WORKED EXAMPLES 3.1
Welded Connection of Tie

Check the resistance of the connection of the flat section, shown in Fig. 1WE3-1, loaded in tension by the factored force $F_{Sd} = 330\ kN$. The steel is Grade S460N. The material partial safety factors are $\gamma_{M0} = 1{,}0$ and $\gamma_{Mw} = 1{,}25$.

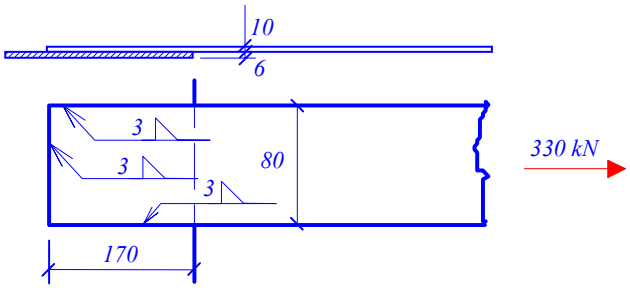

Figure 1WE3-1

The structural welds should be (i) longer than *40 mm,* and (ii) longer than $6\ a_w = 6 * 3 = 18\ mm$. Both of these are satisfied. The full length of the weld can be taken into account in the strength calculation, because $150\ a_w = 50 * 3 = 450\ mm > 170\ mm$.

Longitudinal welds

In the longitudinal welds is $\sigma_\perp = \tau_\perp = 0$. Based on the fillet welds resistance

$$\sqrt{\sigma_\perp^2 + 3\left(\tau_\perp^2 + \tau_{//}^2\right)} \le \frac{f_u}{\beta_w \gamma_{Mw}} \qquad \text{and} \qquad \sigma_\perp \le \frac{f_u}{\gamma_{Mw}}$$

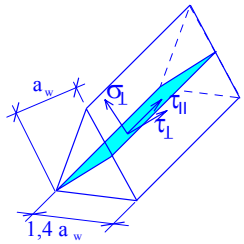

Figure 2WE3-1

is the shear strain

$$\tau_{II.Rd} = \frac{f_u}{\sqrt{3}\beta_w \gamma_{Mw}}.$$

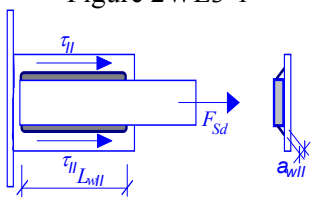

Figure 3WE3-1

The design resistance is

$$F_{II.w.Rd} = \tau_{II.Rd}\ a_{wII}\ 2\ L_{wII} = \frac{550}{\sqrt{3} * 1{,}0 * 1{,}25} * 3 * 2 * 170 = 259{,}1 * 10^3\ N.$$

Front weld

The equation for the resistance may be at the front weld

($\tau_{II.Rd} = 0$ and $\sigma_\perp = \tau_\perp = \frac{\sigma_w}{\sqrt{2}}$) rewritten:

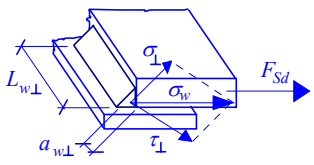

Figure 4WE3-1

$$\sqrt{\left(\frac{\sigma_w}{\sqrt{2}}\right)^2 + 3\left(\frac{\sigma_w}{\sqrt{2}}\right)^2} \le \frac{f_u}{\beta_w\ \gamma_{Mw}}.$$

The front weld design strain is

$$\sigma_{w.Rd} = \frac{f_u}{\beta_w\ \gamma_{Mw}\ \sqrt{2}}.$$

The design resistance of the front weld is

$$F_{\perp.w.Rd} = \sigma_{w.Rd}\ a_{w\perp}\ L_{w\perp} = \frac{550}{1{,}0 * 1{,}25 * \sqrt{2}} * 3 * 80 = 74{,}7 * 10^3\ N$$

Connection resistance

The connection resistance is

$$F_{w.Rd} = F_{II.w.Rd} + F_{\perp.w.Rd} = 259{,}1 + 74{,}7 = 333{,}8\ kN > F_{Sd} = 330\ kN\ .$$

The connection resistance is satisfactory.

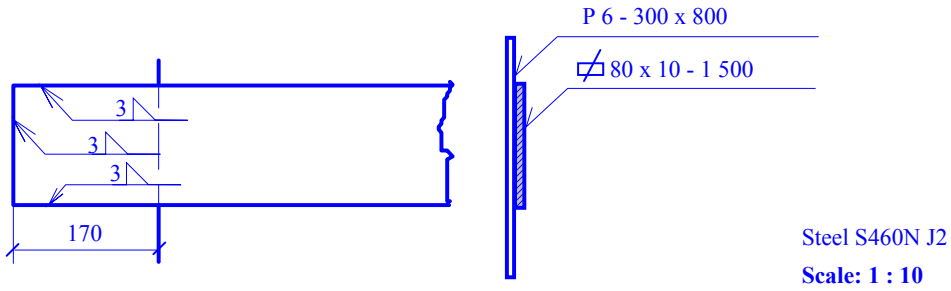

Figure 5WE3-1 Design drawing of the connection

Note:

1) The weld resistance may conservatively be checked independent of the loading direction as follows:

$$F_{w.Rd} = \frac{f_u\ a_w\ L_w}{\beta_w\ \gamma_{Mw}\ \sqrt{3}} = \frac{550 * 3 * (2 * 170 + 80)}{1{,}0 * 1{,}25 * \sqrt{3}} = 320{,}0 * 10^3\ N < F_{Sd} = 330\ kN\ .$$

The welds are not satisfactory uder this model.

2) The tension resistance of a member is

$$N_{u.Rd} = \frac{A\ \ f_y}{\gamma_{M0}} = \frac{80 * 10 * 460}{1{,}0} = 368{,}0 * 10^3\ \ N > 330\ kN\ .$$

The tension resistance is satisfactory.