1. input report

details (section A - A)

steel grade
steel grade S235

column parameters
parameter (I-section):
  overall depth $h = 390.0$ mm, web thickness $t_w = 11.0$ mm
  flange width $b_r = 300.0$ mm, flange thickness $t_r = 24.0$ mm
  rolled section, root radius $r = 27.0$ mm

beam parameters
section HE400A

verification parameters
welds at the connection point:
  beam flange top: fillet weld, weld thickness $a = 10.0$ mm
  beam web: fillet weld, weld thickness $a = 5.0$ mm
beam flange bottom: fillet weld, weld thickness $a = 10.0$ mm

internal forces and moments at the joint periphery referring to the system axes

Lk 1: $N_{b,Ed} = -1190.00$ kN, $M_{b,Ed} = 225.00$ kNm, $V_{b,Ed} = 370.00$ kN

partial safety factors for material
resistance of cross-sections $\gamma_M = 1.00$
resistance of members in stability failure $\gamma_M = 1.10$
resistance of bolts, welds, plates in bearing $\gamma_M = 1.25$

check of data
ok

notes
no verification for cross-sections.
no verification for column web area.

2. Lk 1

2.1. design values

periphery connection $\perp$ zur connection plane partial internal forces and moments

slopes of angle:

$\alpha_b = \alpha_v = \alpha = 0^\circ$
distance: $\delta_1 = 195.0$ mm, $\delta_3 = 185.5$ mm, $\delta_2 = 185.5$ mm

internal forces and moments perpendicular to the connection planes

periphery beam

$N_a = -1190.00$ kN, $M_a = 225.00$ kNm, $V_a = 370.00$ kN

calculation of internal forces and moments at periphery column (top)

$N_{a2} = N_a - V_a = 370.00$ kN

$V_{a2} = N_a - V_a = -1190.00$ kN

$M_{a2} = M_a + V_a \cdot \delta_2 - M_a \cdot V_a \cdot \delta_1 - N_a \cdot (\delta_2 - \delta_3) = -76.41$ kNm

partial internal forces and moments

$N_{b1} = -N_a \cdot \delta_2 / \delta_2 + M_a / \delta_2 = 1204.47$ kN, $z_b = 371.0$ mm, $z_{bb} = 185.5$ mm

$N_{b,0} = N_a \cdot \delta_2 / \delta_2 + M_a / \delta_2 = 11.47$ kN, $z_b = 371.0$ mm, $z_{bo} = 185.5$ mm

2.2. resistance of cross-section

elastic cross-sectional check for $N = 1190.00$ kN, $M_y = -225.00$ kNm, $V_z = 370.00$ kN

$\max \sigma_v = \frac{m_y}{z} \leq \sigma_v = 16.74$ kN/cm², $\tau = 8.10$ kN/cm²

verification: $\sigma_v = 21.85$ kN/cm² $\leq \sigma_v = 23.50$ kN/cm² $\Rightarrow U = 0.990 < 1$ ok

utilizations: resistance $U_{u} = 0.990 < 1$ ok, $c/t$-ratio $U_{c/t} = 0.123 < 1$ ok

2.3. verifications

2.3.1. verification of welds at beam section

weld 1: beam flange in tension outer
welds 2, 3: beam flange in tension inner
welds 4, 5: beam web double-sided
weld 8: beam flange in compression outer
welds 6, 7: beam flange in compression inner

calculation section:

weld 1: $a_w = 10.0$ mm $l_w = 300.0$ mm
weld 2: $a_w = 10.0$ mm $l_w = 117.5$ mm
weld 3: siehe weld 2
weld 4: $a_w = 5.0$ mm $l_w = 298.0$ mm
weld 5: siehe weld 4
weld 6: $a_w = 10.0$ mm $l_w = 117.5$ mm
weld 7: siehe weld 6
weld 8: $a_w = 10.0$ mm $l_w = 300.0$ mm

design values referring to centroid of the section:
$N_{b,Ed} = 1190.00$ kN, $M_{b,Ed} = -225.00$ kNm, $V_{b,Ed} = 370.00$ kN

cross-sectional properties referring to centroid of the line cross-section:
ΔA_w = 136.80 cm², A_{w,z} = 29.80 cm², Δl = 166.6 cm
l_{w,y} = 39579.02 cm³, l_{w,z} = 8963.24 cm³, W_{w,z} = 158.98 cm³, Δz_w = 0.0 mm

distribution of internal forces and moments:

weld 1: N_w = 593.53 kN
weld 2: N_w = 219.77 kN
weld 3: siehe weld 2
weld 4: N_w = 129.61 kN  M_{x,w} = -6.27 kNm
weld 5: siehe weld 4
weld 6: N_w = -15.35 kN
weld 7: siehe weld 6
weld 8: N_w = -71.60 kN

from conventional distribution of shear force: V_{z,w} = 370.00 kN

verifications in weld edges:

weld 1, pt. 0: \sigma_{w,x} = 197.84 N/mm²  \Rightarrow U_w = 0.777 < 1 \text{ ok}
weld 2, pt. 0: \sigma_{w,x} = 187.04 N/mm²  \Rightarrow U_w = 0.735 < 1 \text{ ok}
weld 4, pt. 0: \sigma_{w,x} = 171.69 N/mm²  \tau_{w,z} = 124.16 N/mm²  \Rightarrow U_w = 0.901 < 1 \text{ ok}
  pt. 1: \sigma_{w,x} = 2.28 N/mm²  \tau_{w,z} = 124.16 N/mm²  \Rightarrow U_w = 0.597 < 1 \text{ ok}
weld 6, pt. 0: \sigma_{w,x} = -13.06 N/mm²  \Rightarrow U_w = 0.051 < 1 \text{ ok}
weld 8, pt. 0: \sigma_{w,x} = -23.87 N/mm²  \Rightarrow U_w = 0.094 < 1 \text{ ok}

Result:

weld 4, pt. 0: \sigma_{w,x} = 171.69 N/mm²  \tau_{w,z} = 124.16 N/mm²
\text{Max: } \sigma_{1,w,Ed} = 32.44 kN/cm² < f_{w,d} = 36.00 kN/cm²,
\sigma_{2,w,Ed} = 12.14 kN/cm² < f_{w,d} = 25.92 kN/cm²  \Rightarrow U_w = 0.901 < 1 \text{ ok}

2.3.2. verification result

maximum utilization: max U = 0.930 < 1 \text{ ok}

3. final result

maximum utilization: max U = 0.930 < 1 \text{ ok}

verification succeeded