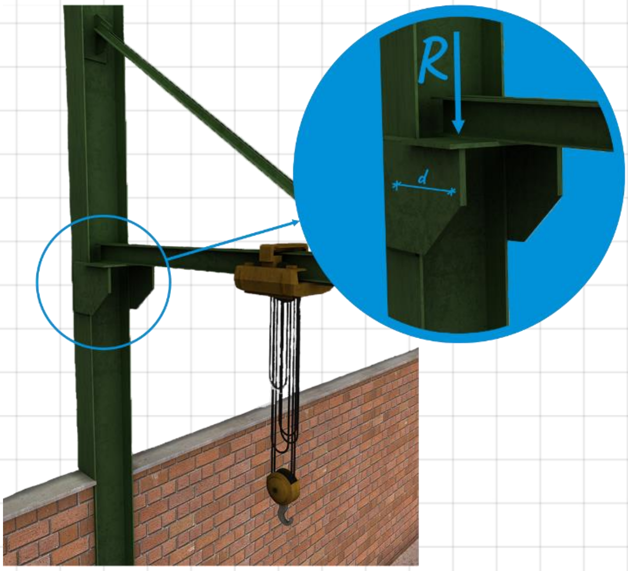
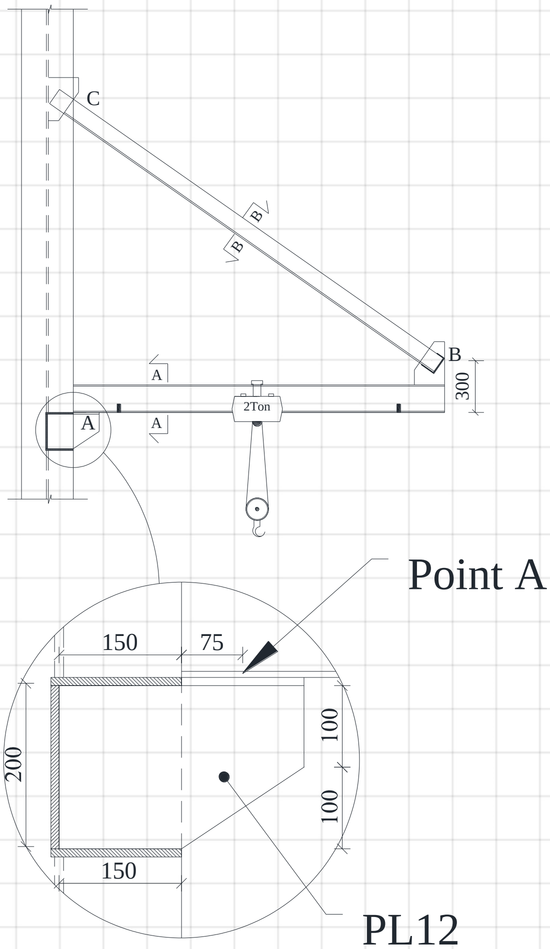
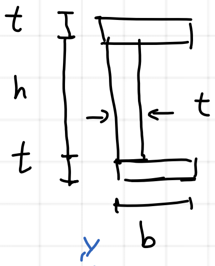
How to calculate the centroid and other properties of the weld?

As you may have noticed and according to available statistics, almost 80% of welded joints are made by fillet welding. Because of the importance of this type of weld, we decided to record a playlist regarding the design of fillet welds according to Eurocode.

In this video, we will go through multiple examples regarding calculating weld centroid and other properties of weld-like area and moment of inertial about the x and y axes. By calculating these kinds of properties of a fillet weld, we can go one step further to calculate the capacity of welds in the following videos of the current playlist.

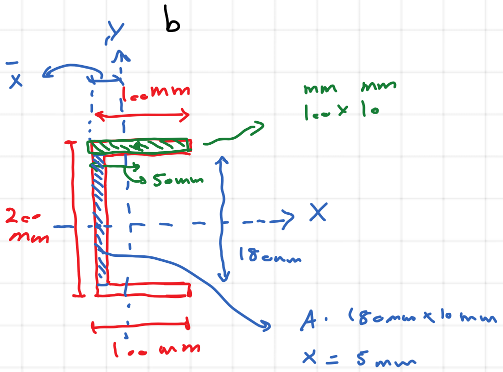






$$\bar{Y} = \frac{\sum A_i \, y_i}{\sum A_i}$$

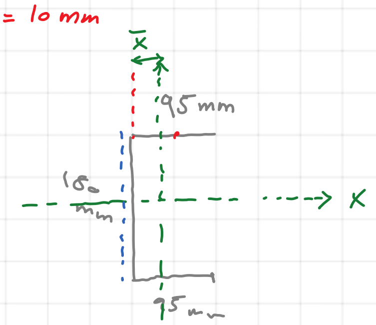
$$\bar{X} = \frac{\sum A_i \cdot x_i}{\sum A_i}$$



2 flanges

$$\bar{X} = \frac{\underbrace{100 \times 10}_{mm^2} \times \underbrace{50}_{mm} \times 2 + \underbrace{180 \times 10}_{mm^2} \times \underbrace{5}_{mm}}{2 \times \underbrace{100 \times 10}_{mm^2} + \underbrace{180 \times 10}_{mm^2}} = 28.7\ mm$$

$t = 10\ mm$



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

$$\bar{X} = \frac{95\ mm \times 47.5\ mm \times 2 + 180\ mm \times 0}{2 \times 95\ mm + 180\ mm} = 24.4$$

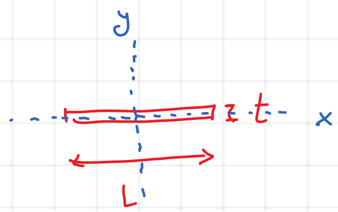
$$A_w = \sum l_i \cdot \omega$$ weld leg size

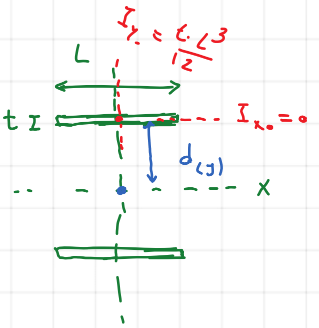
$$\bar{X} = \frac{\sum l_i \cdot x}{\sum l_i} \ , \quad \bar{y} = \frac{\sum l_i \, y_i}{\sum l_i}$$

$$I_x = \sum \left(I_{x_0} + A_i \, d_{i(y)}^2 \right)$$

$$I_y = \sum \left(I_{y_0} + A_i \cdot d_{i(x)}^2 \right)$$

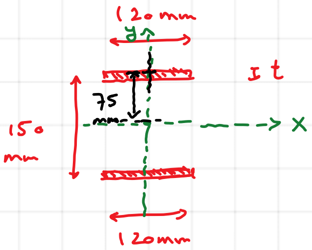
$$I_p = I_x + I_y$$





$I_x = \cancel{L \, t^3 / 12}$

$I_y = t \cdot L^3 / 12$

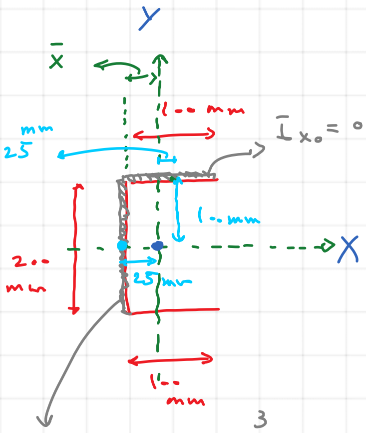


$I_{x_0} = 0 \qquad I_{y_0} = \frac{t\times 120^3}{12} = 144000\,t$

$I_x = 2\times(0 + 120_{mm}\times t\times 75_{mm}^{2}) = 1350000\,t \quad (mm^4)$

$I_y = 2\times\left(\frac{t\times 120_{mm}^3}{12} + 0\right) = 288000\,t \quad (mm^4)$

$I_p = I_x + I_y = 423000\,t \quad (mm^4)$



$\bar{I}_{x_0} = 0, \quad \bar{I}_{y_0} = \frac{t\times 100_{mm}^3}{12}, \quad A = 100^{mm}\,t$

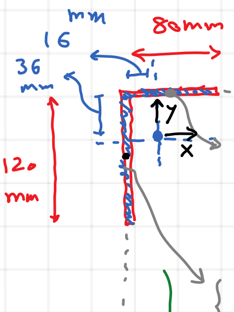
$$\bar{x} = \frac{\sum l_i x_i}{\sum l_i} = \frac{100_{mm}\times 50_{mm}\times 2 + 200\,mm\times 0}{100\,mm\times 2 + 200\,mm} = 25\,mm$$

$I_{x_0} = \frac{t\times(200\,mm)^3}{12}, \quad I_{y_0} = 0, \quad A = 200^{mm}\,t$

$$I_x = \sum(I_{x_0} + A_i\,d_y^2) = \left(0 + 100\,t\times(100\,mm)^2\right)\cdot 2 + \left(\frac{t\times(200\,mm)^3}{12} + 0\right) = 2.67\times10^6\,t \quad (mm^4)$$

$$I_y = \sum(I_{y_0} + A_i\,d_x^2) = \left(\frac{t\times(100\,mm)^3}{12} + 100_{mm}\,t\times(25\,mm)^2\right)\cdot 2 + \left(0 + 200_{mm}\,t\times(25\,mm)^2\right) = 0.42\times10^6\,t \quad (mm^4)$$

$I_p = I_x + I_y \cong 3.1\times10^6\,t \quad (mm^4)$



$I_{x_0} = 0$

$I_{y_0} = \frac{t\times(80\,mm)^3}{12}$

$L = 80\,mm$
$x = 40\,mm$
$y = 0$

$$\bar{x} = \frac{\sum l_i x_i}{\sum l_i} = \frac{80_{mm}\times 40_{mm} + 120_{mm}\times 0}{80_{mm} + 120_{mm}} = 16\,mm$$

$$\bar{y} = \frac{\sum l_i y_i}{\sum l_i} = \frac{80_{mm}\times 0 + 120_{mm}\times 60_{mm}}{80\,mm + 120\,mm} = 36\,mm$$

$L = 120\,mm$
$x = 0$
$y = 60\,mm$

$I_{x_0} = \frac{t\times(120\,mm)^3}{12}$

$I_{y_0} = 0$

$$I_x = \left(0 + 80_{mm}\cdot t\cdot(36\,mm)^2\right) + \frac{t\times(120\,mm)^3}{12} + 120_{mm}\,t\times(60\,mm - 36\,mm)^2$$

$$I_y = \left(\left(\frac{t\times(80\,mm)^3}{12} + t\times 80_{mm}\times(40_{mm} - 16_{mm})^2\right) + (0 + 120_{mm}\,t\ (16\,mm)^2\right.$$

$I_x = 316800\,t\ (mm^4) \quad I_y = 119467\,t\ (mm^4) \quad I_p = I_x + I_y = 4.4\times10^5\,t\ (mm^4)$