UNIT II CONNECTIONS IN STEEL STRUCTURES

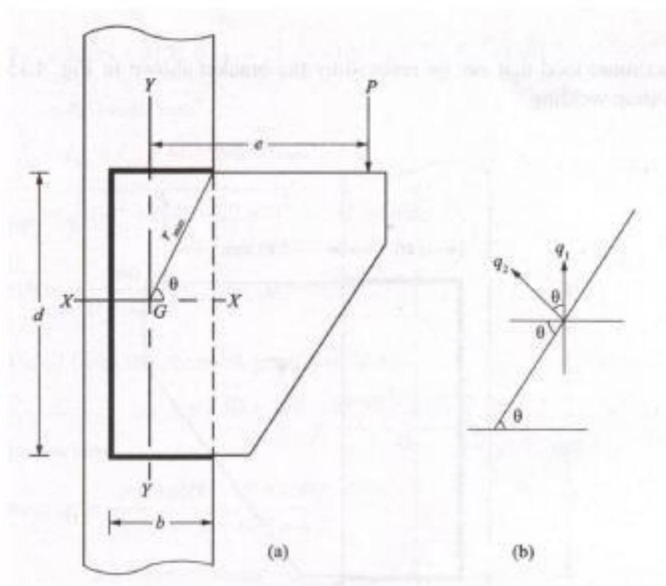
ECCENTRIC CONNECTION:-

Plane of Moment is the same:-

The eccentric load 'P' is equivalent to

(i) A direct axial load acting along the C.G of the group of weld.

(ii) A twisting Moment, M=P x e



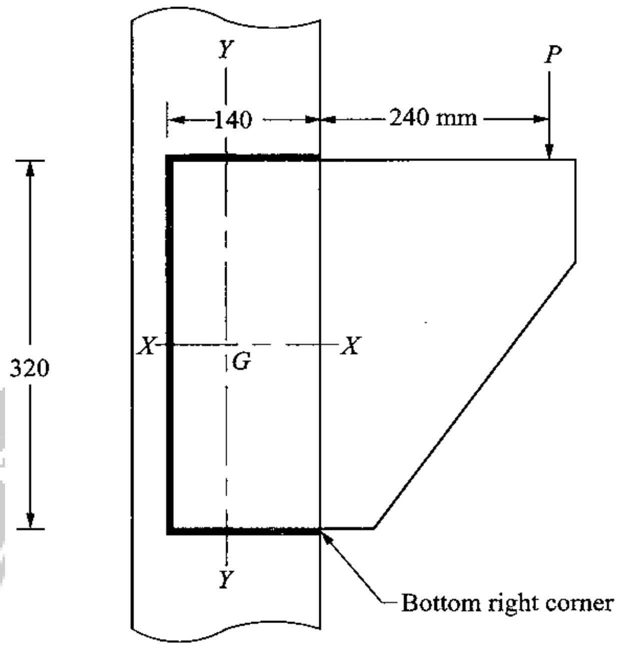
Assuming uniform size of weld with throat tks, 't' and length of weld provided as shown in the fig with sides b&d, the direct shear stress,

$$q_1 = \frac{P}{(2b+d)t}$$

The stress due to twisting moment acting ¿ lr to the C.G of the weld group and the radius vector,

$$q_2 = \frac{p \times e \times y_{max}}{I_{zz}},$$ Resultant stress $q = \sqrt{{q_1}^2 \times {q_2}^2 + 2q_1 q_2 \cos\theta}$

1. Determine the max load that can be resisted by a bracket shown in fig. Fillet weld of size 6mm is provided as shop welding.



Given:-

Size of weld = 6mm

Depth = 300mm

Sln:-

Here the weld group is provided such that the plane of welding is parallel to the plane of moment.

∴ Direct shear stress, $q_1 = \frac{P}{A}$

Shear due to moment $q_2 = \frac{P \times e \times y_{max}}{I_{zz}}$

Resultant stress q = $\sqrt{q_1{}^2 \times q_2{}^2 + 2 q_1 q_2 \cos\theta}$

<u>Weld Group:-</u>

t = threat tks

t = 0.7S

= 0.7(6) = 4.2m

$\bar{y} = \frac{320}{2} = 160\,mm$

$\bar{x} = \frac{a_1 x_1 + a_2 x_2 + a_3 x_3}{a_1 + a_2 + a_3}$

$= \frac{140 \times 4.2 \times 70 + 3116 \times 4.2 \times 2.1 + 4.2 \times 140 \times 70}{588 + 1308.72 + 588}$

$\bar{x}$ = 34.24mm

$I_{xx} + I_{yy} = I_{zz}$

$$I_{xx}=\frac{140\times4.2^3}{12}+140\times4.2\times(317.9-160)^2$$
$$+\frac{311.6\times4.2}{12}+4.2\times311.6(160-160)^2$$
$$+\frac{140\times4.2^3}{12}+140\times4.2(160-2.1)^2$$
$$= 14661121.44+10589132.71+14661121.44$$
$$I_{xx} = 39911375.59\text{mm}^4$$
$$I_{yy}=\left[\frac{4.2\times(140)^3}{12}+4.2\times140(70-34.2)^2\right]\times2$$
$$+\frac{311.6\times(4.2)^3}{12}+311.6\times4.2(34.2-2.1)^2$$
$$I_{yy}=4.78\times10^6 mm^4$$
$$\therefore I_{zz}=44.69\times10^6 mm^4$$

Direct shear stress $q_1=\frac{P}{A}$

A = Total area of the weld group

$$= \frac{P}{[140+320+140]\times4.2}$$
$$q_1=3.968\times10^{-4} PKN$$
$$q_1 = 0.3968 \text{ PN}$$
$$q_2=\frac{p\times e\times\gamma_{max}}{I_{zz}}$$

Where,

e = (140-34.24) + 240

= 345.76mm

$$\gamma_{max}=\sqrt{(160)^2+(140-34.24)^2}$$
$$\gamma_{max} = 191.79\text{mm}$$
$$= \frac{P\times345.76\times191.79}{44.69\times10^6}$$
$$= 1.483\times10^{-3} PKN/mm^2$$
$$q_2=1.483 PN/mm^2$$

Resultant stress $q=\sqrt{(0.3968 P)^2+(1.483 P)^2+2\times0.3968\times1.483 P\times\cos\theta}$

Where,

θ = The angle made by radial distance with the C.G

$$\tan\theta=\frac{160}{140-34.24}$$
$$\tan\theta = 1.51285$$
$$\theta = 56^\circ 32'$$
$$= P\sqrt{2.3567+0.649}$$

q = 1.7336P -→ (1)

The max load that can be applied to resist the stress the weld can take is

$= \frac{410/\sqrt{3}}{1.29}$

$= 189.37\, N/mm^2 \rightarrow (2)$

Equating (1) & (2)

1.7336P = 189.37

$\therefore$ P = 109.24 NS

Eccentric Connection - Plane of weld group ¿ lr to the plane of moment:-

For eccentric connection with plane of weld group ¿ lr to the plane of moment 2 types of stresses are developed,

(i) Direct shear stress, $q = \frac{P}{A}$

Where, A =2bt

(ii) The bending stress @ the extreme end of weld

$$F = \frac{M}{Z} = \frac{p \times e}{\frac{2t \times b^2}{6}}$$

$$F = \frac{6Pe}{2tb^2}$$

The equivalent stress, $f_e = \sqrt{f^2 + 3q^2}$

For the weld to be safe the above equivalent stress is equated to the design stress of weld.

Design stress of weld = $\frac{fu/\sqrt{3}}{\gamma_m}$

1. Design a suitable fillet weld for an eccentrically loaded bracket plate. The working load P=100KN and eccentricity, e = 150mm.Tks of bracket plate is 12mm & tha column used is ISHB300@618 N/m [Plane of weld group is ¿ lr to the plane of moment]

NOTE:-

To find the eff. depth of weld (b) considering only the moment case, the eff. depth is assumed as b = 1.1 $\sqrt{\frac{6M}{2tf_{wd}}}$