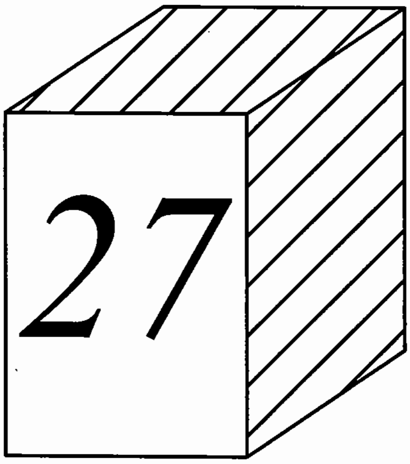
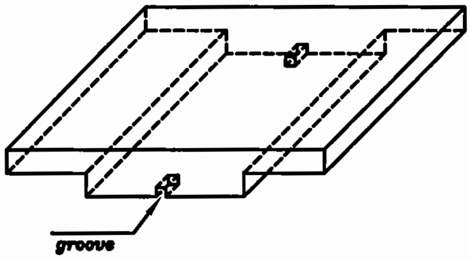
STeel رابع
انشاءات
مدني

١,٥٠

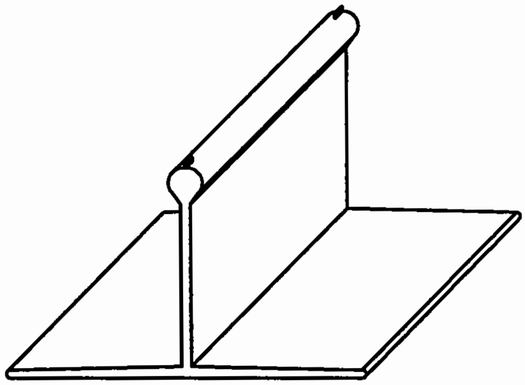


Hinged Bearing

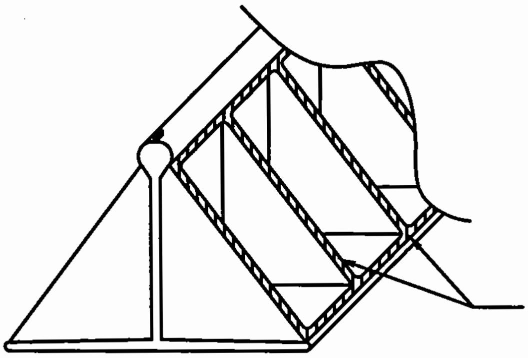
Bridge Bearing (Hinged Type)



(1) Sole Plate



(2) In the shape of the rail stiffined with ribs .



(3) Ribs for stiffen of the web.

1-Sole Plate:

يتم عمل تصميم له مثل ال Roller تماما

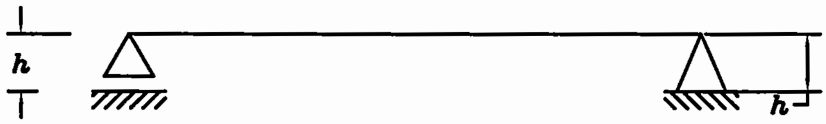
Assume L (40 to 50 cm)

$b = b_f + 8cm.$

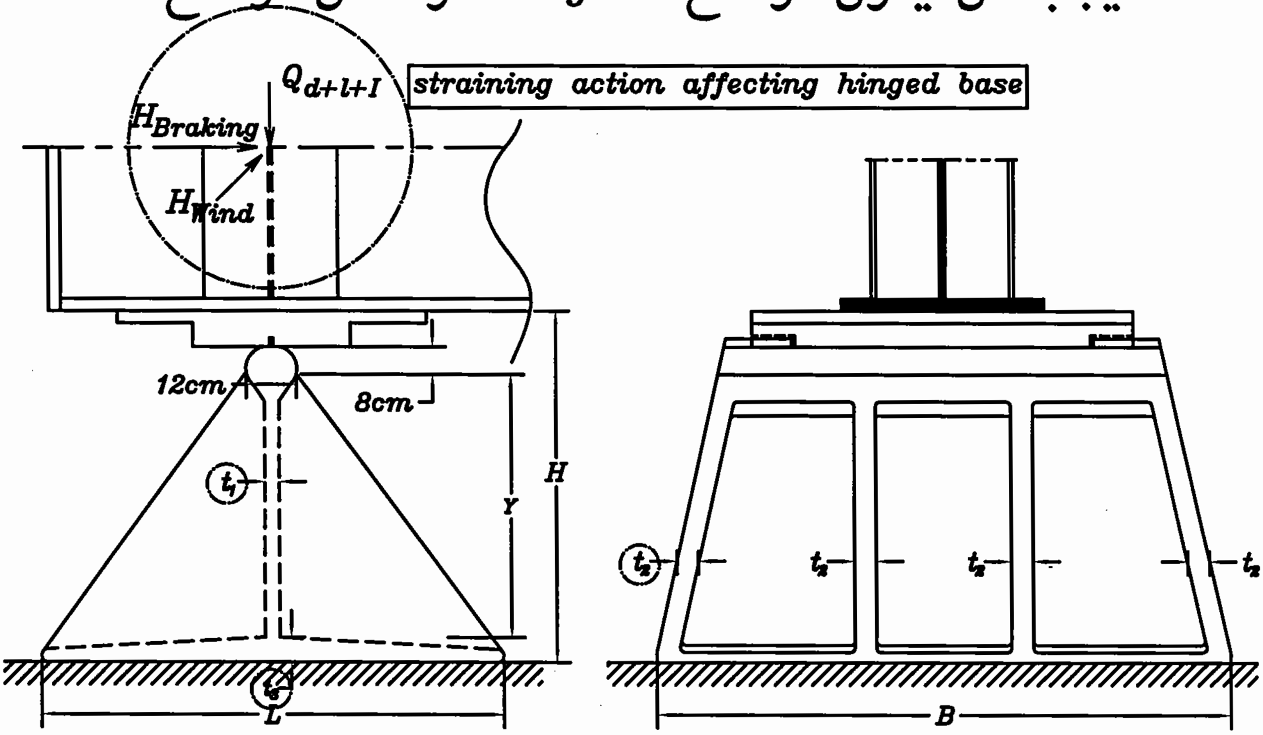
*Calculate "e" ⟶ $M = {}^{R}/_{2} * e$

Get $t_{sole\ plate} = \sqrt{\frac{6M}{b_1 * 1.8}}$

2−Block:



لاحظ انه يجب ان يكون ارتفاع ال *Hinge* هو نفس ارتفاع ال *Roller*



فى الامتحان اذا كانت *H* غير معطاة يتم فرضها بـ*40cm*.

$H_{hinged}=H_{Roller}=(t_1+t_2+t_3+d)$

- t_1 → *Sole Plate*
- t_2 → *Upper Bearing Plate*
- t_3 → *Lower Bearing Plate*
- d → *Roller*

(t_1) →	*Thickness of the Stem.*
(t_2) →	*Thickness of the Rib.*
(t_3) →	*Thickness of the Base.*

plates thikness for hinged base

Approximate dimensions are given below:

$\Sigma t_2 = B/5$ $\quad$ $t_1 = H/6-8$ $\quad$ $t_3 = H/5$

Assume dimension of the block L*B

$L \triangleq B \triangleq 1.2 b_{roller}$

$(b_{roller} = b_{flange} + 20cm.)$ ⟶ if b_{roller} not given or not calculated before

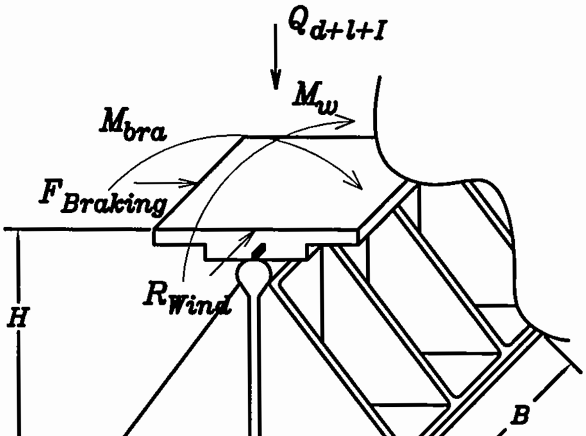
تم عمل فرض لابعاد القاعدة و على هذا يتم عمل check على ان الابعاد سليمة .

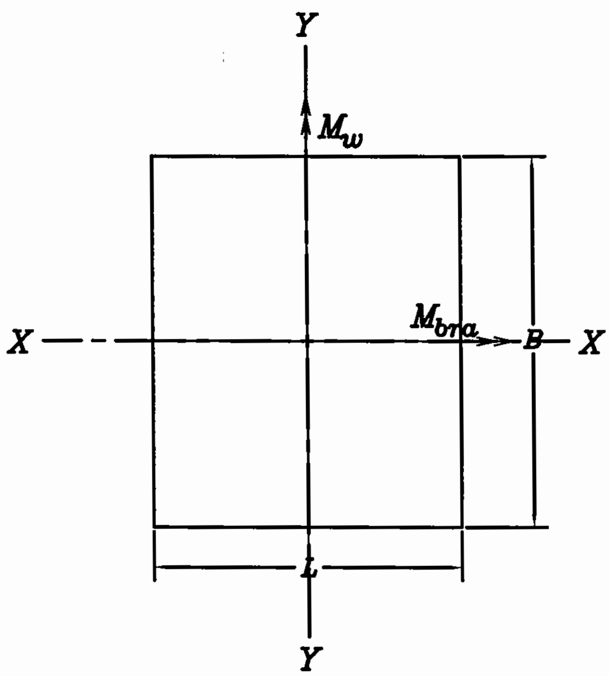
–Design of Hinged Block:

–The Hinged Block is subjected to:

(1) R=Vertical Reaction of Main Girder $= Q_{d+l+I}$

(2) $M_{Wind} = R_{Wind} * H$ $\quad$, $M_{Braking} = F_{Braking} * H$





-Calculation of R_{Wind}: (moment of wind about X-X)

a-For deck bridge with 2 bracings: (X-frame)

$R_{Wind} = R_u/2 + R_l/2$

Where $R_u = W_{u\,loaded} * L/2$, $R_l = W_{l\,loaded} * L/2$

b-For deck bridge with one bracing: (inverted U-frame)

$R_{Wind} = R/2$

Where $R = W_{loaded} * L/2$

c-For pony bridge with one bracing:

$R_{Wind} = R/2$

Where $R = W_{loaded} * L/2$

-Calculation of $R_{braking}$: (moment of braking about Y-Y)

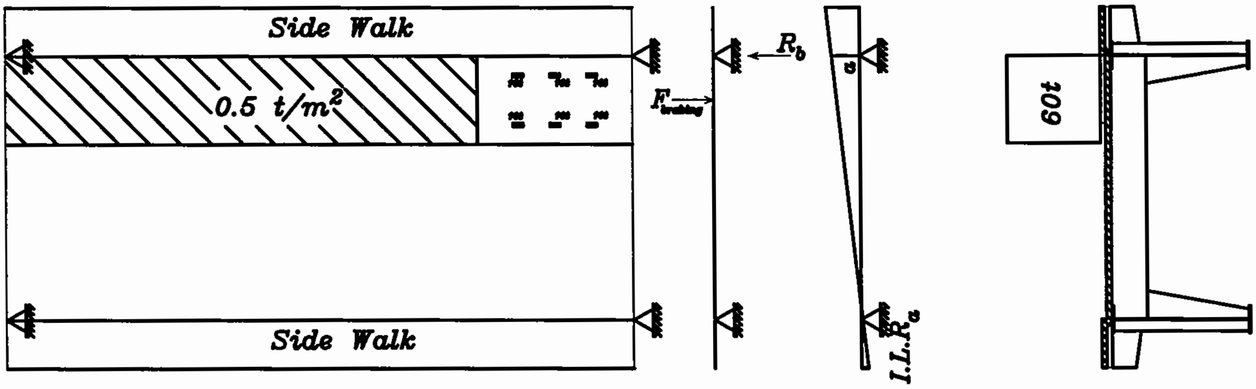
Road Way

$F_{braking} = 1/4$ (Vertical Loads of Main Lane without Impact) $< 90t$

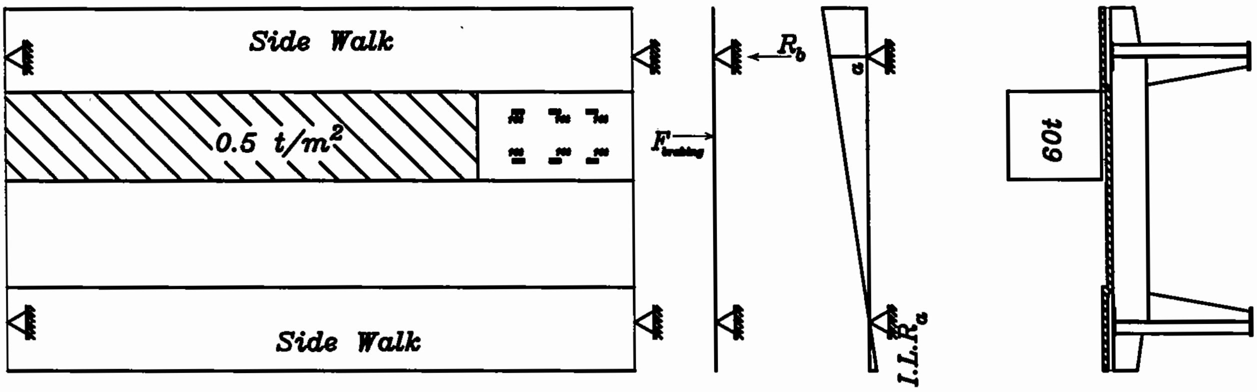
Vertical Loads of Main Lane for Roar Way=60+{(L-6)*3*0.5}

$R_{braking}$=Distribution of braking on the 2 supports as a simple beam taking into considration the critical case of loading and assume the braking force at the middle of the lain.

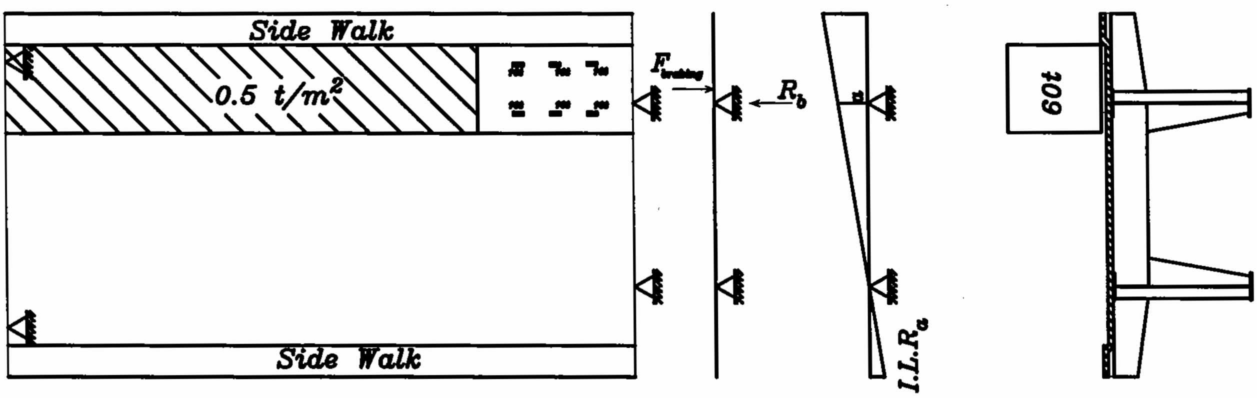
–Calculation of $R_{breaking}$ case of road way bridge



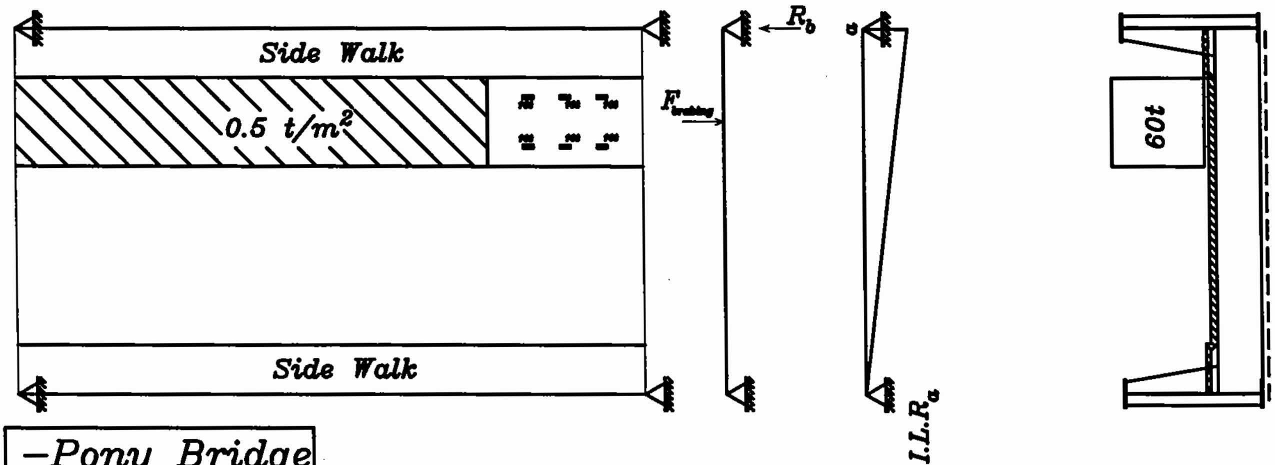
–Deck Bridge with Side Walk=Cant.



–Deck Bridge with Side Walk<Cant.ilever



–Deck Bridge with Side Walk<Cant.ilever

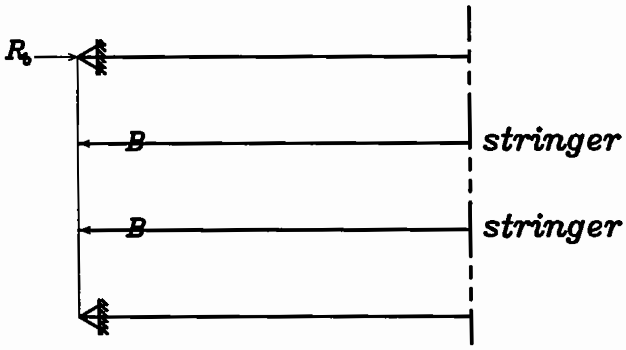


–Pony Bridge

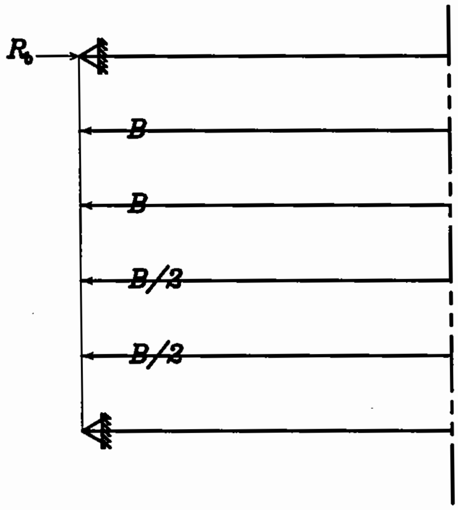
-Calculation of $R_{breaking}$ case of rail way bridge

Single track:

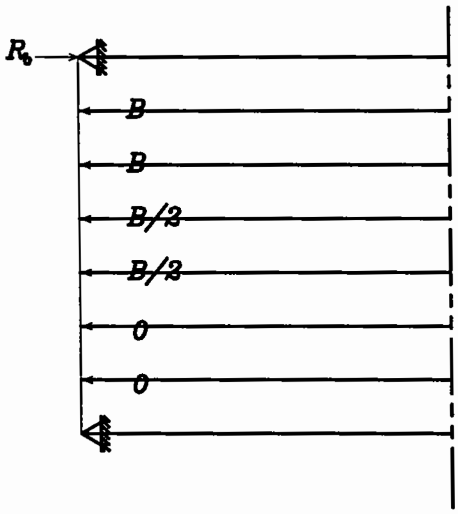
$$B = \frac{Wheel\ Loads}{7} = ...tons.$$



Double track:



Triple track:



$-$check stresses on Cocrete:

in check stresses on concrete, the effect of R_{D+L+I}, M_{Wind} and $M_{Braking}$ are appear:

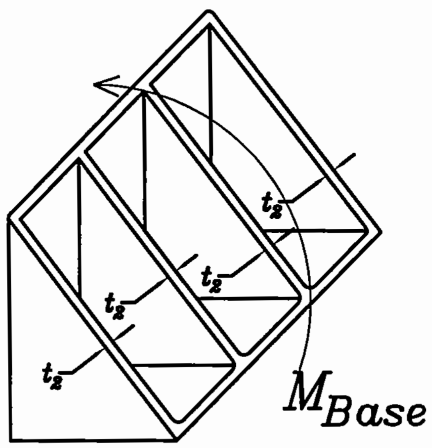
$$F_{max} = \frac{R}{L*B} + \frac{M_{wind}}{L*B^2/6} + \frac{M_{braking}}{L^2*B/6} = ...\ngtr 70Kg/cm^2$$

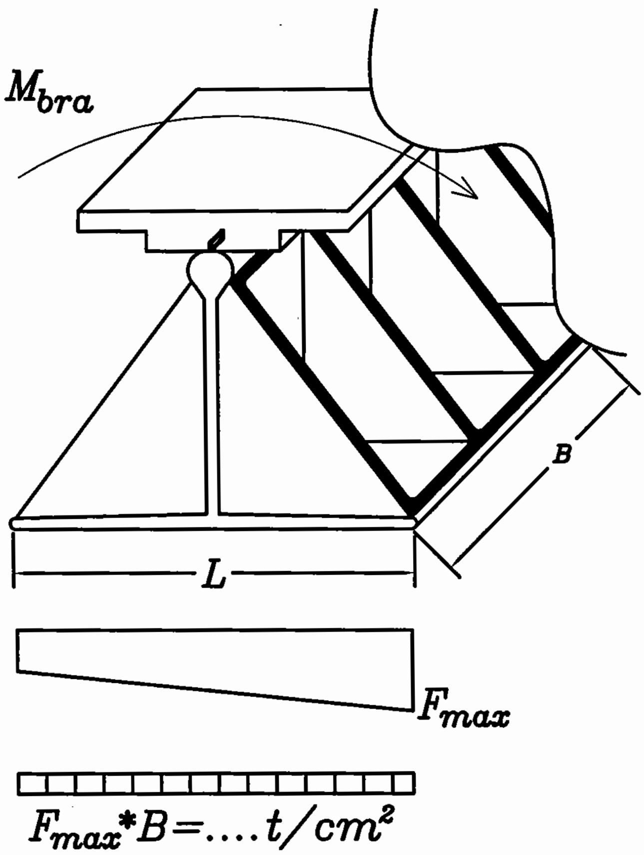
$$F_{min} = \frac{R}{L*B} - \frac{M_{wind}}{L*B^2/6} - \frac{M_{braking}}{L^2*B/6} = ...> Zero \qquad \text{(No Tension)}$$

Where L,B ⟶ Dimension of the Block.

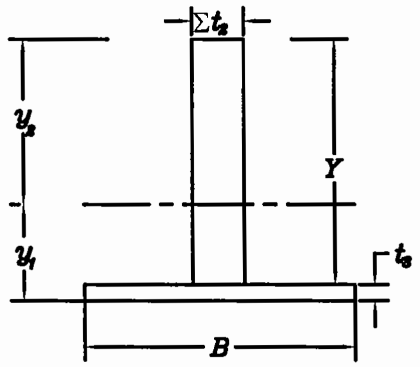
$-$check stresses on Steel Block:

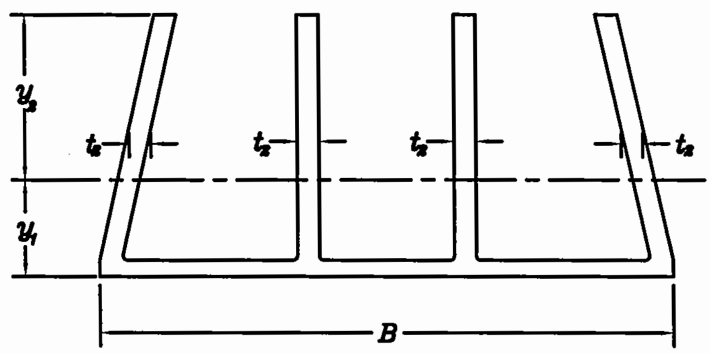
In check stresses on steel block, the effect of R_{D+L+I} and $M_{Braking}$ only while neglect the effect of wind load M_{Wind}





The previous section can be translated into the following Section





$Y=H-t_3-t_{sole\ plate}$

H ⟶ hight of roller and hinge bearing.

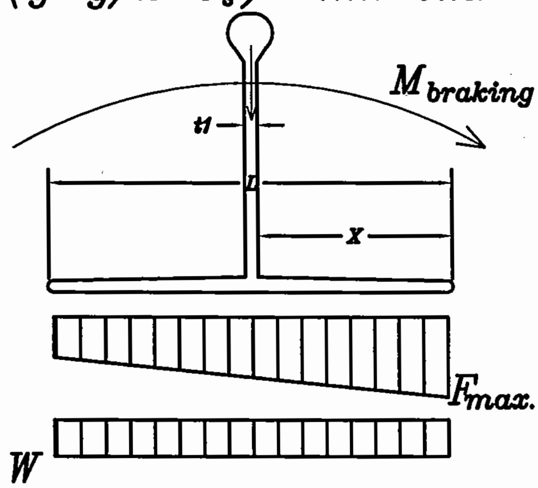
$t_{sole\ plate}$ ⟶ *is the calculated thickness of sole plate.*

$$\bar{y}=y_1=\frac{B*t_3*t_3/2+y*\Sigma t_2(y/2+t_3)}{B*t_3+y*\Sigma t_2}= ....\ cm.$$

Calculate I_x

$$I_x=\frac{Bt_3^3}{12}+Bt_3\left(y_1-\frac{t_3}{2}\right)^2+\frac{\Sigma t_2 y^3}{12}+\Sigma t_2*y*(\bar{y}-y/2-t_3) = ...\ cm^4$$

$$F_{max}=\frac{R}{L*B}+\frac{M_{braking}}{L^2*B/6}= ....\ t/cm^2$$



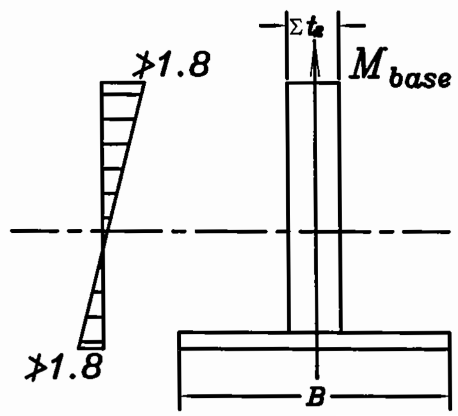
$W=F_{max}*B= ....\ t/cm'.$

$$X=\frac{L-t_1}{2}$$

$$M_{base}=\frac{W*X^2}{2}= ....\ cm.t.$$

$$f=\frac{M_{Plate}}{I_x}(y_1\ or\ y_2) \not> 1.8t/cm^2$$

ايهما اكبر



Example(3):

Design Hinged support for a pony bridge of span 35m, equivlant L.L. (including impact) is 5 t/m' and equivelant D.L. is 3t/m' , the hight of M.G. is 3.50m, the bredth of the bridge is 12.00m with 2m side walk each side, $h_{x.G.}$ =1.80m, b_f after curtailment is 25cm, F_{ou}=350Kg/cm²

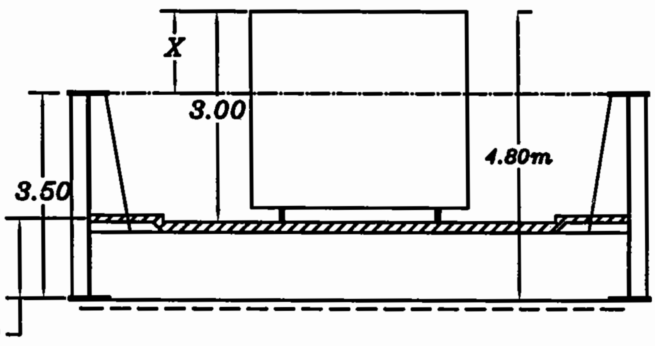
with allwable stress=75Kg/cm².

Solution:

W_t=3+5=8t/m' $\qquad R_{D+LL+I}=\frac{8*35}{2}$=140t.

M_{wind} ⟶ for case of loaded bridge

خلى بالك تم استعمال R_{D+LL+I} و سوف يتم استعمال قوى الفرملةوهذا يعنى ان الكوبرى محمل.



X=1.8+3−3.50=1.30m.

W_w =0.1(3.5+1.3)=0.48t/m'

R_w =0.48*35/2=8.40t

R_w is supported on 2 supports.

R=8.4/2=4.2 on each support.

Hight of bearing is not given so it can be assumed=40cm.

M_w =4.2*0.4=1.68m.t

F_{br} =1/4{60+(35−6)*3*0.50}=25.9t<90t.

X_1 =side walk width+1/2(width of main lane)

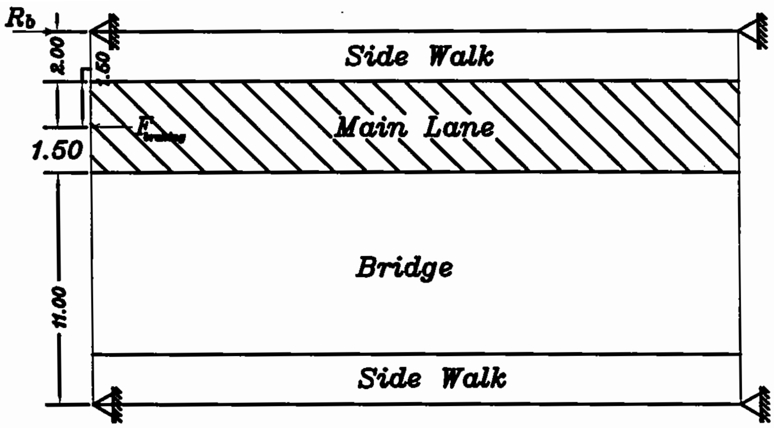
X_1 =2+1.50=3.50m.

$R_{br}=25.9*\frac{12.5}{16}$=20.23t.

M_{br} =20.23*0.4=8.10m.t

b_{roller}=25+20=45cm.

b_{hinge}=45*1.2=55cm



$$F_{\substack{max\\min}} = \frac{140}{55*55} \pm \frac{168*6}{55^3} \pm \frac{810*6}{55^3} = 0.081 t/cm^2$$

$$= 81 Kg/cm^2 > 75 Kg/cm^2 \text{ "Unsafe"}$$

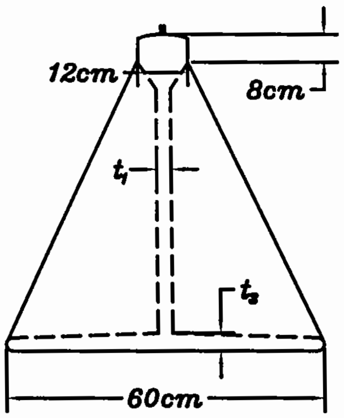
Assume base=60*60.

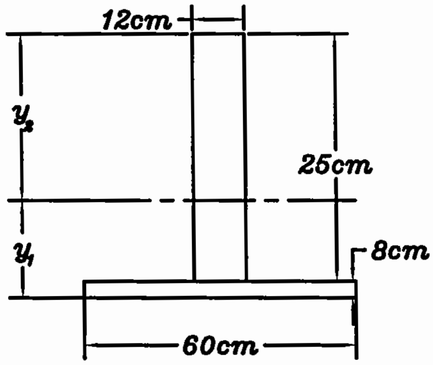
$$F_{\substack{max\\min}} = \frac{140}{60*60} \pm \frac{168*6}{60^3} \pm \frac{810*6}{60^3} = 0.066 t/cm^2$$

$F_{max} = 66 Kg/cm < 75 Kg/cm$

$F_{min} = 0.01 t/cm > Zero$

} O.K.





$t_1 = \frac{40}{6-8} = \boxed{7.0cm}$ $\Sigma t_2 = \frac{60}{5} = \boxed{12.00cm}$ $t_3 = \frac{40}{5} = \boxed{8Cm}$

Assume $t_{sole\ plate} = 7.0cm$.

$\therefore Y = 40 - 7 - 8 = 25cm$.

$$\bar{y} = \frac{60*8*4 + 25*12*(8+25/2)}{60*8 + 25*12} \quad , y_1 = 10.34cm.$$

$y_2 = 25 + 8 - 10.34 = 22.66cm$.

$$I_x = 60*\frac{8^3}{12} + 60*8*(10.34-4)^2 + \frac{12*25^3}{12} + 12*25*(25/2+8-10.34)^2$$

$I_x = 68446 cm^4$

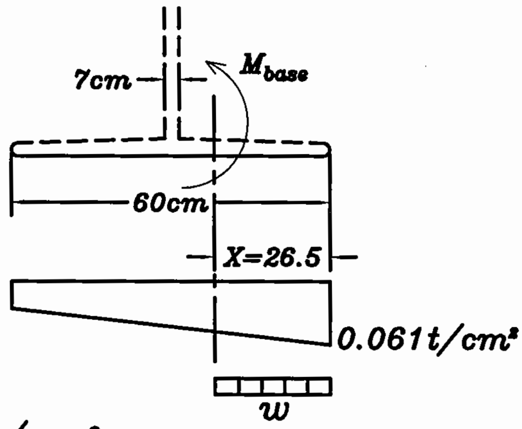
check stresses in cast steel plate:

$X = (60-7)/2 = 26.5cm.$

$F_{max} = \frac{140}{60*60} + \frac{810*6}{60^3} = 0.061 t/cm^2$

$W = 0.061*60 = 3.66 t/cm'$

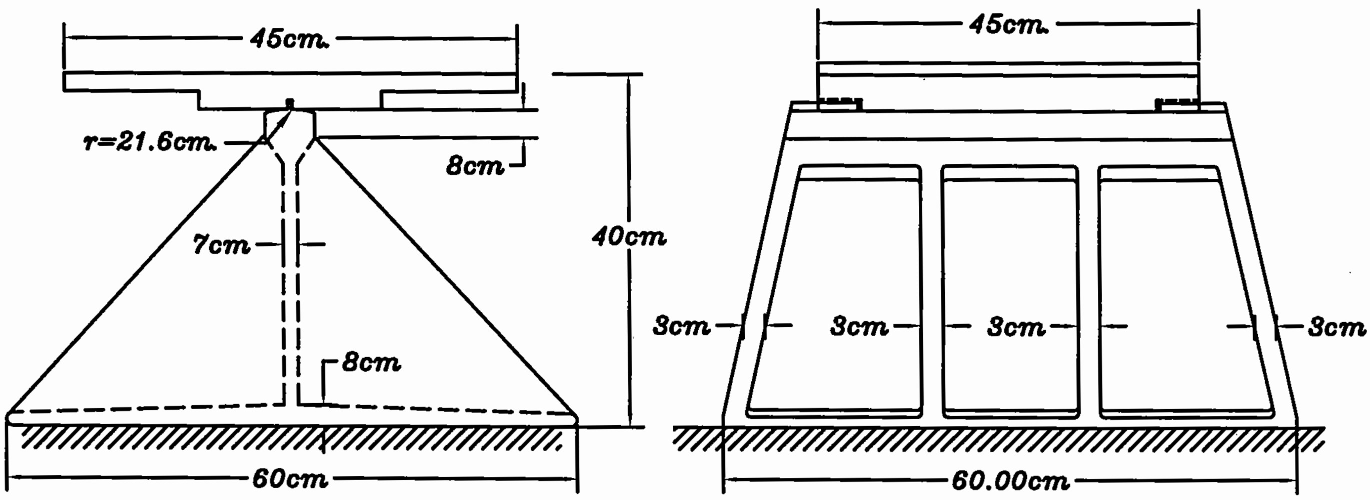
$M = \frac{3.66*26.5^2}{2} = 1285.17 cm.t.$



check

$\frac{1285.117}{68446} *22.66 = 0.425 t/cm^2 < 1.80 t/cm^2$

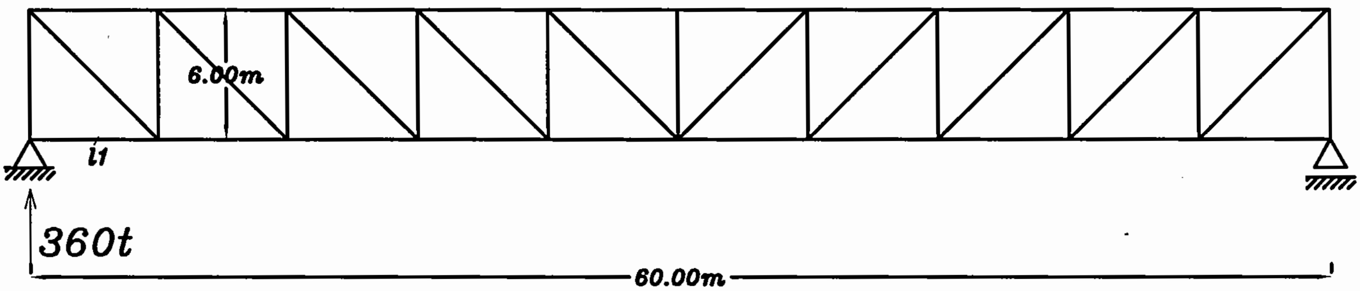
∴ O.K. Safe

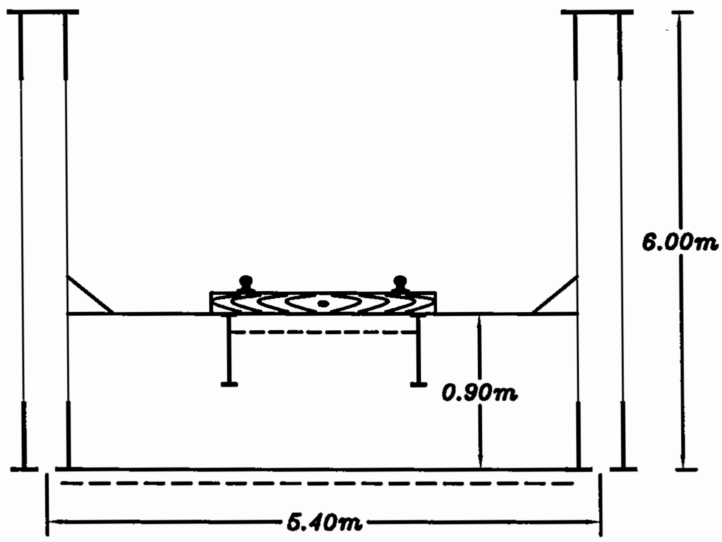


Example(4):

it is required to design hinged base for single track rail way pony bridge having a span of 60.00m and depth of main girder is 6.00m, the maximum reaction on the bearing due to total loads is 360t, roller bearing height is 52cm and dimension of roller base plate is 76cm*76cm

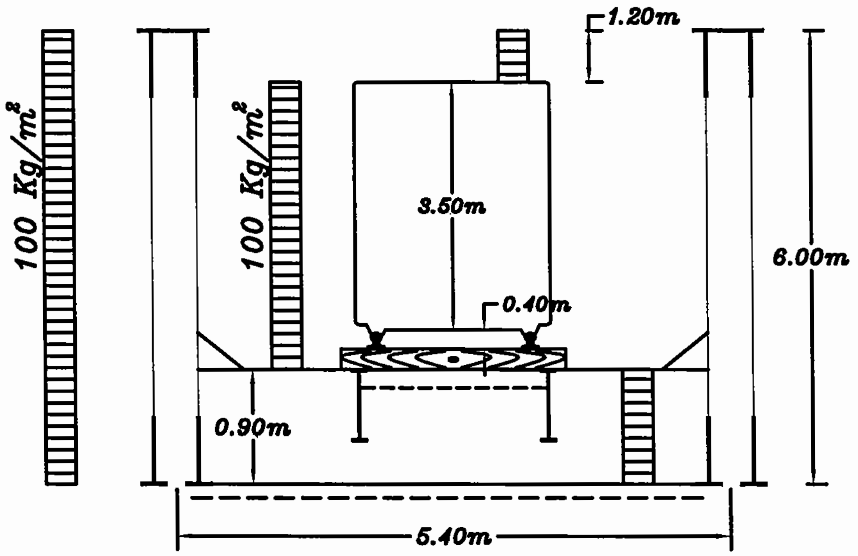
allwable concrete stress=75Kg/cm²





take thikness of sole plate = 8.00Cm

wind load



case(3): $W_w = 0.1*(0.5*6)+0.1*(3.5+0.4)+0.1*(0.5*2.1) = 0.79\ t/m'$

$$R_3 = \frac{0.79*60}{2} + 6t = 29.7t \qquad \text{(loaded case)}$$

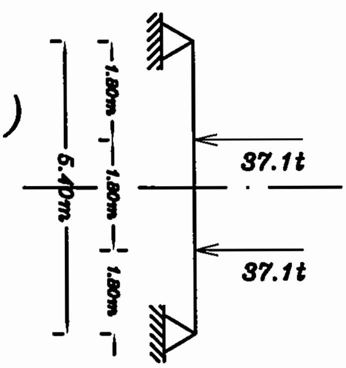
$R = 29.7/2 = \boxed{14.85t}$ on each support

height of the bearing is = 0.52m (given)

$M_w = 14.85t*0.52 = \boxed{7.7m.t}$

bracking load

$$B = \frac{\sum \text{Wheel Loads}}{7}$$



L = 9.00m(Loc.) + 8.40m(Ten.) + 10.50m(Loc.) + 8.40m(Ten.) = 36.3 m

$$\text{no. of wagons} = \frac{60.00m - 36.30m}{12.00m} = 2$$

Wagon Length

$\sum$ Wheel Loads = (50+40)*2 + 40*2 = 260t

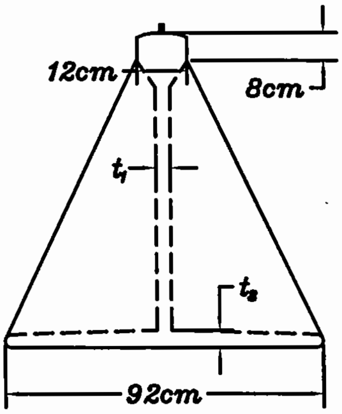
$$B = \frac{260}{7} = 37.1\ t \qquad R_b = \boxed{37.1t}$$

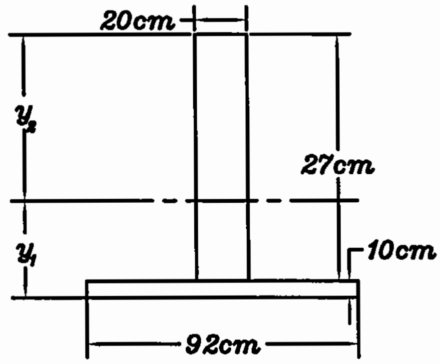
$M_{bracking} = 37.1t*0.52 = \boxed{19.3m.t}$

*hinged base dimensions = 1.2*76cm = 92Cm*

*take hinged base to be 92*92Cm*

$$F_{\substack{max\\min}} = \frac{360}{92*92} \pm \frac{770*6}{92^3} \pm \frac{1930*6}{92^3} \begin{matrix} =0.063t/cm^2 \\ =0.021t/cm^2 \end{matrix} \Bigg\} O.K.$$





$t_1 = \frac{52}{6-8} = \boxed{7.0cm}$	$\Sigma t_2 = \frac{92}{5} = \boxed{20.00cm}$	$t_3 = \frac{52}{5} = \boxed{10Cm}$

Assume $t_{sole\ plate}=7.0cm.$

$\therefore Y=52-7-8=37cm.$

$$\bar{y}= \frac{92*10*5+27*20*(10+27/2)}{92*10+27*20} \quad ,y_1=11.84cm.$$

$y_2=27+10-11.84=25.16cm.$

$$I_x=92*\frac{10^3}{12}+92*10*(11.84-5)^2+\frac{20*27^3}{12}+20*27*(27/2+10-11.84)^2$$

$I_x=156930cm^4$

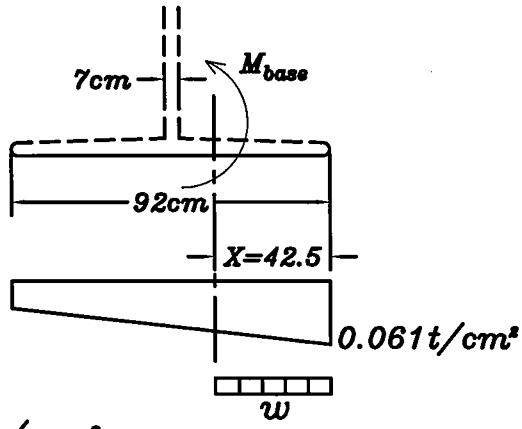
check stresses in cast steel plate:

$X=(92-7)/2=42.5cm.$

$$F_{max} = \frac{360}{92*92} + \frac{1930*6}{92^3} = 0.057t/cm^2$$

$W=0.057*92=5.28t/cm'$

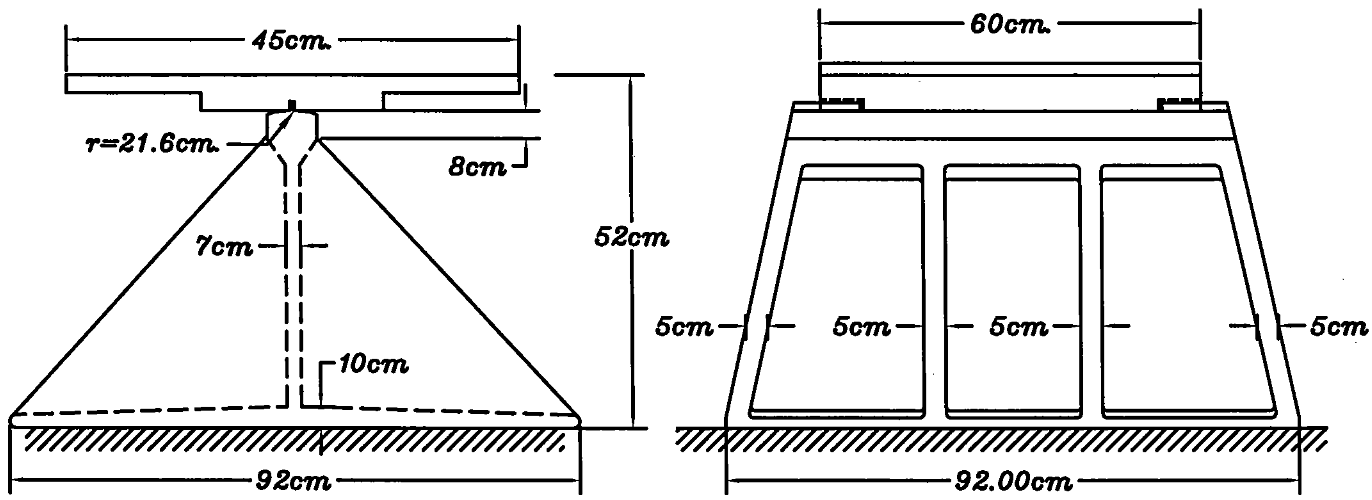
$$M= \frac{5.28*42.5^2}{2} = 4768.5cm.t.$$

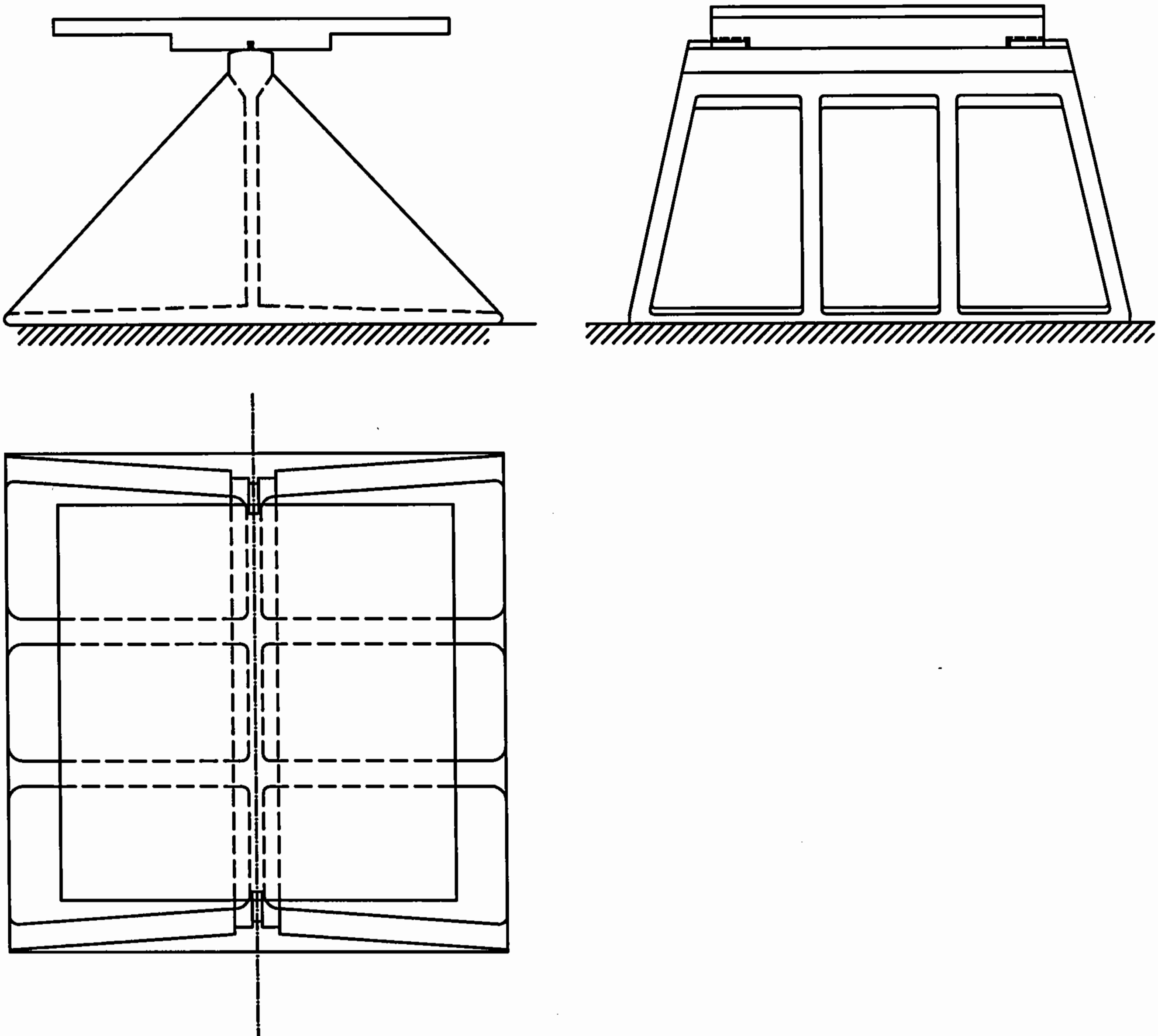


check

$$\frac{4768.5}{156930} *25.16=0.764t/cm^2 <1.80t/cm^2$$

∴ O.K. Safe





Hinged Details