Problems on Eccentric Welded (Bracket) Connections

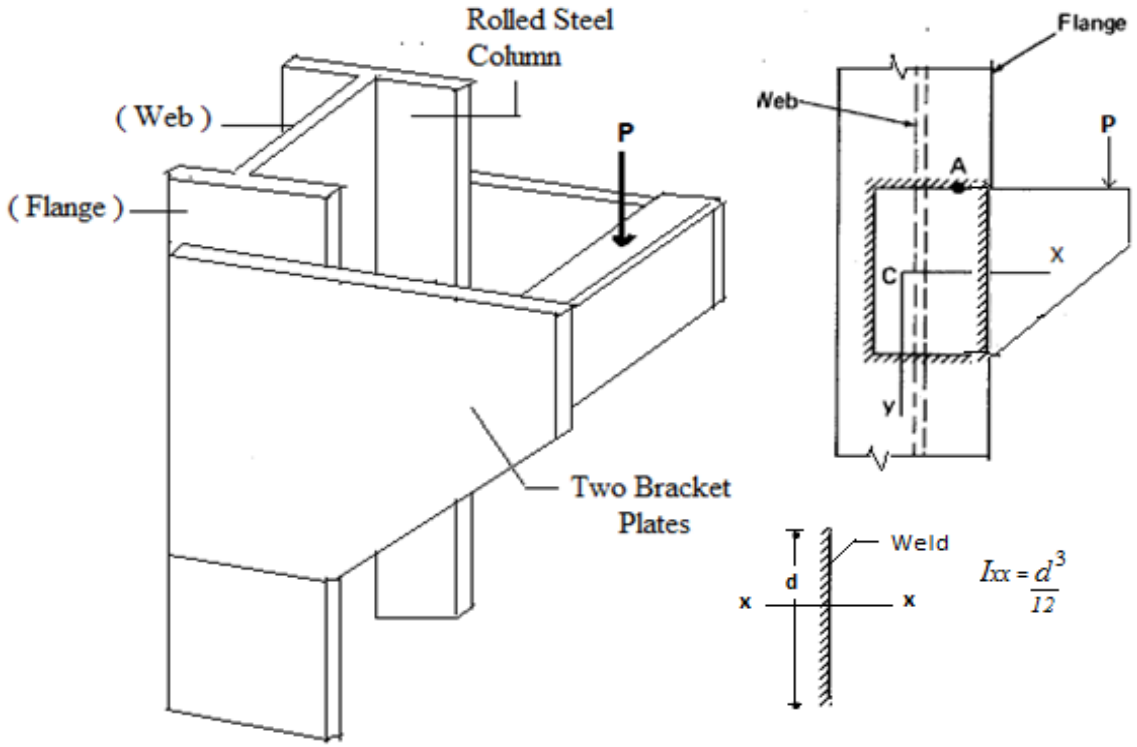
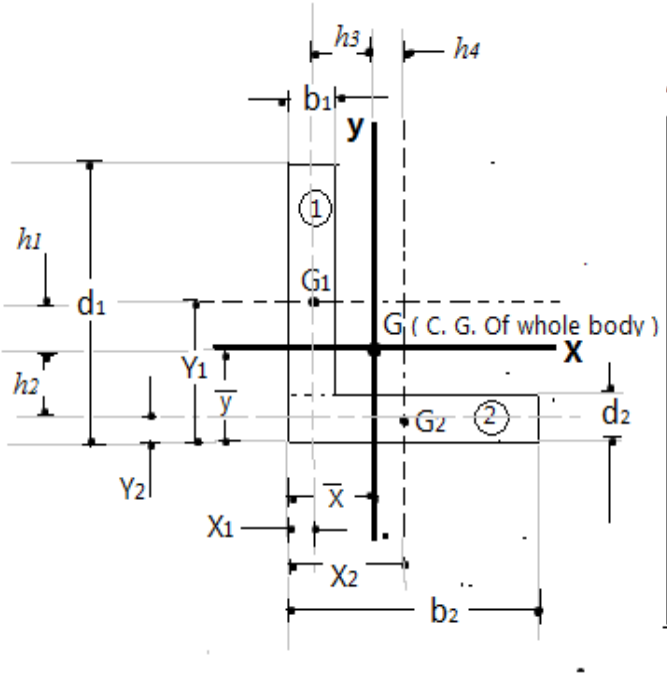


Fig. : Eccentric welded connection for Bracket



sample calculation :

To Find *Ixx* and *Iyy* of fig. given : -

$$\overline{X} = \frac{a_1 X_1 + a_2 X_2}{a_1 + a_2} \; ; \; \overline{y} = \frac{a_1 Y_1 + a_2 Y_2}{a_1 + a_2}$$

$I_{xx} = I_{xx\text{-}1} + I_{xx\text{-}2}$	$I_{yy} = I_{yy\text{-}1} + I_{yy\text{-}2}$
$I_{xx\text{-}1} = I_{xx\text{-}1\ self} + A(h_1)^2$	$I_{yy\text{-}1} = I_{yy\text{-}1\ self} + A(h_3)^2$
$I_{xx\text{-}2} = I_{xx\text{-}2\ self} + A(h_2)^2$	$I_{yy\text{-}2} = I_{yy\text{-}2\ self} + A(h_4)^2$
$I_{xx\text{-}1\ (self)} = \frac{b1 \times d1^3}{12}$	$I_{xx\text{-}2\ (self)} = \frac{b2 \times d2^3}{12}$
$I_{yy\text{-}1\ (self)} = \frac{d1 \times b1^3}{12}$	$I_{yy\text{-}2\ (self)} = \frac{d2 \times b2^3}{12}$

$A = (a_1 + a_2)$

Problem 1) : Fig. shows arrangment to support bracket plate . The load applied to a bracket is 100 KN . Find the greatest resistance offered by weld per mm length. Use 6 mm Fillet weld ?

Answer : Given a) P = 100 KN

b) H^l Distance of Centroid G of the weld group from A$(\bar{x}) = \frac{100}{2} = 50$

c) Total length of weld = 2(200) + 2(100) = 600 mm

d) eccentricity (e) $= \bar{x} + 50 = 100$ mm

f) Throat thickness of weld = t_t = 0.7 × size of weld = 0.7 × 6 = 4.2 mm

Step 1) Moment of Inertia of weld lengths :

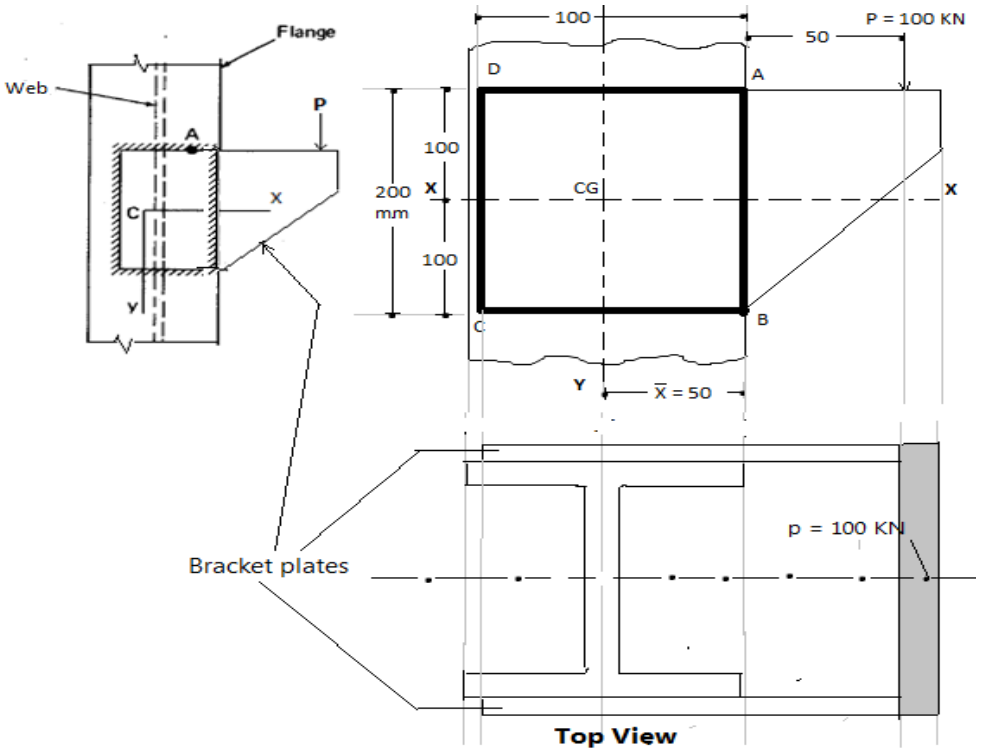
$$I_{xx} = 2\left[\frac{d^3}{12} + (100 \times 100^2)\right]$$

$$I_{xx} = 2\left[\frac{200^3}{12} + (100 \times 100^2)\right] = 3.33 \times 10^6 \text{ mm}^4$$

$$I_{yy} = 2\left[\frac{d^3}{12} + (200 \times 50^2)\right]$$

$$I_{yy} = 2\left[\frac{100^3}{12} + (200 \times 50^2)\right] = 1.167 \times 10^6 \text{ mm}^4$$

$$\therefore \; I_{xx} + I_{yy} = 4.50 \times 10^6 \text{ mm}^4$$



Step 2) Resistance against the translation per mm length of weld :

$$= \text{P/L} = \frac{Load}{Total\ length\ of\ weld} = \frac{100\times 10^3}{600} = 166.7 \quad N/mm$$

Step 3) Resistance against the rotation per mm length of weld at a distance Of r From the centroid G :

Considering pt. A ;

Resistance force against Rotation = Sa = $k_a r_a$

Where $K_a = \left(\frac{p \times e}{I_{xx} + I_{yy}} \right)$

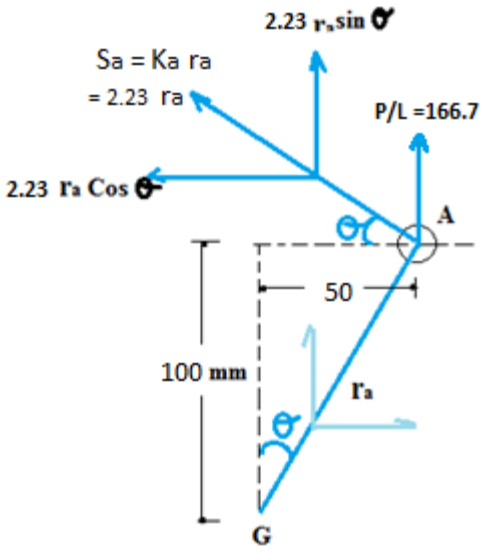
$$= \left(\frac{100 \times 10^3 \times 100}{4.50 \times 10^6} \right)$$

$= 2.23 \quad N/mm$

We have ; $\sin\theta = \left(\frac{opp.}{hypo} \right) = \left(\frac{50}{r_a} \right)$

$\therefore \quad r_a \times \sin\theta = 50$

$\therefore \quad r_a \times \cos\theta = 100$



Total Vertical component at A (V) =

166.7 + 2.23 $r_a \sin\theta$ = 166.7 + (2.23 × 50)

$\therefore$ V = 278.2 N

Total Horizontal component at A (H) = 2.23 $r_a \times \cos\theta$ = 2.23 × 100

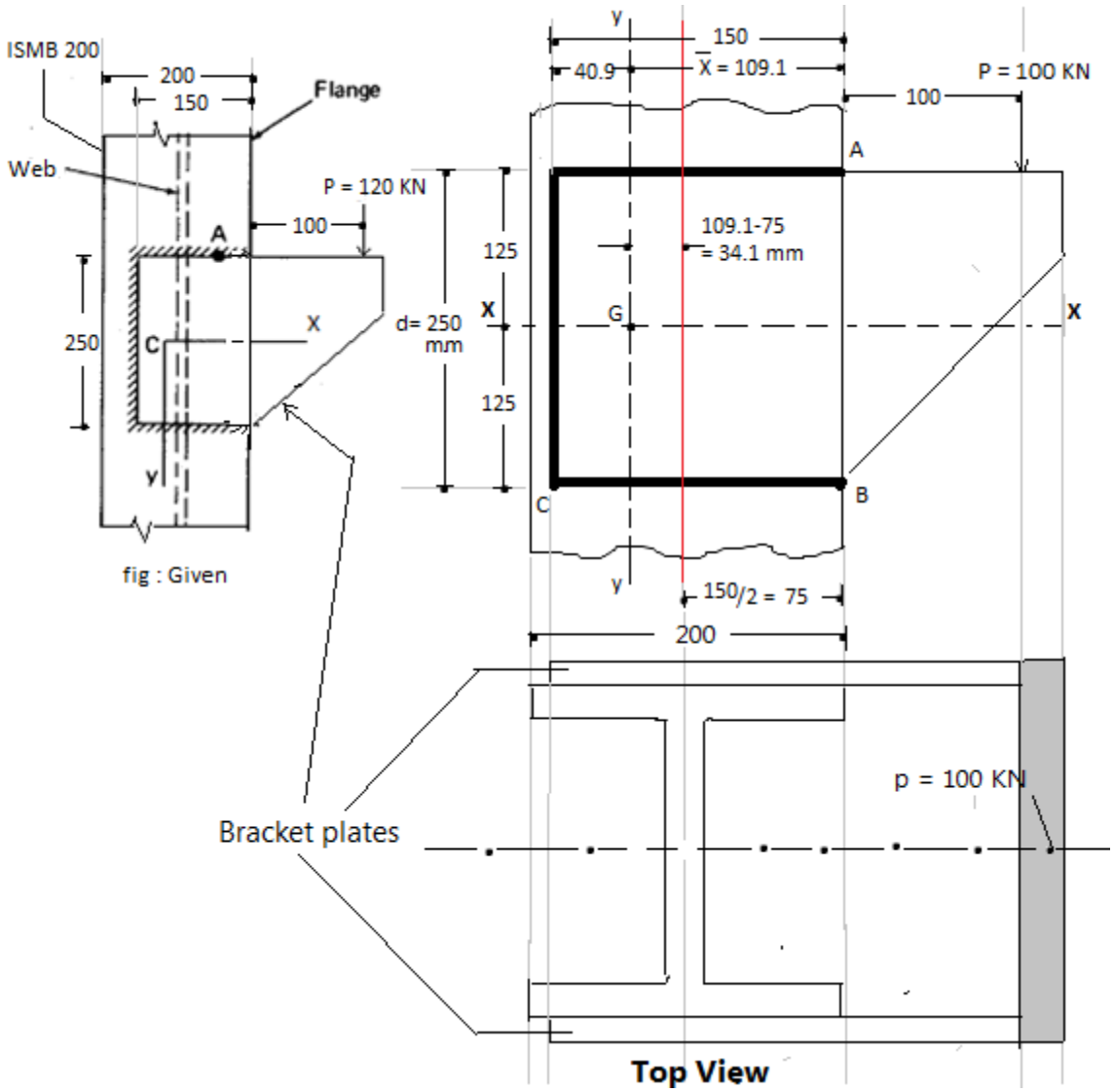
H = 223 N

Resultant Resistance offered at A = $\sqrt{V^2 + H^2}$

A = $\sqrt{278.2^2 + 223^2}$ = 356.54 N

Problem 2) : A Bracket plate shown in figure welded to flange of an ISMB 200 column has to support a factored load of 120 KN. Determine size of weld required ?

Answer :



Given a) P = 100 KN

b) H^l Distance of Centroid G of the weld group from A

$$(\bar{x}) = \frac{b(b+d)}{b+(b+d)} = \frac{150(150+250)}{150+(150+250)} = 109.1 \text{ mm}$$

c) Total length of weld = 2(150) + 250 = 550 mm

d) eccentricity (e) $= \bar{x} + 100 = 209.1$ mm

Step 1) Moment of Inertia of weld lengths :

$$I_{xx} = \frac{d^3}{12} + 2(150 \times 125^2)$$

$$I_{xx} = \frac{250^3}{12} + 2(150 \times 125^2) = 5.989 \times 10^6 \text{ mm}^4$$

$$I_{yy} = 2\left[\frac{d^3}{12} + 150\,(109.1 - 75)^2\right] + (250 \times 40.9^2)$$

$$I_{yy} = 2\left[\frac{150^3}{12} + 150\,(109.1 - 75)^2\right] + (250 \times 40.9^2)$$

$$= 1.329 \times 10^6 \text{ mm}^4$$

$$\therefore I_{xx} + I_{yy} = 7.31 \times 10^6 \text{ mm}^4$$

Step 2) Resistance against the translation per mm length of weld :

$$= \text{P/L} = \frac{Load}{Total\ length\ of\ weld} = \frac{120 \times 10^3}{550} = 218.18 \quad N/mm$$

Step 3) Resistance against the rotation per mm length of weld at a distance Of r From the centroid G :

Resistance force against Rotation = Sa = $k_a r_a$

Where $K_a = \left(\frac{p \times e}{I_{xx} + I_{yy}}\right) = \left(\frac{120 \times 10^3 \times 209.1}{7.31 \times 10^6}\right)$

$= 3.428$

We have ; $\sin\theta = \left(\frac{opp.}{hypo}\right) = \left(\frac{109.1}{r_a}\right)$

$\therefore \quad r_a \times \sin\theta = 109.1$

$\therefore \quad r_a \times \cos\theta = 125$

Total Vertical component at A (V) =

$218.18 + 3.428\ r_a \sin\theta = 218.18 + (3.428 \times 109.1)$

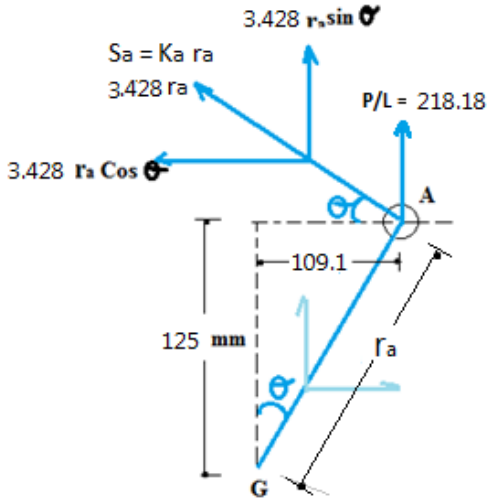
$(V) = 592.17 \quad {}^{N}/_{mm}$

Total Horizontal component at A $(H) = 3.428\ r_a \cos\theta = 3.428 \times 125$

$H = 428.5 \quad N$

Resultant Resistance offered at A = $\sqrt{V^2 + H^2}$

$A = \sqrt{592.17^2 + 428.5^2} = 730.94 \quad N$



Step 4) Design stress for weld = $\frac{f_{up}}{\sqrt{3}\,\gamma}$ ……10.5.7 ; Pg 79

$= \frac{410}{\sqrt{3} \times 1.25} = 189.37 \quad {}^{N}/_{mm^2}$

∴ Design strength of weld per mm length = $189.37 \times 1 \times 0.7$ s

$132.58 \times S = 189.37$

∴ $S = 5.51$ mm say 6 mm size of weld

Problem 3) : A Bracket plate shown in figure welded to flange of an ISMB 200 column has to support a factored load of P . Determine factored load P per bracket plate that can be resisted by bracket shown in figure ? Use 8 mm fillet weld. *(refer problem No. 2)*

Answer :

Procedure is same upto step no. 02

Step 2) Resistance against the translation per mm length of weld :

$$= \text{P/L} = \frac{Load}{Total\ length\ of\ weld} = \frac{P}{550} = 0.00182\ \text{P}\quad {}^{N}/_{mm}$$

Step 3) Resistance against the rotation per mm length of weld at a distance Of r From the centroid G :

Resistance force against Rotation = Sa = $k_a r_a$

$$\text{Where } K_a = \left(\frac{p \times e}{I_{xx} + I_{yy}} \right) = \left(\frac{P \times 209.1}{7.31 \times 10^6} \right)$$

$$= 0.00003\ \text{P}$$

We have ; $\sin\theta = \left(\frac{opp.}{hypo} \right) = \left(\frac{109.1}{r_a} \right)$

$\therefore\ r_a \times \sin\theta = 109.1$

$\therefore\ r_a \times \cos\theta = 125$

Total Vertical component at A (V) =

$0.00182\ \text{P} + 0.00003\ \text{P} \times r_a \sin\theta = 0.00182\ \text{P} + (0.00003\ \text{P} \times 109.1)$

$(V) =$ Ans. $\times$ P……...Equation. 1

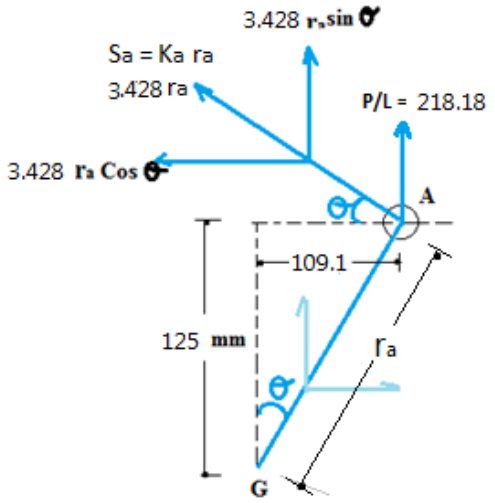
Total Horizontal component at A (H) = $(0.00003 \times \text{P}) \times r_a \cos\theta$

$= (0.00003 \times \text{P}) \times 125$

H = (Ans $\times$ P) ……Equation. 2

Resultant Resistance offered at A = $\sqrt{V^2 + H^2}$

A = $\sqrt{Eq1^{\,2} + Eq2^{\,2}}$ = (Ans $\times$ P) newton…… ...Equation. 3



Step 4) Design stress for weld = $\frac{f_{up}}{\sqrt{3}\,\gamma}$ **……**

$= \frac{410}{\sqrt{3}\times 1.25} = 189.37 \quad {}^{N}/_{mm^2}$

∴ Design strength of weld per mm length = $189.37 \times 1 \times 0.7$ s

$132.58 \times S = 189.37$

∴ $S = 5.51$ mm say 6 mm size of weld

Various Questions From Unv. Exams on Unit :- *Connections*

Note : Each Que. Carry 10 marks

1) A bracket plate is used to transfer the reaction shown in fig. calculate maximum load that can placed over the bracket plate at a distance of 100 mm. use 6 mm fillet weld.
(Eccentric Welded connections). – Use Fig. 1.1

2) A bracket plate is used to transfer the load of 100 KN. to the column flange shown in fig. Design the welded bracket connection ? *(Eccentric Welded connections). – Use Fig. 2.1*

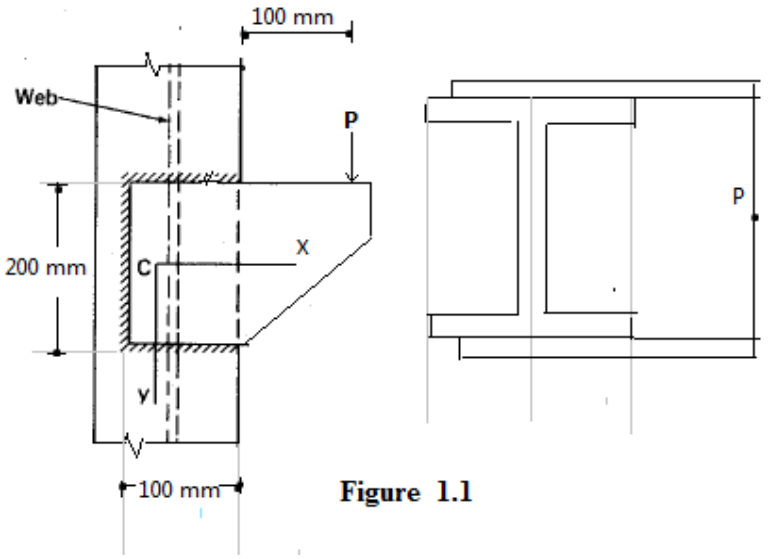


Figure 1.1

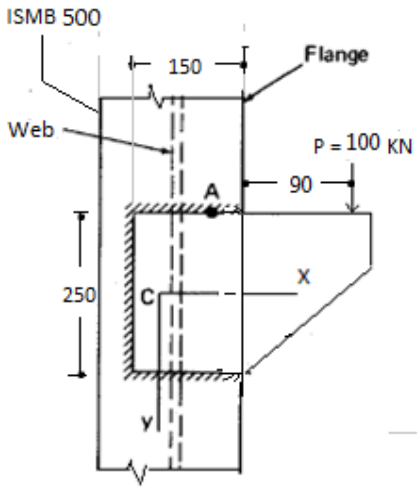


Figure 2.1

3) A bolted bracket of column is shown in fig. calculate maximum stress in the bolt and design the connection ? clearly mention the type of bolts used ? – *(Eccentric Bolted connections). – Use Fig.3.1*

4) An ISMB 200@254 N/m transmits an end reaction of 200 KN to the web of ISMB 450@ 724 N/m. Design the framed connection. Give neat sketch ? *(Beam to Beam connection)*
Note : - (Design it by welded or bolted connection because it is not mention in problem)

5) A beam ISMB 450 Transmit an end shear of 270 KN to the flange of column ISHB 400@822 N/m. Design the welded connection ? (*Beam to column connection –Welded)*

6) A bracket plate is used to transmit reaction P from beam to column flange shown in Fig. The bracket plate is connected to flange of column by 6 mm fillet weld. Compute the maximum reaction P. Also determine the required thickness of Bracket plate ?*(Eccentric Welded connections). – fig (4.1)*

7) Design the welded bracket connection to support 200 KN load at an eccentricity of 500 mm for ISMB 500 shown in fig . ?*(Eccentric Welded connections).*

A bracket plate is used to transfer the reaction of Beam to a column flange shown in fig. The bracket plate is connected to the column flange by 6 mm fillet weld. Compute maximum load that can be placed over the bracket at a distance of 85 mm from the flange of column section *(Eccentric Welded connections).*

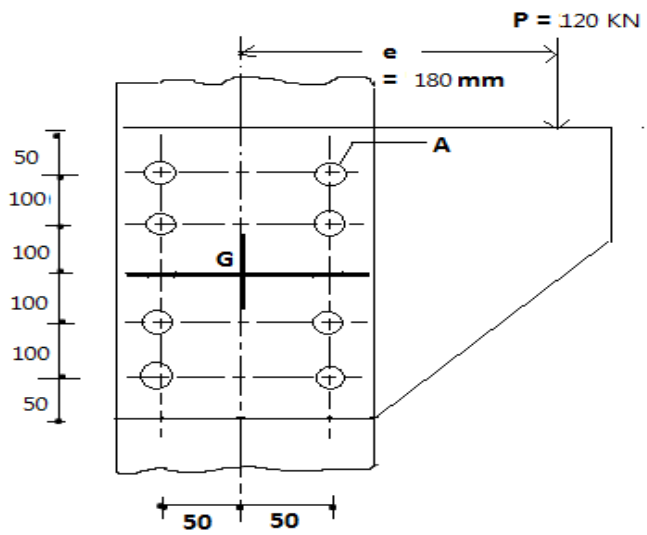


figure 3.1

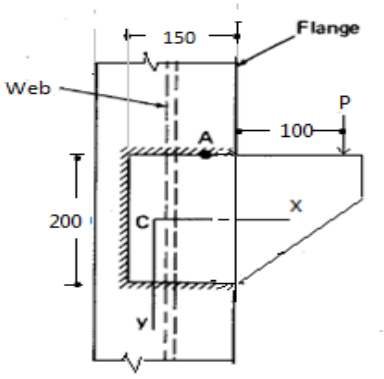


figure 4.1

8) A load 100 KN is carried by a bracket bolted to the flange plate of column as shown in fig. calculate maximum Shear force in any bolt. ? Calculate diameter of bolt ?

(Eccentric Bolted connections).

Design the welded bracket connection to support 200 KN load at an eccentricity of 500 mm for ISMB 500 shown in figure ?