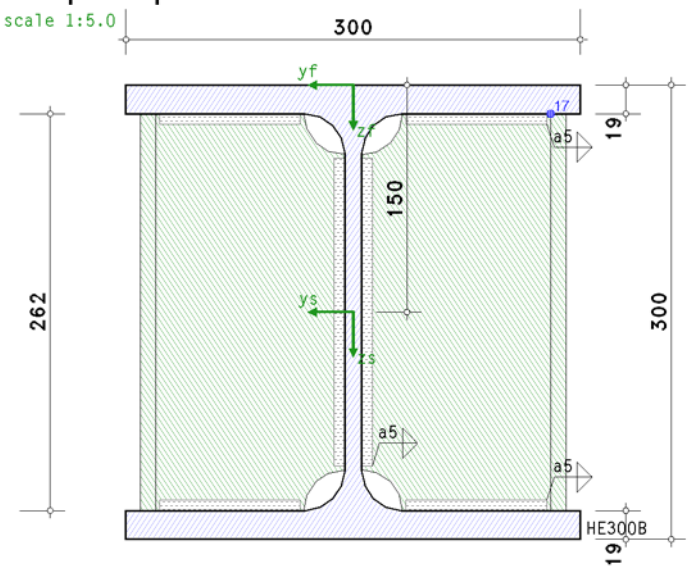
detailed problems acc. to Eurocode 3, EC 3-1-9 (12.10), NA: Deutschland 4H-EC3EM version: 11/2016-1g

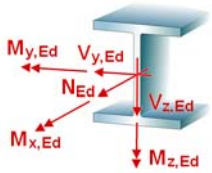
1. input report



local loading in einen Biegeträger
steel grade
steel grade S235
cross-section
beam: section HE300B
transverse stiffeners: section ½ IPE270
recess at transverse stiffener $c_{st,q}$ = 27.0 mm
weld thickness $a_{st,q}$ = 5.0 mm
parameters
damage equivalent stress factors λ_σ = 0.315, λ_τ = 0.500
notch class / valid notch stresses bei N = $2 \cdot 10^6$ cycles:

Pt.	y_f mm	z_f mm	$\Delta\sigma_{x,Rd}$ N/mm²	$\Delta\tau_{Rd}$ N/mm²	$\Delta\sigma_{z,Rd}$ N/mm²	notch point	EC 3-1-9, tab.
17	-130.3	19.0	80.0	0.0	0.0	due to transv.stiff.	8.4(7)

loading
Lk 1: $M_{y,Ed}$ = -85.2 kNm
Lk 2: $M_{y,Ed}$ = 0.0 kNm
material safety factor
design concept: damage tolerance, damage consequence: high ⇒ fatigue strength γ_{Mf} = 1.15



2. fatigue design

check of stress ranges.

cross-sectional properties
A = 149.08 cm², z_s = 150.0 mm, I_y = 25165.90 cm⁴, y_s = 0.0 mm, I_z = 8562.83 cm⁴

effective loading length $l_{eff} = s_s + 2 \cdot t_f$ = 38.0 mm, s_s = 0.0 mm

length of local loading
pt. 17: y_f = -130.3 mm, z_f = 19.0 mm stress range $\Delta\sigma_{x,Ed}$ = 44.4 N/mm² ≤ $1.5 \cdot f_y$ = 352.5 N/mm² ok

elastic stresses / stress ranges
$\Delta\sigma_{x,Ed} = \sigma_{x,max} - \sigma_{x,min}$, $\tau_{Ed} = \tau_{xz,max} - \tau_{xz,min} + 2 \cdot \tau_0$, $\Delta\sigma_{z,Ed} = -\sigma_{0z}$
pt. 17: y_f = -130.3 mm, z_f = 19.0 mm Lk 1: σ_x = 44.4 N/mm²
2: σ_x = 0.0 N/mm²
$\Delta\sigma_{x,Ed}$ = 44.4 N/mm²

equivalent constand amplitude stress range
$\Delta\sigma_{x,f} = \Delta\sigma_{x,Ed} \cdot \lambda_\sigma$, $\Delta\tau_f = \Delta\tau_{Ed} \cdot \lambda_\tau$, $\Delta\sigma_{z,f} = \Delta\sigma_{z,Ed} \cdot \lambda_\sigma$
pt. 17: y_f = -130.3 mm, z_f = 19.0 mm $\Delta\sigma_{x,f}$ = 14.0 N/mm²

valid notch stresses

$\Delta\sigma_{x,Rd,f} = \Delta\sigma_{x,Rd}/\gamma_{Mf}$, $\Delta\tau_{Rd,f} = \Delta\tau_{Rd}/\gamma_{Mf}$, $\Delta\sigma_{z,Rd,f} = \Delta\sigma_{z,Rd}/\gamma_{Mf}$

pt. 17: y_f = -130.3 mm, z_f = 19.0 mm $\Delta\sigma_{x,Rd,f}$ = 69.6 N/mm²

verification of notch stresses

pt. 17: y = -130.3 mm, z = 19.0 mm $\Delta\sigma_{x,f}$ = 14.0 N/mm² < $\Delta\sigma_{x,Rd,f}$ = 69.6 N/mm² ⇒ $U_{\Delta\sigma x}$ = 0.201 ok

3. final result

fatigue design [pt. 17]: max U = 0.201 < 1 ok

verification succeeded