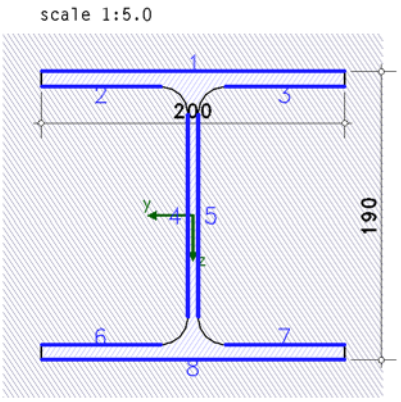
POS. 1: I-SECTION, EC3, TABLE

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

Welded connection

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

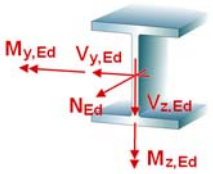


material
steel grade S 235
partial safety factors for material
resistance of cross sections γ_{M0} = 1.00
resistance of bolts, welds, plates in bearing γ_{M2} = 1.25
geometry
section HE200A
plate: thickness t_p = 35.0 mm
welds as fillet weld:

a_{w1} = 6.0 mm, l_{w1} = 200.0 mm	a_{w1} = 3.0 mm, l_{w1} = 200.0 mm	a_{w2} = 6.0 mm, l_{w2} = 78.8 mm
a_{w3} = 6.0 mm, l_{w3} = 78.8 mm	a_{w4} = 6.0 mm, l_{w4} = 134.0 mm	a_{w5} = 6.0 mm, l_{w5} = 134.0 mm
a_{w6} = 6.0 mm, l_{w6} = 78.8 mm	a_{w7} = 6.0 mm, l_{w7} = 78.8 mm	a_{w8} = 6.0 mm, l_{w8} = 200.0 mm
a_{w8} = 3.0 mm, l_{w8} = 200.0 mm		

length of welds is not checked.
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},$V_{z,Ed}$,$M_{z,Ed}$,$V_{y,Ed}$: 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}	$V_{z,Ed}$	$M_{z,Ed}$	$V_{y,Ed}$	U_σ	$U_{c/t}$	U_w
--	kN	kN	kNm	kN			
1	8.44	-2.30	-2.65	6.54	0.091	0.136	0.100
2	14.15	-6.21	21.68	5.42	0.700	0.408	0.759*
3	-11.73	2.06	-16.15	7.96	0.522	0.360	0.566

Final result

maximum utilization [Lk 2]: design resistance max U = 0.759 < 1 ok.
c/t-ratio max U = 0.408 < 1 ok.

verification succeeded

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/NA, Nationaler Anhang zur DIN EN 1993-1-1, Ausgabe Dezember 2010

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

Detailed edition

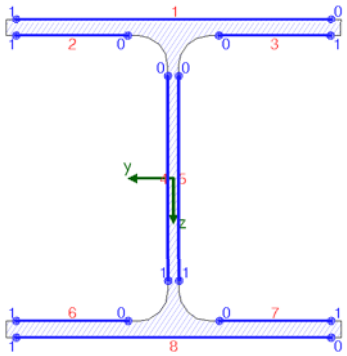
Lk 2:

cross-sectional check

design values: N_{Ed} = 14.15 kN, $V_{z,Ed}$ = -6.21 kN, $M_{z,Ed}$ = 21.68 kNm, $V_{y,Ed}$ = 5.42 kN
elastic stresses: max σ_x = 164.5 N/mm², min σ_x = -159.2 N/mm², max τ = 5.5 N/mm², max σ_v = 164.5 N/mm²
valid stresses: σ_{Rd} = 235.0 N/mm², τ_{Rd} = 135.7 N/mm²
utilizations: design resistance U_σ = 0.700 < 1 **ok.**, c/t-ratio $U_{c/t}$ = 0.408 < 1 **ok.**

verification of welds

calculation section:
weld 4: weld thickness a = 6.0 mm > $a_{max} = t_{min}$ = 4.6 mm !!
weld 5: weld thickness a = 6.0 mm > $a_{max} = t_{min}$ = 4.6 mm !!



weld 1:	a_w = 6.0 mm	l_w = 188.0 mm
weld 2:	a_w = 6.0 mm	l_w = 66.8 mm
weld 3:	a_w = 6.0 mm	l_w = 66.8 mm
weld 4:	a_w = 6.0 mm	l_w = 122.0 mm
weld 5:	a_w = 6.0 mm	l_w = 122.0 mm
weld 6:	a_w = 6.0 mm	l_w = 66.8 mm
weld 7:	a_w = 6.0 mm	l_w = 66.8 mm
weld 8:	a_w = 6.0 mm	l_w = 188.0 mm

design values:
N_{Ed} = 14.15 kN, $V_{z,Ed}$ = -6.21 kN, $M_{z,Ed}$ = 21.68 kNm, $V_{y,Ed}$ = 5.42 kN
cross-sectional properties refering to centroid of the line cross section:
ΣA_w = 53.22 cm², Σl_w = 88.7 cm
$I_{w,y}$ = 3376.23 cm⁴, $I_{w,z}$ = 1314.73 cm⁴, Δy_w = 0.0 mm, Δz_w = 0.0 mm
member forces distributed to the individual welds:

weld 1:	N_w = 3.00 kN	$M_{z,w}$ = 5.48 kNm	$V_{y,w}$ = 2.49 kN	$V_{z,w}$ = -0.01 kN
weld 2:	N_w = -38.98 kN	$M_{z,w}$ = 0.25 kNm	$V_{y,w}$ = 0.11 kN	$V_{z,w}$ = -0.00 kN
weld 3:	N_w = 41.11 kN	$M_{z,w}$ = 0.25 kNm	$V_{y,w}$ = 0.11 kN	$V_{z,w}$ = -0.00 kN
weld 4:	N_w = -1.98 kN	$M_{z,w}$ = 0.00 kNm	$V_{y,w}$ = 0.00 kN	$V_{z,w}$ = -3.09 kN
weld 5:	N_w = 5.87 kN	$M_{z,w}$ = 0.00 kNm	$V_{y,w}$ = 0.00 kN	$V_{z,w}$ = -3.09 kN
weld 6:	N_w = -38.98 kN	$M_{z,w}$ = 0.25 kNm	$V_{y,w}$ = 0.11 kN	$V_{z,w}$ = -0.00 kN
weld 7:	N_w = 41.11 kN	$M_{z,w}$ = 0.25 kNm	$V_{y,w}$ = 0.11 kN	$V_{z,w}$ = -0.00 kN
weld 8:	N_w = 3.00 kN	$M_{z,w}$ = 5.48 kNm	$V_{y,w}$ = 2.49 kN	$V_{z,w}$ = -0.01 kN

verifications in the edge points of the individual welds:

weld 1,	pt. 0:	$\sigma_{w,x}$ = 157.69 N/mm²	$\tau_{w,y}$ = 2.20 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow U_w$ = 0.759 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -152.38 N/mm²	$\tau_{w,y}$ = 2.20 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow U_w$ = 0.733 < 1 **ok.**
weld 2,	pt. 0:	$\sigma_{w,x}$ = -42.28 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow U_w$ = 0.203 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -152.38 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow U_w$ = 0.733 < 1 **ok.**
weld 3,	pt. 0:	$\sigma_{w,x}$ = 47.60 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow U_w$ = 0.229 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = 157.69 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow U_w$ = 0.759 < 1 **ok.**

weld 4,	pt. 0:	$\sigma_{w,x}$ = -2.70 N/mm²	$\tau_{w,y}$ = 0.00 N/mm²	$\tau_{w,z}$ = 4.21 N/mm²	$\Rightarrow$ U_w = 0.024 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -2.70 N/mm²	$\tau_{w,y}$ = 0.00 N/mm²	$\tau_{w,z}$ = 4.21 N/mm²	$\Rightarrow$ U_w = 0.024 < 1 **ok.**
weld 5,	pt. 0:	$\sigma_{w,x}$ = 8.02 N/mm²	$\tau_{w,y}$ = 0.00 N/mm²	$\tau_{w,z}$ = 4.21 N/mm²	$\Rightarrow$ U_w = 0.044 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = 8.02 N/mm²	$\tau_{w,y}$ = 0.00 N/mm²	$\tau_{w,z}$ = 4.21 N/mm²	$\Rightarrow$ U_w = 0.044 < 1 **ok.**
weld 6,	pt. 0:	$\sigma_{w,x}$ = -42.28 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow$ U_w = 0.203 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -152.38 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow$ U_w = 0.733 < 1 **ok.**
weld 7,	pt. 0:	$\sigma_{w,x}$ = 47.60 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow$ U_w = 0.229 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = 157.69 N/mm²	$\tau_{w,y}$ = 0.28 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow$ U_w = 0.759 < 1 **ok.**
weld 8,	pt. 0:	$\sigma_{w,x}$ = 157.69 N/mm²	$\tau_{w,y}$ = 2.20 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow$ U_w = 0.759 < 1 **ok.**
	pt. 1:	$\sigma_{w,x}$ = -152.38 N/mm²	$\tau_{w,y}$ = 2.20 N/mm²	$\tau_{w,z}$ = 0.01 N/mm²	$\Rightarrow$ U_w = 0.733 < 1 **ok.**

Result:

weld 1, pt. 0: $\sigma_{w,x}$ = 157.69 N/mm² $\tau_{w,y}$ = 2.20 N/mm² $\tau_{w,z}$ = 0.01 N/mm²

$F_{w,Ed}$ = 9.14 kN/cm < $F_{w,Rd}$ = 12.47 kN/cm $\Rightarrow$ U_w = 0.759 < 1 **ok.**