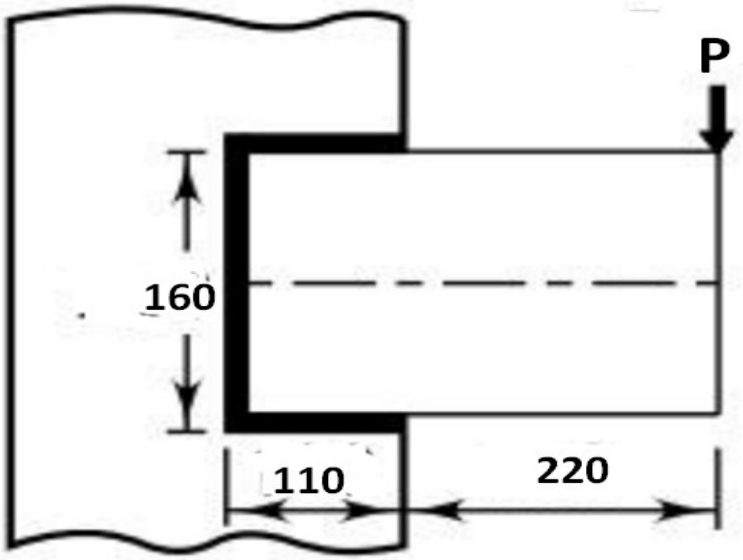
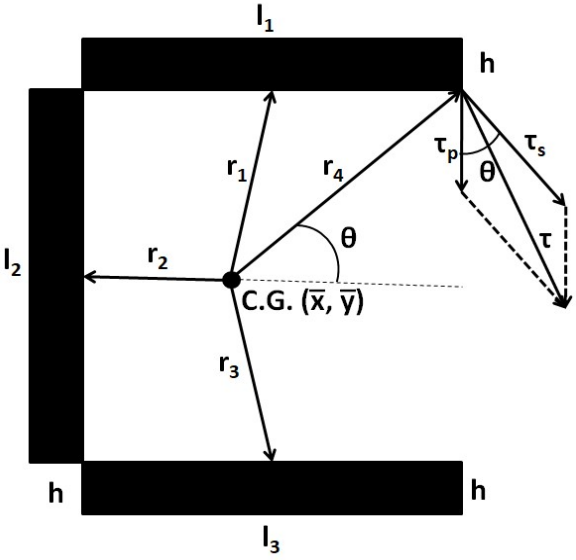
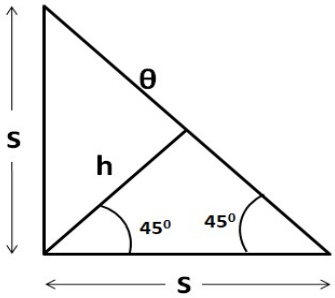
Eccentrically loaded welded joint

Design 6: Determine the size of eccentrically loaded welded joint as shown. The allowable shear stress in the weld material is 95 MPa. The applied load is P = 40/55/60/65 kN.







s is size or leg of weld

h is throat thickness

$$\frac{h}{s} = \sin 45 = \frac{1}{\sqrt{2}}$$

$$\Rightarrow s = \sqrt{2}h \text{ or } h = 0.707s$$

Design Steps:

1. Determination of C.G. $(\bar{x}, \bar{y})$ of group of welds:

$$A_1 = l_1 h, \qquad A_2 = l_2 h, \qquad A_3 = l_3 h$$

$$A = A_1 + A_2 + A_3$$

$$\bar{x} = \frac{\sum A_i x_i}{\sum A_i} \qquad \bar{y} = \frac{\sum A_i y_i}{\sum A_i}$$

2. Primary Shear Stress (τ_p)

$$\tau_p = \frac{P}{A}$$

3. Calculation of radius of welds (r) from C.G.

$$r_1 = \sqrt{(l_2 - \bar{y})^2 + \left(\frac{l_1}{2} - \bar{x}\right)^2} = r_3$$

$$r_2 = \bar{x}$$

$$r_4 = \sqrt{(l_2 - \bar{y})^2 + (l_1 - \bar{x})^2} = r_{max}$$
$$Load\ eccentricity, e = 220 + l_1 - \bar{x}$$

4. Secondary Shear Stress (τ_s)

$$\tau_s = \frac{Tr}{J} = \frac{P.e.r_{max}}{J}$$

where, J = Polar Moment of Inertia of all weld materials about a perpendicular axis passing through C.G.

$$J = J_1 + J_2 + J_3$$
$$= \left[\frac{l_1 h^3}{12} + \frac{h l_1^3}{12} + l_1 h r_1^2\right] + \left[\frac{l_2 h^3}{12} + \frac{h l_2^3}{12} + l_2 h r_2^2\right] + \left[\frac{l_3 h^3}{12} + \frac{h l_3^3}{12} + l_1 h r_3^2\right]$$

5. Resultant Shear Stress (τ)

$$\tau = \sqrt{\tau_s^2 + \tau_p^2 + 2\tau_s \tau_p \cos\theta} = \tau_{per}$$
$$where, \cos\theta = \frac{l_1 - \bar{x}}{r_4}$$

Solve and find 'h'

6. Size or leg of weld, $\boldsymbol{s = \sqrt{2}h}$

VIVA QUESTIONS

1. What is throat of fillet weld?
2. What is the relationship between leg and throat of fillet weld?
3. Which plane is subjected to maximum shear stress in case of parallel and transverse fillet weld?