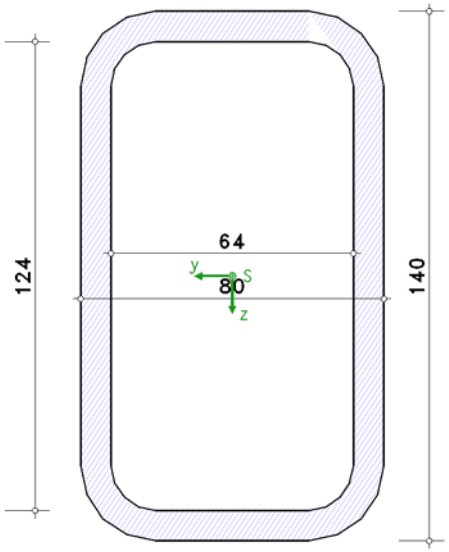
POS. 4: RR 140, S355, FEM+DIV

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

1. input report

scale 1:2.0



steel
steel grade S235
material safety factor
resistance of cross-sections γ_{M0} = 1.00
geometry
section RR 140 x 80 x 8.0(k)
resistance
elastic verification, calculation with FE-method
plastic verification with strain iteration
valid normal, shear-, equivalent stress: $\sigma_{x,Rd}$ = 235.0 N/mm², τ_{Rd} = 135.7 N/mm², $\sigma_{v,Rd}$ = 235.0 N/mm²
internal forces and moments refering to local axes of cross-section
σ-generating forces (N, M) work at centroid, τ-generating forces (V, T_t) work at shear center
warping forces (T_ω, B) work at shear center
Lk 1: B_{Ed} = 1600.00 kNcm²

notes
buckling is not investigated.

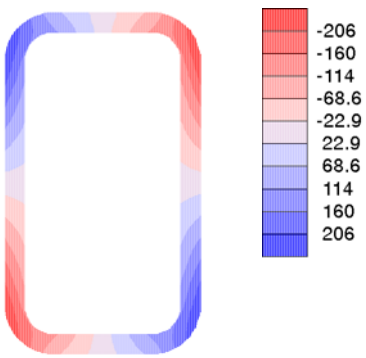
2. Lk 1

2.1. verification of cross-section

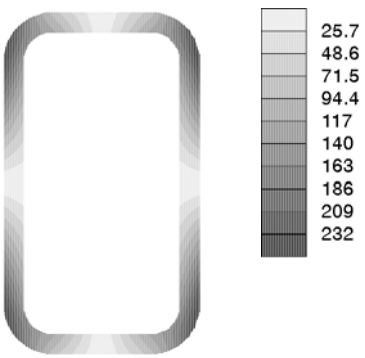
2.1.1. elastic verification

elastic verification for B = 0.16 kNm²

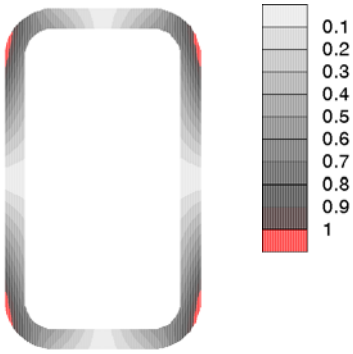
normal stresses σ_x [N/mm²]
min σ_x = -257.4, max σ_x = 257.4



equivalent stresses σ_v [N/mm²]
max σ_v = 257.4



utilization U_σ
max U_σ = 1.095



stresses, utilizations

y mm	z mm	σ_x N/mm²	σ_v N/mm²	U_σ
-0.4	16.1	257.36	257.36	1.095 > 1
-0.4	123.9	-257.36	257.36	1.095 > 1
-79.6	123.9	257.36	257.36	1.095 > 1
-79.6	16.1	-257.36	257.36	1.095 > 1

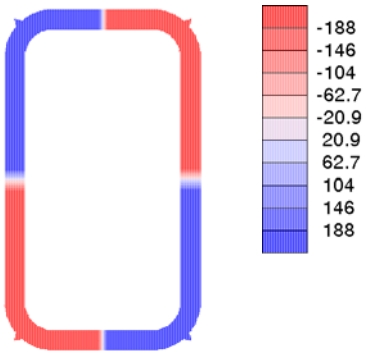
y,z: node coordinates; σ_x,σ_v: stresses; U_σ: stress utilization

verification: max σ_v = 257.36 N/mm² > $\sigma_{v,Rd}$ = 235.00 N/mm² ⇒ U = 1.095 > 1 fault !!

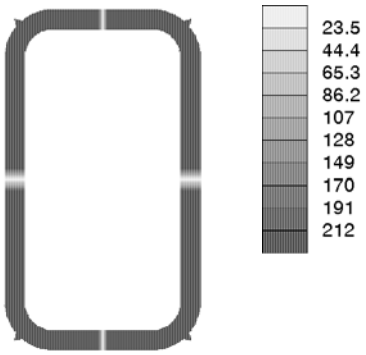
2.1.2. plastic verification

plastic verification for B = 0.16 kNm²
shear stresses not ensured.
max. load factor of normal stresses (plastic): $f_{\sigma,pl}$ = 1.616 ⇒ $U_{\sigma,pl}$ = 0.619
total: utilization: U_{pl} = 0.619 < 1 ok

normal stresses σ_x [N/mm²]
min σ_x = -235.0, max σ_x = 235.0



equivalent stresses σ_v [N/mm²]
max σ_v = 235.0



stresses

y mm	z mm	σ_x N/mm²	σ_v N/mm²
-4.0	136.0	-235.00	235.00
-76.0	136.0	235.00	235.00

y,z: node coordinates; σ_x,σ_v: stresses

3. final result

maximum utilization: resistance max U = 1.095 > 1 fault !!

resistance not ensured !!

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 September 2017