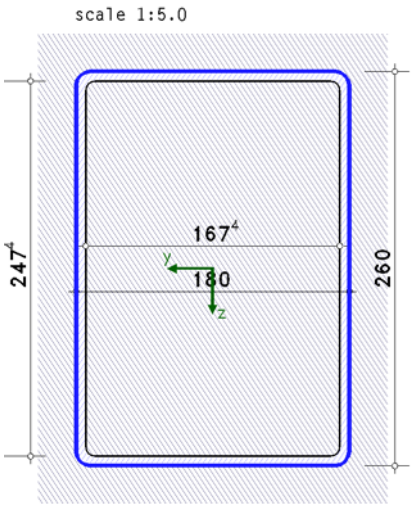
POS. 5: KASTEN, EC3, TABLE

4H-EC3SA version: 10/2014-1m

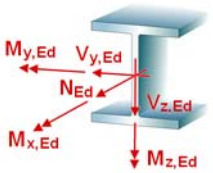
Welded connection

EC 3-1-8 (12.10), NA: Deutschland



material
steel grade S 355
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 MSH260X180X6.3
plate: thickness t_p = 35.0 mm
surrounding fillet weld: a_w = 6.0 mm, 75% decrease of the axial force by pressure contact
design resistance
elastic cross-sectional check
weld verification with the simplified method
resolution of shear force is made by the stiffness of the single weld.

internal forces and moments and utilizations
N_{Ed},$V_{z,Ed}$,$M_{z,Ed}$,$V_{y,Ed}$,$M_{x,Ed}$: internal forces and moments by sign definition of statics
U_σ: stress utilization of cross section, U_w: stress utilization of welds
$U_{c/t}$: c/t-utilization of cross section



Lk	N_{Ed}	$V_{z,Ed}$	$M_{z,Ed}$	$V_{y,Ed}$	$M_{x,Ed}$	U_σ	$U_{c/t}$	U_w
--	kN	kN	kNm	kN	kNm			
1	-82.12	-5.56	51.11	37.78	22.23	0.499	0.754	0.650*
2	-38.25	-0.08	36.27	-2.93	0.31	0.340	0.625	0.445
3	-65.61	-2.54	12.06	20.82	10.14	0.147	0.404	0.189

Final result

maximum utilization [Lk 1]: design resistance max U = 0.650 < 1 ok.
c/t-ratio max U = 0.754 < 1 ok.

verification succeeded

Detailed edition

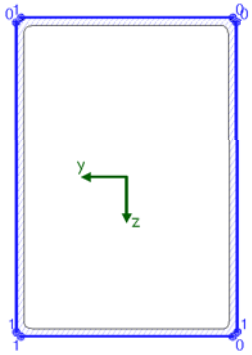
Lk 1:

cross-sectional check

design values: N_{Ed} = -82.12 kN, $V_{z,Ed}$ = -5.56 kN, $M_{z,Ed}$ = 51.11 kNm, $V_{y,Ed}$ = 37.78 kN
elastic stresses: max σ_x = 144.2 N/mm², min σ_x = -175.3 N/mm², max τ = 18.9 N/mm², max σ_v = 177.2 N/mm²
valid stresses: σ_{Rd} = 355.0 N/mm², τ_{Rd} = 205.0 N/mm²
utilizations: design resistance U_σ = 0.499 < 1 **ok.**, c/t-ratio $U_{c/t}$ = 0.754 < 1 **ok.**

verification of welds

calculation section:



weld 1: a_w = 6.0 mm l_w = 172.6 mm
weld 2: a_w = 6.0 mm l_w = 252.6 mm
weld 3: a_w = 6.0 mm l_w = 252.6 mm
weld 4: a_w = 6.0 mm l_w = 172.6 mm

design values:
N_{Ed} = -20.53 kN, $V_{z,Ed}$ = -5.56 kN, $M_{z,Ed}$ = 51.11 kNm, $V_{y,Ed}$ = 37.78 kN, $M_{x,Ed}$ = 22.23 kNm
cross-sectional properties refering to centroid of the line cross section:
ΣA_w = 51.02 cm², Σl_w = 85.0 cm
$I_{w,y}$ = 5111.84 cm⁴, $I_{w,z}$ = 2969.96 cm⁴, $W_{w,t}$ = 561.60 cm³, Δy_w = 0.0 mm, Δz_w = 0.0 mm
member forces distributed to the individual welds:

weld 1:	N_w = -4.17 kN	$M_{z,w}$ = 4.42 kNm	$V_{y,w}$ = 18.86 kN	$V_{z,w}$ = -0.00 kN
weld 2:	N_w = -240.82 kN	$M_{z,w}$ = 0.01 kNm	$V_{y,w}$ = 0.03 kN	$V_{z,w}$ = -2.78 kN
weld 3:	N_w = 228.62 kN	$M_{z,w}$ = 0.01 kNm	$V_{y,w}$ = 0.03 kN	$V_{z,w}$ = -2.78 kN
weld 4:	N_w = -4.17 kN	$M_{z,w}$ = 4.42 kNm	$V_{y,w}$ = 18.86 kN	$V_{z,w}$ = -0.00 kN

verifications in the edge points of the individual welds:

weld 1,	pt. 0:	$\sigma_{w,x}$ = 144.47 N/mm²	$\tau_{w,y}$ = 57.80 N/mm²	$\tau_{w,z}$ = 0.00 N/mm²	$\Rightarrow$ U_w = 0.619 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -152.52 N/mm²	$\tau_{w,y}$ = 57.80 N/mm²	$\tau_{w,z}$ = 0.00 N/mm²	$\Rightarrow$ U_w = 0.649 < 1 **ok.**
weld 2,	pt. 0:	$\sigma_{w,x}$ = -158.91 N/mm²	$\tau_{w,y}$ = 0.02 N/mm²	$\tau_{w,z}$ = 37.76 N/mm²	$\Rightarrow$ U_w = 0.650 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -158.91 N/mm²	$\tau_{w,y}$ = 0.02 N/mm²	$\tau_{w,z}$ = 37.76 N/mm²	$\Rightarrow$ U_w = 0.650 < 1 **ok.**
weld 3,	pt. 0:	$\sigma_{w,x}$ = 150.86 N/mm²	$\tau_{w,y}$ = 0.02 N/mm²	$\tau_{w,z}$ = 41.42 N/mm²	$\Rightarrow$ U_w = 0.622 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = 150.86 N/mm²	$\tau_{w,y}$ = 0.02 N/mm²	$\tau_{w,z}$ = 41.42 N/mm²	$\Rightarrow$ U_w = 0.622 < 1 **ok.**
weld 4,	pt. 0:	$\sigma_{w,x}$ = 144.47 N/mm²	$\tau_{w,y}$ = 21.38 N/mm²	$\tau_{w,z}$ = 0.00 N/mm²	$\Rightarrow$ U_w = 0.581 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -152.52 N/mm²	$\tau_{w,y}$ = 21.38 N/mm²	$\tau_{w,z}$ = 0.00 N/mm²	$\Rightarrow$ U_w = 0.612 < 1 **ok.**

Result:
weld 2, pt. 0: $\sigma_{w,x}$ = -158.91 N/mm² $\tau_{w,y}$ = 0.02 N/mm² $\tau_{w,z}$ = 37.76 N/mm²
$F_{w,Ed}$ = 9.24 kN/cm < $F_{w,Rd}$ = 15.09 kN/cm $\Rightarrow$ U_w = 0.650 < 1 **ok.**