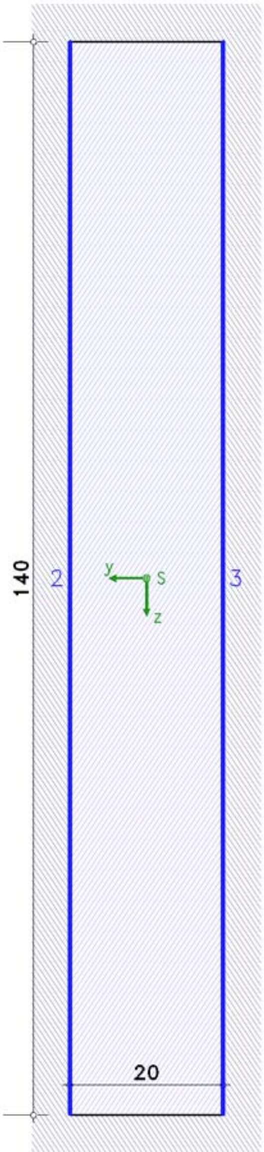
POS. 174: WELDED T-CONNECTION (FILLET WELD)

axial force connection 4H-EC3NV version: 6/2018-1n

welded T-connection (fillet weld) EC 3-1-8 (12.10), NA: Deutschland

1. input report



material
steel grade S235
partial safety factors for material
resistance of cross-sections γ_{M0} = 1.00
resistance of bolts, welds, plates in bearing γ_{M2} = 1.25
geometry
section parameters (flat steel):
height h = 140.0 mm, thickness t = 20.0 mm
plate: thickness t_p = 30.0 mm
welds as fillet weld (full-size):
a_{w2} = 6.0 mm, l_{w2} = 140.0 mm a_{w3} = 6.0 mm, l_{w3} = 140.0 mm
resistance
weld verification with the directional method
internal forces and moments
Lk 1: N_{Ed} = 400.00 kN

2. Lk 1

2.1. verification of welds

welds:

weld 1: $a_w = 0.0$ mm $l_w = 0.0$ mm
weld 2: $a_w = 6.0$ mm $l_w = 140.0$ mm
weld 3: $a_w = 6.0$ mm $l_w = 140.0$ mm
weld 4: $a_w = 0.0$ mm $l_w = 0.0$ mm

design values refering to centroid of the section:

$N_{Ed} = 400.00$ kN

cross-sectional properties refering to centroid of the line cross-section:

$\Sigma A_w = 16.80$ cm², $\Sigma l_w = 28.0$ cm
$I_{w,y} = 274.40$ cm⁴, $I_{w,z} = 16.80$ cm⁴, $\Delta y_w = 0.0$ mm, $\Delta z_w = 0.0$ mm

distribution of internal forces and moments:

weld 2: $N_w = 200.00$ kN
weld 3: $N_w = 200.00$ kN

stresses in weld edges:

weld 2, pt. 0: $\sigma_{w,x} = 238.10$ N/mm²
pt. 1: $\sigma_{w,x} = 238.10$ N/mm²
weld 3, pt. 0: $\sigma_{w,x} = 238.10$ N/mm²
pt. 1: $\sigma_{w,x} = 238.10$ N/mm²

verifications in weld edges:

verification of weld 2, pt. 0:

stresses on the design area of the weld ($\alpha = 45°$, $\sigma_w = \sigma_{w,x}$):
$\sigma_s = \sigma_w \cdot \cos(\alpha) = 168.4$ N/mm²
$\tau_s = \sigma_w \cdot \sin(\alpha) = 168.4$ N/mm²
$\sigma_{1,w,Ed} = (\sigma_s^2 + 3 \cdot (\tau_s^2 + \tau_p^2))^{1/2} = 336.72$ N/mm²
resistance of a weld (req.1): $f_{1w,d} = f_u / (\beta_w \cdot \gamma_{M2}) = 360.00$ N/mm²
$\sigma_{1,w,Ed} = 336.72$ N/mm² $<$ $f_{1w,d} = 360.00$ N/mm² $\Rightarrow$ $U = 0.935 < 1$ ok
$\sigma_{2,w,Ed} = |\sigma_s| = 168.36$ N/mm²
resistance of a weld (req.2): $f_{2w,d} = 0.9 \cdot f_u / \gamma_{M2} = 259.20$ N/mm²
$\sigma_{2,w,Ed} = 168.36$ N/mm² $<$ $f_{2w,d} = 259.20$ N/mm² $\Rightarrow$ $U = 0.650 < 1$ ok

verification of weld 2, pt. 1:

stresses on the design area of the weld ($\alpha = 45°$, $\sigma_w = \sigma_{w,x}$):
$\sigma_s = \sigma_w \cdot \cos(\alpha) = 168.4$ N/mm²
$\tau_s = \sigma_w \cdot \sin(\alpha) = 168.4$ N/mm²
$\sigma_{1,w,Ed} = (\sigma_s^2 + 3 \cdot (\tau_s^2 + \tau_p^2))^{1/2} = 336.72$ N/mm²
resistance of a weld (req.1): $f_{1w,d} = f_u / (\beta_w \cdot \gamma_{M2}) = 360.00$ N/mm²
$\sigma_{1,w,Ed} = 336.72$ N/mm² $<$ $f_{1w,d} = 360.00$ N/mm² $\Rightarrow$ $U = 0.935 < 1$ ok
$\sigma_{2,w,Ed} = |\sigma_s| = 168.36$ N/mm²
resistance of a weld (req.2): $f_{2w,d} = 0.9 \cdot f_u / \gamma_{M2} = 259.20$ N/mm²
$\sigma_{2,w,Ed} = 168.36$ N/mm² $<$ $f_{2w,d} = 259.20$ N/mm² $\Rightarrow$ $U = 0.650 < 1$ ok

verification of weld 3, pt. 0:

stresses on the design area of the weld ($\alpha = 45°$, $\sigma_w = \sigma_{w,x}$):
$\sigma_s = \sigma_w \cdot \cos(\alpha) = 168.4$ N/mm²
$\tau_s = \sigma_w \cdot \sin(\alpha) = 168.4$ N/mm²
$\sigma_{1,w,Ed} = (\sigma_s^2 + 3 \cdot (\tau_s^2 + \tau_p^2))^{1/2} = 336.72$ N/mm²
resistance of a weld (req.1): $f_{1w,d} = f_u / (\beta_w \cdot \gamma_{M2}) = 360.00$ N/mm²
$\sigma_{1,w,Ed} = 336.72$ N/mm² $<$ $f_{1w,d} = 360.00$ N/mm² $\Rightarrow$ $U = 0.935 < 1$ ok
$\sigma_{2,w,Ed} = |\sigma_s| = 168.36$ N/mm²
resistance of a weld (req.2): $f_{2w,d} = 0.9 \cdot f_u / \gamma_{M2} = 259.20$ N/mm²
$\sigma_{2,w,Ed} = 168.36$ N/mm² $<$ $f_{2w,d} = 259.20$ N/mm² $\Rightarrow$ $U = 0.650 < 1$ ok

verification of weld 3, pt. 1:

stresses on the design area of the weld ($\alpha = 45°$, $\sigma_w = \sigma_{w,x}$):
$\sigma_s = \sigma_w \cdot \cos(\alpha) = 168.4$ N/mm²
$\tau_s = \sigma_w \cdot \sin(\alpha) = 168.4$ N/mm²
$\sigma_{1,w,Ed} = (\sigma_s^2 + 3 \cdot (\tau_s^2 + \tau_p^2))^{1/2} = 336.72$ N/mm²
resistance of a weld (req.1): $f_{1w,d} = f_u / (\beta_w \cdot \gamma_{M2}) = 360.00$ N/mm²
$\sigma_{1,w,Ed} = 336.72$ N/mm² $<$ $f_{1w,d} = 360.00$ N/mm² $\Rightarrow$ $U = 0.935 < 1$ ok
$\sigma_{2,w,Ed} = |\sigma_s| = 168.36$ N/mm²
resistance of a weld (req.2): $f_{2w,d} = 0.9 \cdot f_u / \gamma_{M2} = 259.20$ N/mm²
$\sigma_{2,w,Ed} = 168.36$ N/mm² $<$ $f_{2w,d} = 259.20$ N/mm² $\Rightarrow$ $U = 0.650 < 1$ ok

Result:

weld 2, pt. 0: $\sigma_{w,x} = 238.10$ N/mm²
Max: $\sigma_{1,w,Ed} = 336.72$ N/mm² $<$ $f_{1w,d} = 360.00$ N/mm²,

$\sigma_{2,w,Ed}$ = 168.36 N/mm² < $f_{2w,d}$ = 259.20 N/mm² ⇒ U_w = 0.935 < 1 ok

3. final result

maximum utilisation: resistance max U = 0.935 < 1 ok

verification succeeded

4. Regulations

DIN EN 1990, Eurocode 0: Grundlagen der Tragwerksplanung;
Deutsche Fassung EN 1990:2002 + A1:2005 + A1:2005/AC:2010, Ausgabe Dezember 2010
DIN EN 1990/NA, Nationaler Anhang zur DIN EN 1990, Ausgabe Dezember 2010

DIN EN 1993-1-1, Eurocode 3: Bemessung und Konstruktion von Stahlbauten -
Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau;
Deutsche Fassung EN 1993-1-1:2005 + AC:2009, Ausgabe Dezember 2010
DIN EN 1993-1-1/A1, Ergänzungen zur DIN EN 1993-1-1, Ausgabe Juli 2014
DIN EN 1993-1-1/NA, Nationaler Anhang zur DIN EN 1993-1-1, Ausgabe Dezember 2018

DIN EN 1993-1-8, Eurocode 3: Bemessung und Konstruktion von Stahlbauten -
Teil 1-8: Bemessung von Anschlüssen;
Deutsche Fassung EN 1993-1-8:2005 + AC:2009, Ausgabe Dezember 2010
DIN EN 1993-1-8/NA, Nationaler Anhang zur DIN EN 1993-1-8, Ausgabe Dezember 2010