BRU2482

Lasberekening stalen klemconstructie

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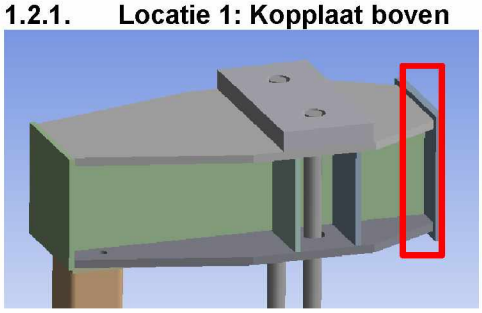
1 Lasberekening

1.1. Lasberekeningen Algemeen

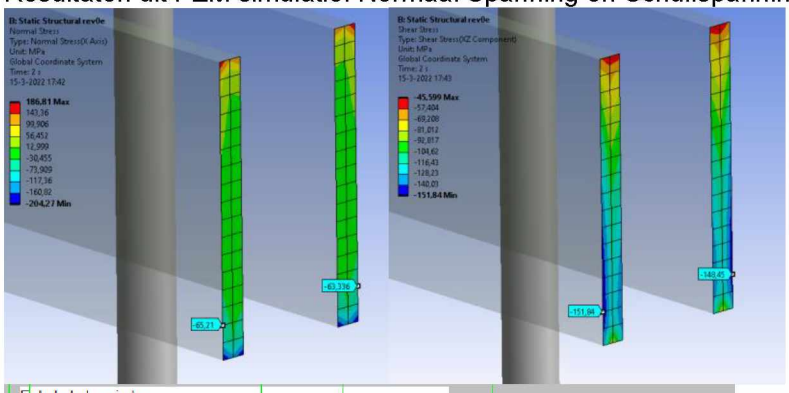
Pas een 0.8t las dikte toe voor alle lassen met uitzondering van de locaties bepaald in paragraaf 1.2.

1.2. Lasberekeningen uitzonderingen

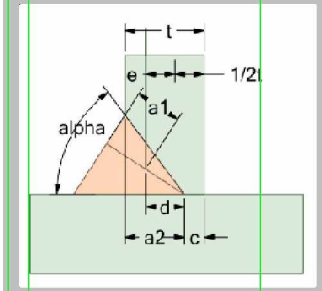
1.2.1. Locatie 1: Kopplaat boven



Resultaten uit FEM simulatie: Normaal Spanning en Schuifspanning

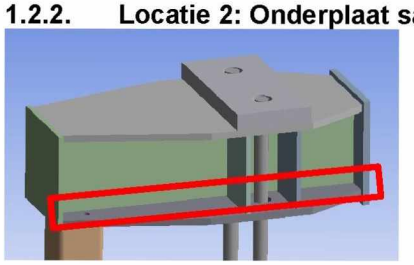


Enkele halve pin las

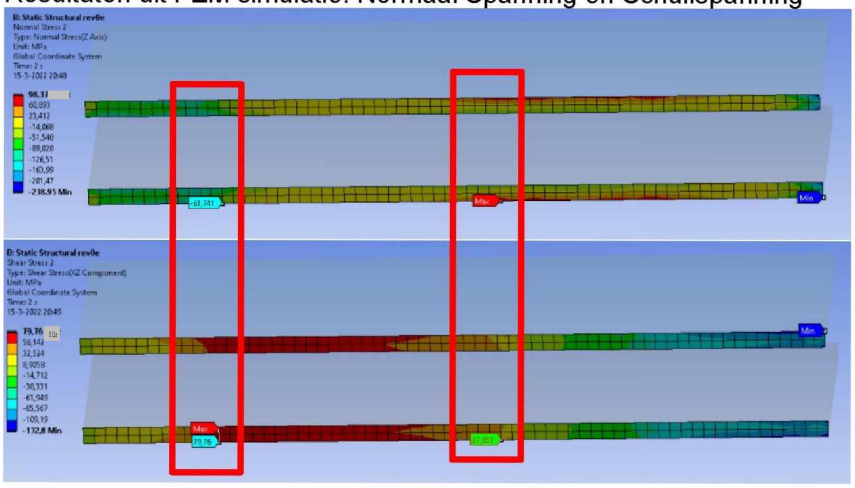


Keeldoorsnede	$a1_2 := 25mm$	
Hoek las:	$\alpha_2 := 45 \cdot deg$	
wand dikte:	$t_2 := 30mm$	
	$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 19 \cdot mm$	
	$c_2 := t_2 - a2_2 = 11 \cdot mm$	
	$d_2 := \frac{1}{2} a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 12 \cdot mm$	
	$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 7 \cdot mm$	
Normaalspanning:	$\sigma_2 := 65MPa$	
Schuifspanning:	$\tau_2 := 152MPa$	
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 55 \cdot MPa$	
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 139 \cdot MPa$	
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 194 \cdot MPa$	$\leq \frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 55 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 182 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3 \cdot \left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 383 \cdot MPa$	$\leq f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.92$	

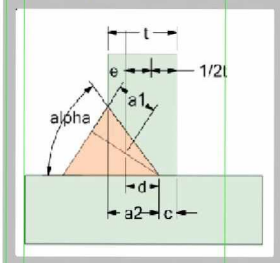
1.2.2. Locatie 2: Onderplaat samengestelde koker



Resultaten uit FEM simulatie: Normaal Spanning en Schuifspanning

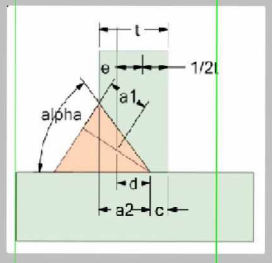


Enkele halve pin las



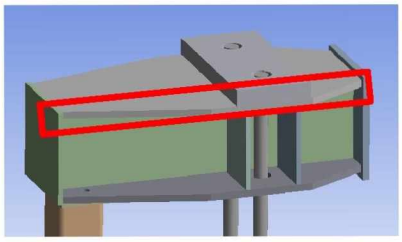
Keeldoorsnede	$a1_2 := 20mm$	
Hoek las:	$\alpha_2 := 45 \cdot deg$	
wand dikte:	$t_2 := 30mm$	
	$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 15 \cdot mm$	
	$c_2 := t_2 - a2_2 = 15 \cdot mm$	
	$d_2 := \frac{1}{2} \cdot a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 9 \cdot mm$	
	$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 9 \cdot mm$	
Normaalspanning:	$\sigma_2 := 60MPa$	
Schuifspanning:	$\tau_2 := 80MPa$	
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 64 \cdot MPa$	
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 241 \cdot MPa$	
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 305 \cdot MPa$	$\leq \frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 64 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 120 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3 \cdot \left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 385 \cdot MPa$	$\leq f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.92$	

Enkele halve pin las

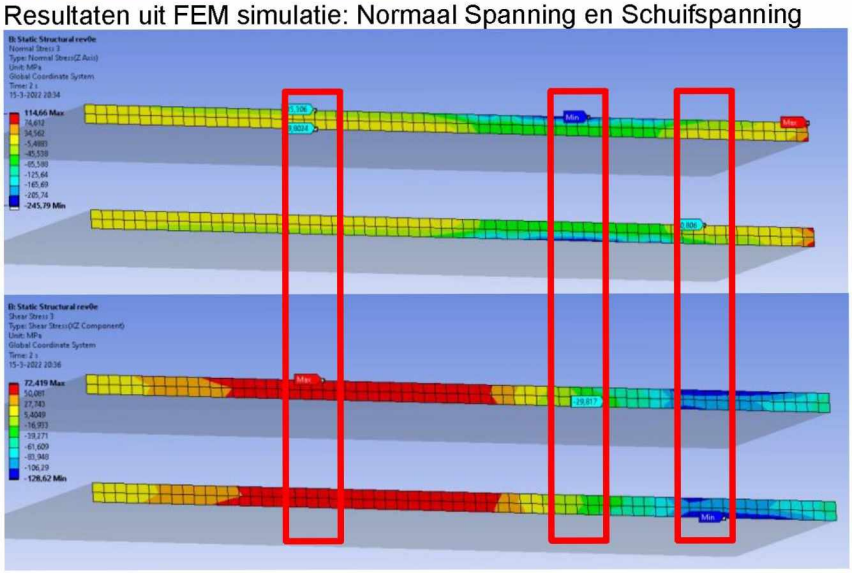


Keeldoorsnede	$a1_2 := 25mm$	
Hoek las:	$\alpha_2 := 45 \cdot deg$	
wand dikte:	$t_2 := 30mm$	
	$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 19 \cdot mm$	
	$c_2 := t_2 - a2_2 = 11 \cdot mm$	
	$d_2 := \frac{1}{2} \cdot a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 12 \cdot mm$	
	$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 7 \cdot mm$	
Normaalspanning:	$\sigma_2 := 100MPa$	
Schuifspanning:	$\tau_2 := 30MPa$	
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 85 \cdot MPa$	
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 214 \cdot MPa$	
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 298 \cdot MPa$	$\leq \frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 85 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 36 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3 \cdot \left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 338 \cdot MPa$	$\leq f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.81$	

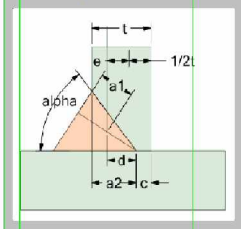
1.2.3. Locatie 3: Bovenplaat samengestelde koker



Resultaten uit FEM simulatie: Normaal Spanning en Schuifspanning



Enkele halve pin las



Keeldoorsnede $a1_2 := 15mm$

Hoek las: $\alpha_2 := 45 \cdot deg$

wand dikte: $t_2 := 30mm$

$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 11 \cdot mm$

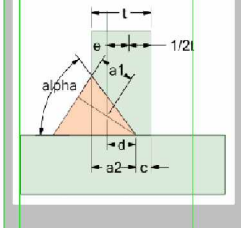
$c_2 := t_2 - a2_2 = 19 \cdot mm$

$d_2 := \frac{1}{2} \cdot a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 7 \cdot mm$

$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 10 \cdot mm$

Normaalspanning:	$\sigma_2 := 15MPa$	
Schuifspanning:	$\tau_2 := 72MPa$	
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 21 \cdot MPa$	
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 125 \cdot MPa$	
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 147 \cdot MPa$	$\leq \frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 21 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 144 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3 \cdot \left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 292 \cdot MPa$	$\leq f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.70$	

Enkele halve pin las



Keeldoorsnede $a1_2 := 20mm$

Hoek las: $\alpha_2 := 45 \cdot deg$

wand dikte: $t_2 := 30mm$

$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 15 \cdot mm$

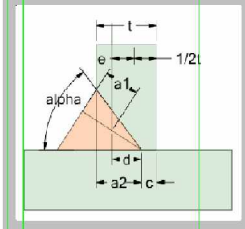
$c_2 := t_2 - a2_2 = 15 \cdot mm$

$d_2 := \frac{1}{2} \cdot a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 9 \cdot mm$

$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 9 \cdot mm$

Normaalspanning:	$\sigma_2 := 11MPa$	
Schuifspanning:	$\tau_2 := 128MPa$	
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 12 \cdot MPa$	
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 44 \cdot MPa$	
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 56 \cdot MPa$	$\leq \frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 12 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 192 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3 \cdot \left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 338 \cdot MPa$	$\leq f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.81$	

Enkele halve pin las



Keeldoorsnede $a1_2 := 35mm$

Hoek las: $\alpha_2 := 45 \cdot deg$

wand dikte: $t_2 := 30mm$

$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 27 \cdot mm$

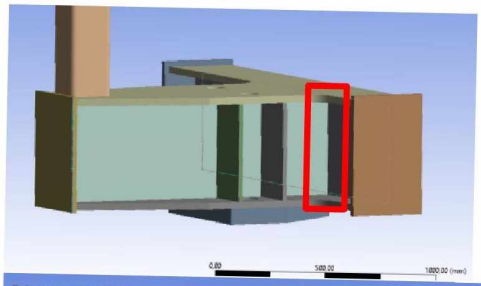
$c_2 := t_2 - a2_2 = 3 \cdot mm$

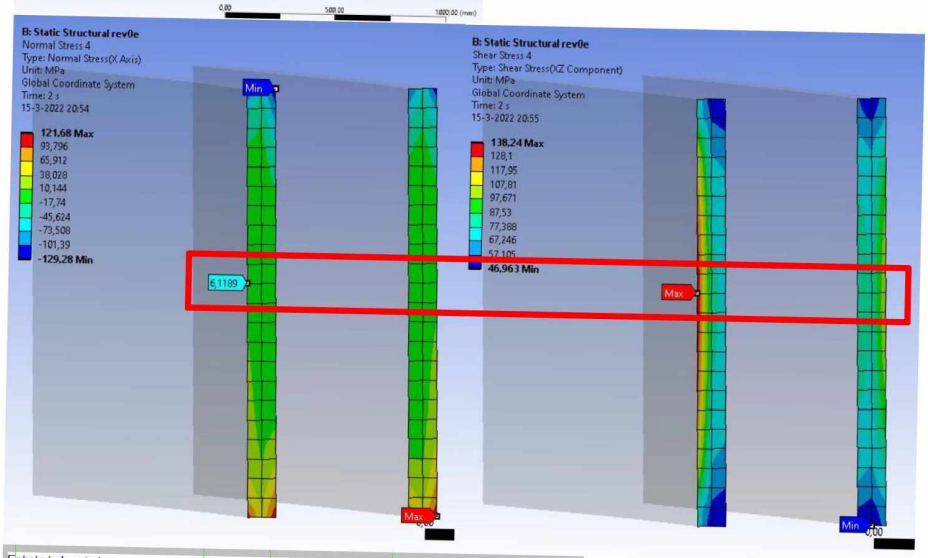
$d_2 := \frac{1}{2} \cdot a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 16 \cdot mm$

$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 4 \cdot mm$

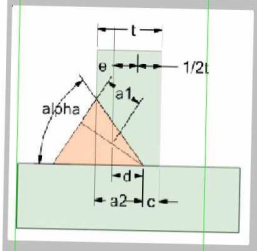
Normaalspanning:	$\sigma_2 := 245MPa$	
Schuifspanning:	$\tau_2 := 30MPa$	
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 148 \cdot MPa$	
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 158 \cdot MPa$	
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 306 \cdot MPa$	$\leq \frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 148 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 26 \cdot MPa$	$\leq f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3 \cdot \left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 402 \cdot MPa$	$\leq f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.96$	

1.2.4. Locatie 4: Samensgestelde koker naar evenaar





Enkele halve pin las



Keeldoorsnede $a1_2 := 20mm$

Hoek las: $\alpha_2 := 45 \cdot deg$

wand dikte: $t_2 := 30mm$

$a2_2 := \frac{a1_2}{\cos\left(\frac{\alpha_2}{2}\right)} \cdot \cos(\alpha_2) = 15 \cdot mm$

$c_2 := t_2 - a2_2 = 15 \cdot mm$

$d_2 := \frac{1}{2} \cdot a1_2 \cdot \cos\left(\frac{\alpha_2}{2}\right) = 9 \cdot mm$

$e_2 := d_2 + c_2 - \frac{1}{2} \cdot t_2 = 9 \cdot mm$

Normaalspanning:	$\sigma_2 := 6MPa$		
Schuifspanning	$\tau_2 := 140MPa$		
Spanning loodrecht σ door kracht	$\sigma_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \cos(\alpha_2) = 6 \cdot MPa$		
Spanning loodrecht σ door mom.	$\sigma_{2.2} := \frac{6 \cdot \sigma_2 \cdot t_2 \cdot e_2}{a1_2^2} = 24 \cdot MPa$		
Totaal spanning loodrecht	$\sigma_{3.2} := \sigma_{1.2} + \sigma_{2.2} = 30 \cdot MPa$	$\leq$	$\frac{0.9 \cdot f_u}{\gamma_{M2}} = 338 \cdot MPa$
Schuifspanning loodrecht	$\tau_{1.2} := \frac{\sigma_2 \cdot t_2}{a1_2} \cdot \sin(\alpha_2) = 6 \cdot MPa$	$\leq$	$f_{v.wd} = 241 \cdot MPa$
Schuifspanning evenwijdig	$\tau_{2.2} := \frac{\tau_2 \cdot t_2}{a1_2} = 210 \cdot MPa$	$\leq$	$f_{v.wd} = 241 \cdot MPa$
combinatie lasspanning	$\sigma_{w.sd.2} := \sqrt{\sigma_{3.2}^2 + 3\left(\tau_{1.2}^2 + \tau_{2.2}^2\right)} = 365 \cdot MPa$	$\leq$	$f_{u.wd} = 418 \cdot MPa$
Unity Check	$UC_4 := \frac{\sigma_{w.sd.2}}{f_{u.wd}} = 0.87$		