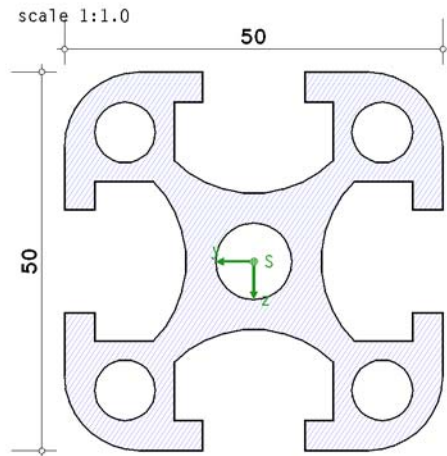


POS. 1: SPEZIAL, AL6060, FEM

verification of cross-section EC 3-1-8 (12.10), NA: Deutschland

1. input report



aluminium

alloy 6060, T6, $t \leq 20$ mm

material safety factor

resistance of cross-sections $\gamma_{M0} = 1.10$

geometry

section depth, width $h = 50.0$ mm, $b = 50.0$ mm

centroid $y_s = -25.0$ mm, $z_s = 25.0$ mm

cross-sectional area $A = 10.19$ cm²

second moment of area $I_y = 22.92$ cm⁴, $I_z = 22.92$ cm⁴

torsional moment of inertia $I_T = 3.78$ cm⁴

warping moment of inertia $I_\omega = 16.90$ cm⁶

resistance

elastic verification, calculation with FE-method

valid normal, shear-, equivalent stress: $\sigma_{x,Rd} = 145.5$ N/mm², $\tau_{Rd} = 84.0$ N/mm², $\sigma_{v,Rd} = 159.3$ N/mm²

notes

aluminium alloy cross-sections must be at least in class 3.

buckling is not investigated.

2. table of results

internal forces and moments and utilizations

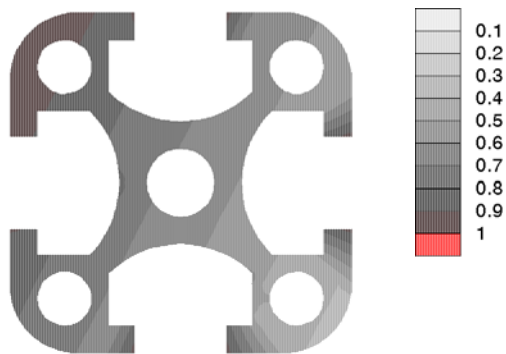
Lk	N_{Ed} kN	$M_{y,Ed}$ kNcm	$V_{z,Ed}$ kN	$M_{z,Ed}$ kNcm	$T_{t,Ed}$ kNcm	B_{Ed} kNcm ²	U	
--								
1	-100.00	15.00	---	30.00	---	---	0.978*	compression and bending
2	---	---	10.00	---	10.00	---	0.866	shear force and torsion
3	---	---	---	---	---	70.00	0.939	warping

$N_{Ed}, M_{y,Ed}, V_{z,Ed}, M_{z,Ed}, T_{t,Ed}, B_{Ed}$: internal forces and moments by sign definition of statics; U: total utilization

*) maximum utilization

3. final result

maximum stress utilization max U_{σ} due to 3 Lk
max max $U_{\sigma} = 0.978$



maximum stress utilization max U_{σ} due to 3 Lk

y mm	z mm	ε ‰	σ_x N/mm ²	τ N/mm ²	σ_v N/mm ²	U_{σ}
1.0	5.6	-2.582	-142.23	0.00	142.23	0.978

y,z: node coordinates; ε : cross-sectional strains; σ_x, τ, σ_v : stresses; U_{σ} : stress utilization

maximum utilization [Lk 1]: resistance max $U = 0.978 < 1$ **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 1999-1-1, Eurocode 9: Bemessung and Konstruktion von aluminiumtragwerken -

Teil 1-1: Allgemeine Bemessungsregeln;

Deutsche Fassung EN 1999-1-1:2007 + A1:2009 + A2:2013, Ausgabe März 2014

DIN EN 1999-1-1/NA, Nationaler Anhang zur DIN EN 1999-1-1, Ausgabe Mai 2013

DIN EN 1999-1-1/NA - A1:2014 + A2:2015 + A3:2015, Änderungen

5. Lk 1 (decisive)

5.1. verification of cross-section

5.1.1. elastic verification

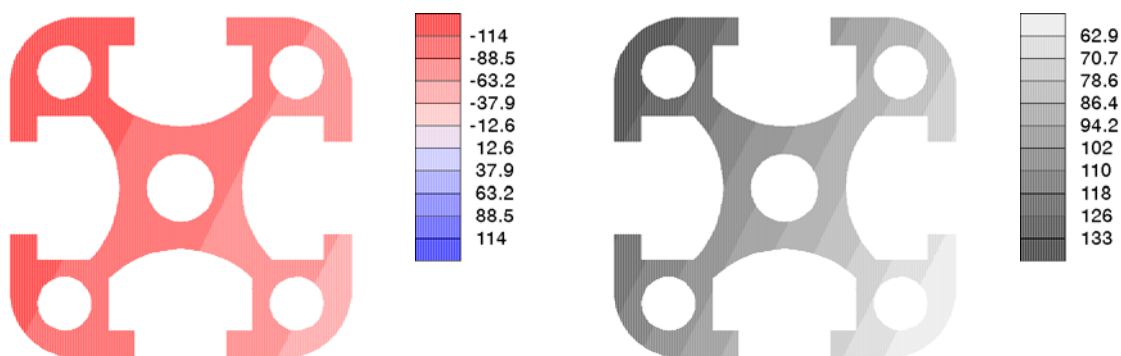
elastic verification for $N = -100.00$ kN, $M_y = 0.15$ kNm, $M_z = 0.30$ kNm

normal stresses σ_x [N/mm²]

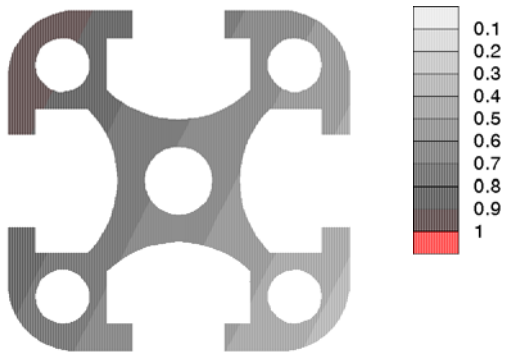
min $\sigma_x = -142.2$, max $\sigma_x = -54.1$

equivalent stresses σ_v [N/mm²]

max $\sigma_v = 142.2$



utilization U_σ
max $U_\sigma = 0.978$



stresses, utilizations

y mm	z mm	σ_x N/mm ²	σ_y N/mm ²	U_σ
-1.0	5.6	-142.23	142.23	0.978
-49.0	44.4	-54.06	54.06	0.372

y,z: node coordinates; σ_x, σ_y : stresses; U_σ : stress utilization

verifications

max $|\sigma_x| = 142.23 \text{ N/mm}^2 < \sigma_{x,Rd} = 145.45 \text{ N/mm}^2 \Rightarrow U_{\sigma_x} = 0.978 < 1$ **ok**

max $\sigma_y = 142.23 \text{ N/mm}^2 < \sigma_{y,Rd} = 159.34 \text{ N/mm}^2 \Rightarrow U = 0.893 < 1$ **ok**

total: max $U_\sigma = 0.978 < 1$ **ok**