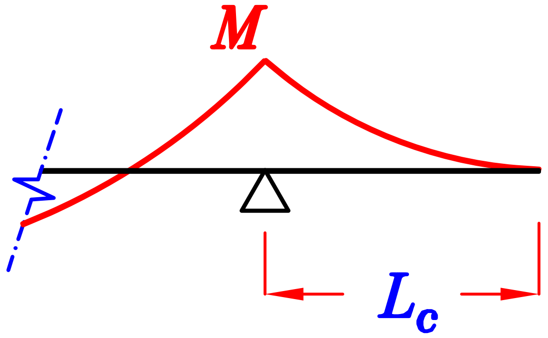
$$A_s = \frac{M}{J\,F_y\,d} = \checkmark\ mm^2\backslash rib = 2\,\phi\checkmark\,\backslash rib$$

⑤ Dimensions of the solid part & Blocks Arrangement.



($X_{min} = 250$ mm) Solid Part أقل قيمة للـ

$$M_R = \left(R_{max} \frac{F_{cu}}{\gamma_c} b\, d^2\right)$$



* IF M_R (kN.m\rib) $\geq$ M

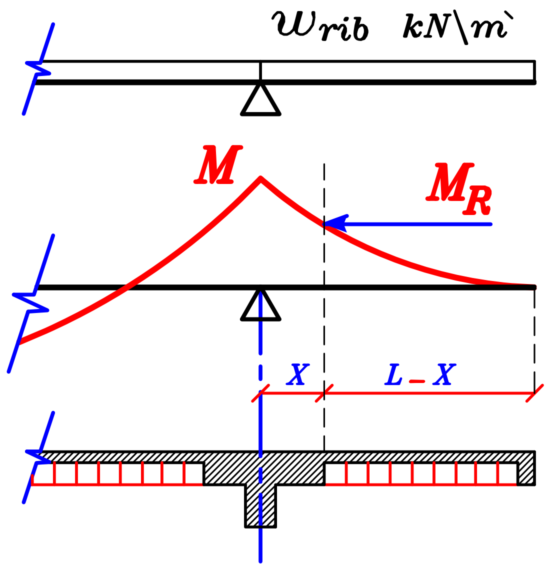
Use min. Solid Part $X = 250$ mm

* IF M_R (kN.m\rib) $<$ M

Calculate X From

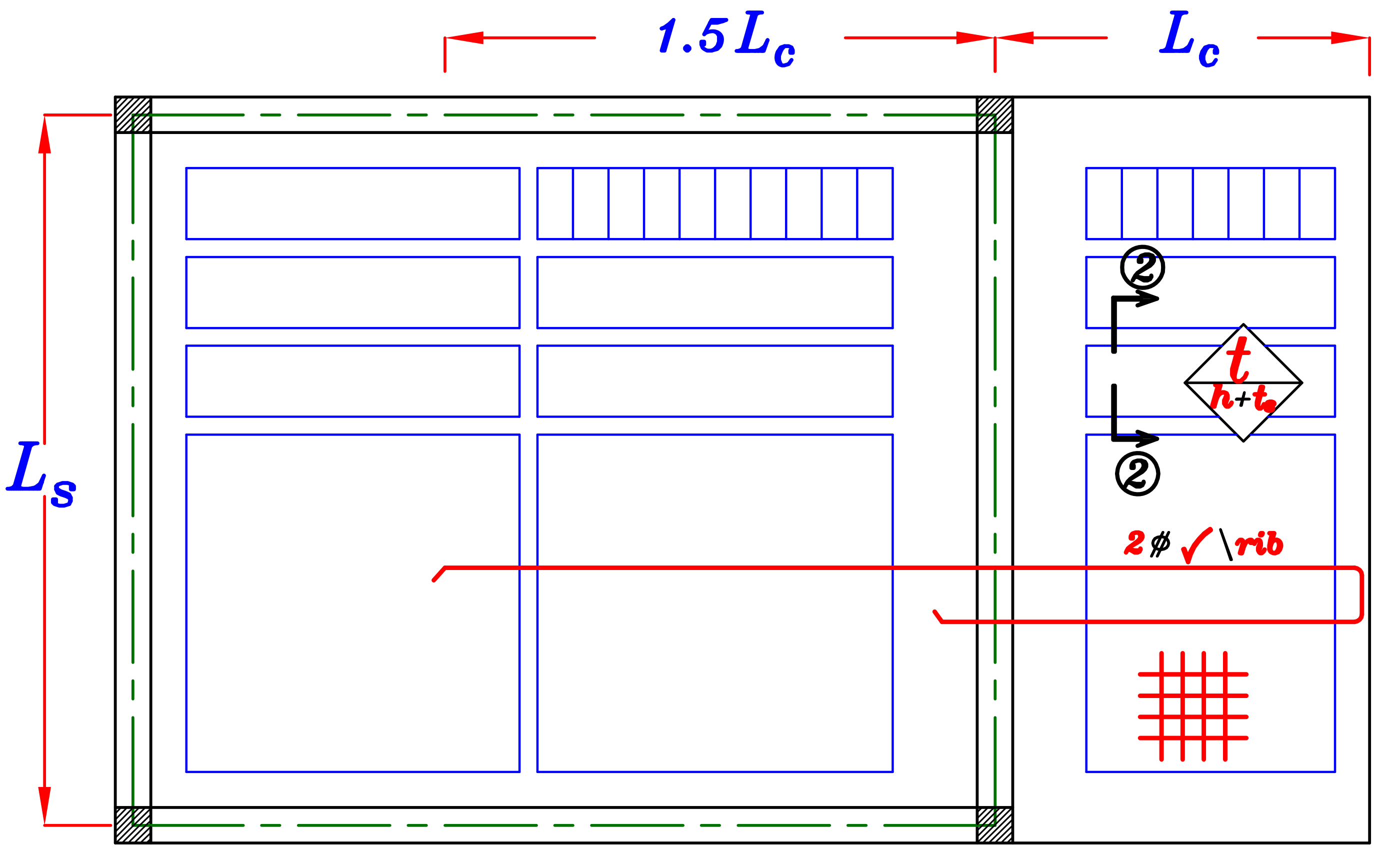
$$M_R = w_{rib} \frac{(L-X)^2}{2}$$

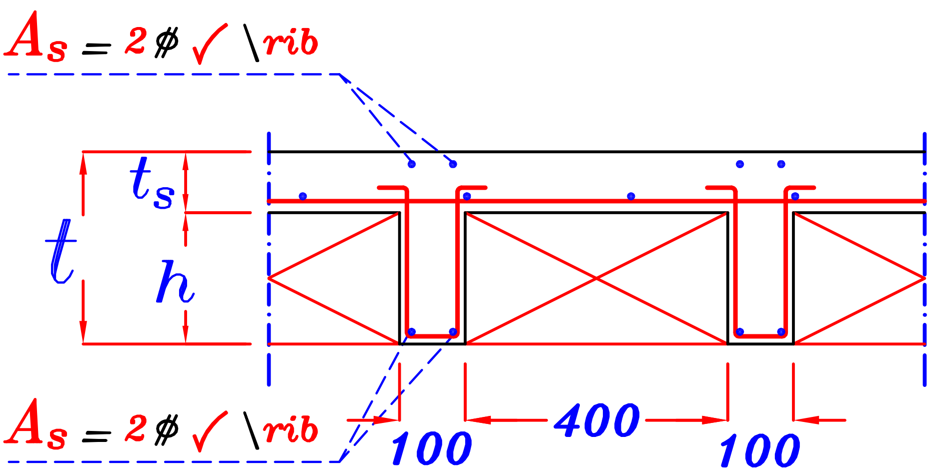
Get $X = \checkmark$ m.



Note: IF $X < 0.25$ m. $\xrightarrow{Take}$ $X = 0.25$ m.

⑧ Drawing the RFT. [Plan & Cross-Sections].

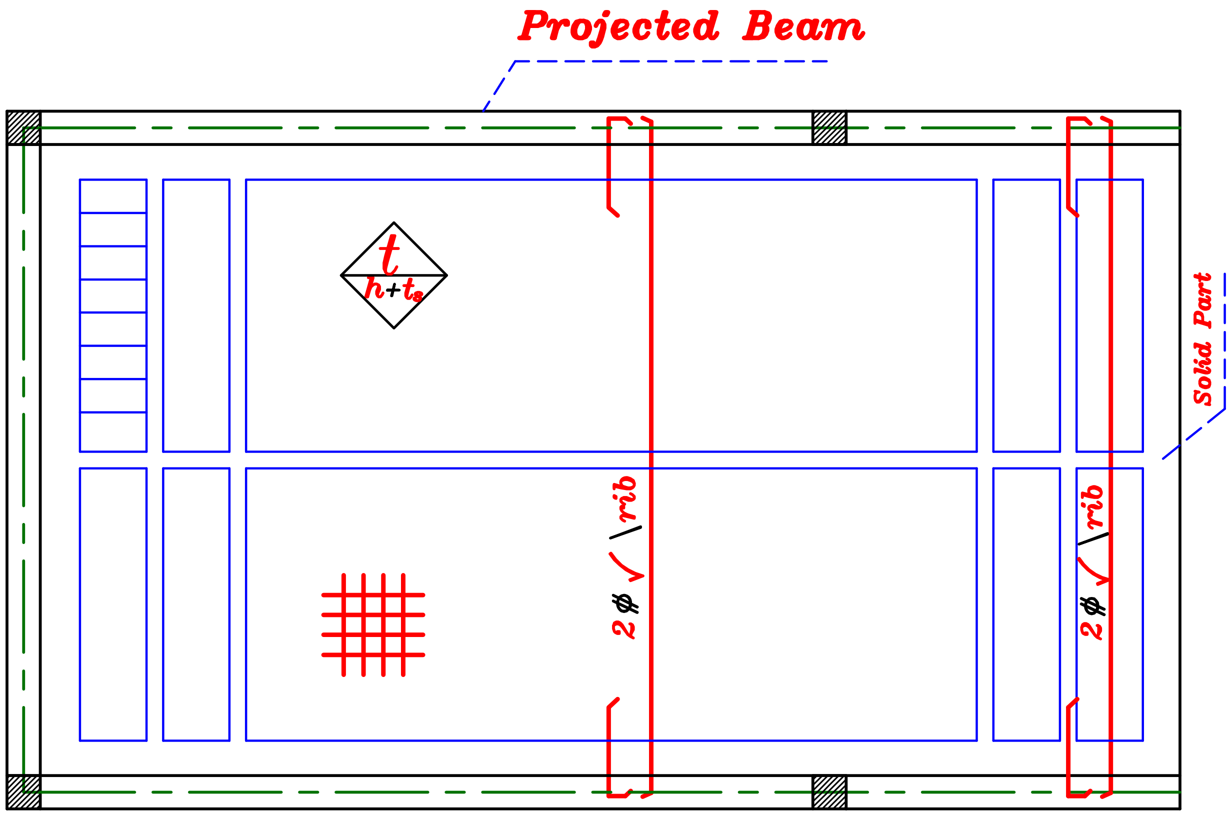


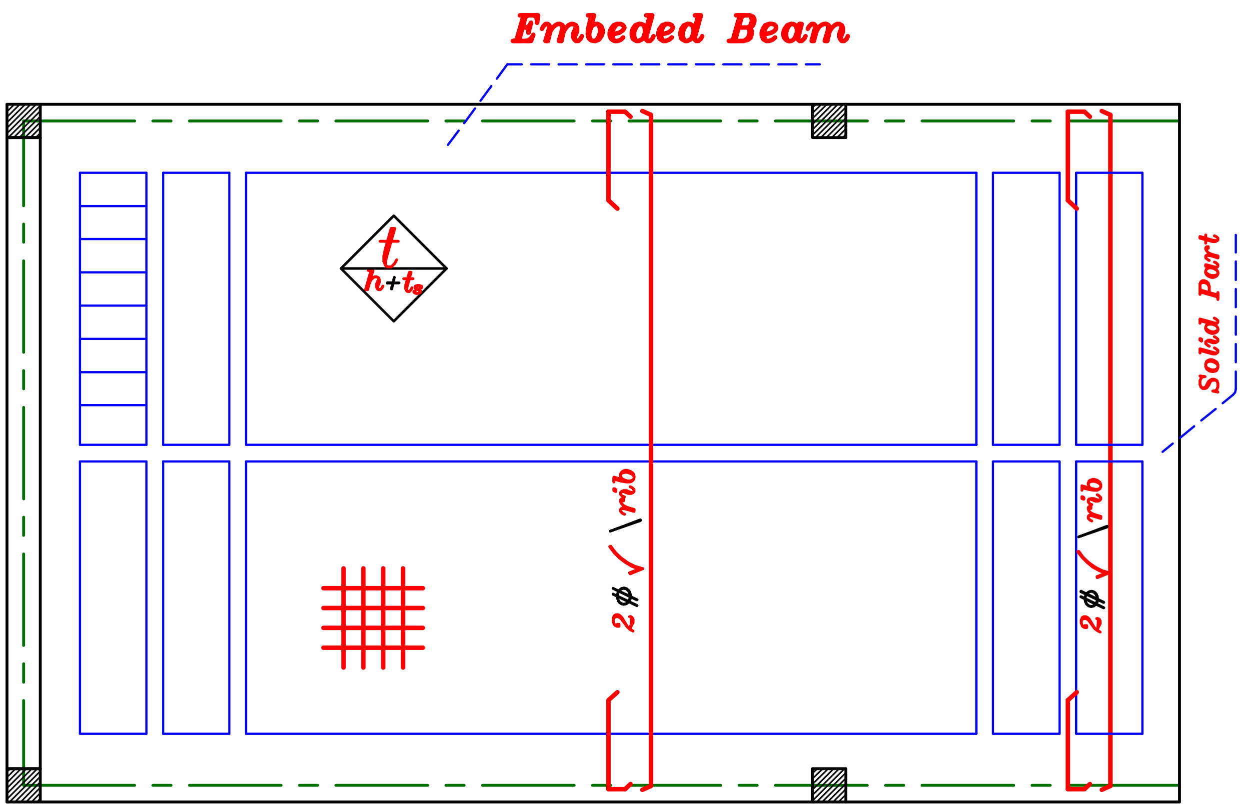


Sec. (1–1)

فكره مسأله مهمه .

ممكن فى البلكونات بدل من عمل البلاطه *Cantilever Slab*
عمل بلاطه *one way H.B. slab* فى الاتجاه الاخر .



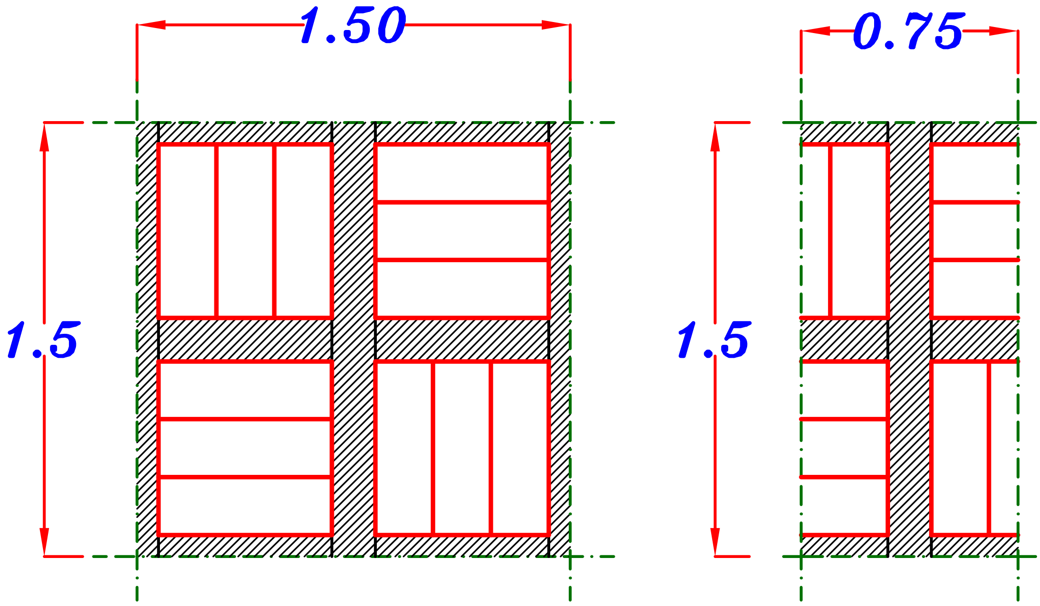


Note. For Two Way H.B.

Block Dimensions. $(200 * 600 * h)$

$S = 0.75\ m \qquad b = 0.15\ m$

$t_s = 0.06\ m$



$$(w_{rib})_{U.L.} = \left[1.4\,(t_s\,\gamma_c + F.C.) + 1.6\,(L.L.)\right] S$$
$$+ 1.4\,(b\,h * 2.7 * \gamma_c) + 1.4\,\left[6\,(\text{Weight of One Block})\right]$$

ملحوظه هامه

بعد حساب w_{rib} يتم قسمتها على ١,٥٠ حتى يكون على المتر الطولى

$$\frac{w_{rib}}{1.5}$$

Double Blocks.

أكبر مقاس معروف للبلوك $h = 250$ mm

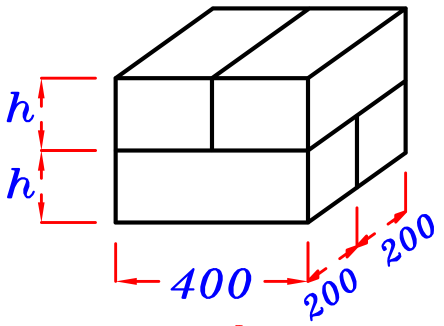
أكبر تخانه (t_s) للبلاطه الـ H.B. $t_s = 80$ mm

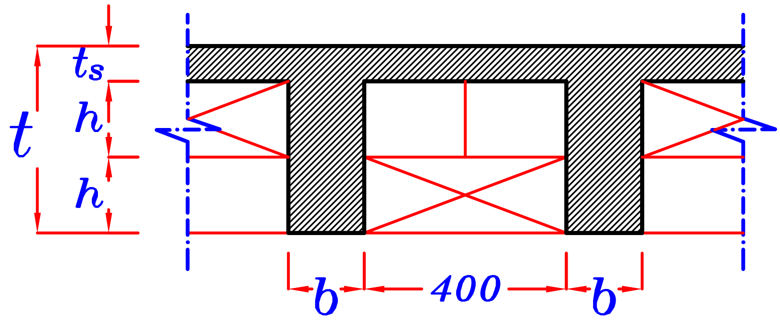
فتكون أكبر تخانه للبلاطه الـ H.B. $t = t_s + h = 80 + 250 = 330$ mm

فإذا كان الـ B.M. على البلاطه كبير جداً .

$$d = t - 30\ mm = C_1 \sqrt{\frac{M_{(kN.m\backslash rib)}}{F_{cu}\ B}} \longrightarrow C_1 < 2.78 \longrightarrow \text{Over Reinforced Sec.}$$

لذا نستخدم بلوكين كما هو موضح لزياده التخانه $t = t_s + 2h$





$\because\ b \nless \dfrac{t}{3}$

$\therefore$ IF we take $t_s = 80$ mm , $h = 200$ mm

$t = t_s + 2h = 80 + 2(200) = 480$ mm $\longrightarrow b = \dfrac{480}{3} = 160$ mm

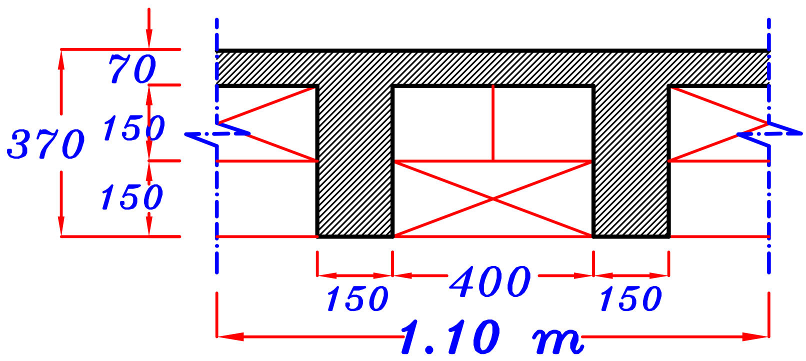
$b = 200$mm

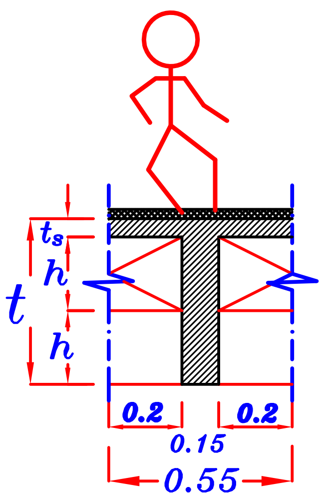
Example.

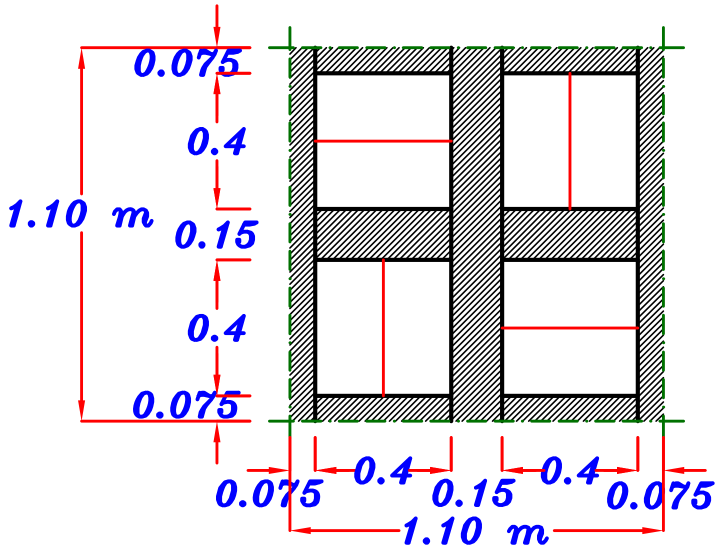
$\therefore$ IF we take $t_s = 70$ mm , $h = 150$ mm

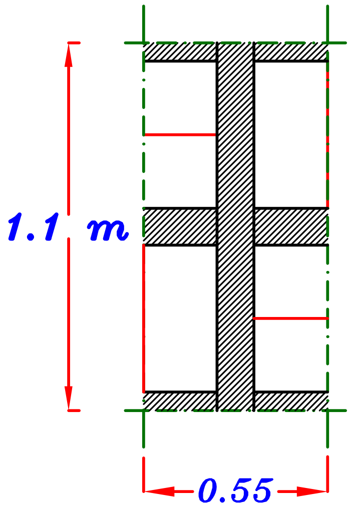
$t = t_s + 2h = 70 + 2(150) = 370$ mm $\longrightarrow b = \dfrac{370}{3} = 123.4$ mm

$b = 150$mm









$$S = e + b = 0.4 + 0.15 = 0.55 \text{ m}$$

$$(w_{rib})_{U.L.} = \left[1.4\,(t_s \gamma_c + F.C.) + 1.6\,(L.L.)\right](S * 1.1)$$
$$+ 1.4\left[b\,(2h) * 1.9 * \gamma_c\right]$$
$$+ 1.4\left[8\,(\text{Weight of One Block})\right] = \checkmark\ (kN \backslash (1.0 * S\ m^2))$$

Strip in the slab.

$$w = \frac{\alpha\, w_{rib}}{1.1} = \checkmark\ kN\backslash m'$$

$$M = \checkmark\ kN.m\backslash rib$$

$$\because t = \checkmark\ mm$$

$$\therefore d = t - 30\ mm\ (Cover) = \checkmark\ mm$$

$$\because d = C_1 \sqrt{\frac{M\ (kN.m\backslash rib)}{F_{cu}\ B}}\ , \quad B = 550\ mm$$

Get $C_1 = \checkmark \longrightarrow J = \checkmark$

$$A_s = \frac{M}{J\, F_y\, d} = \checkmark\ mm^2\backslash rib$$
$$= 2\,\phi\,\checkmark\ \backslash rib$$