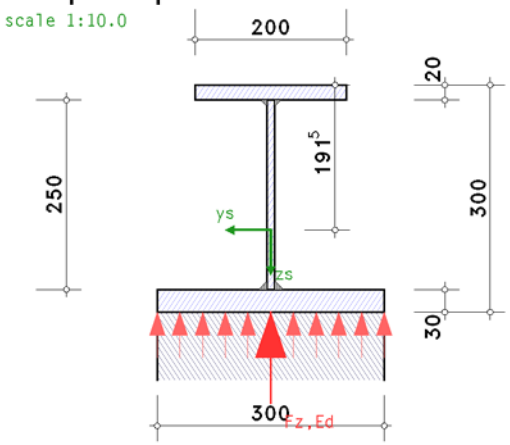
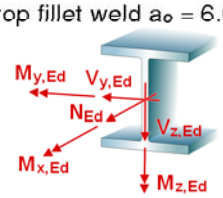
POS. 2: BSP. 1 AUFLAGER

detailed problems acc. to Eurocode 3, EC 3-6 (12.10), NA: Deutschland 4H-EC3LK version: 11/2016-1f

1. input report



steel grade
steel grade S235
cross-section
beam: parameter (I-section):
h = 300.0 mm, t_w = 10.0 mm, b_{fo} = 200.0 mm, t_{fo} = 20.0 mm, b_{fu} = 300.0 mm, t_{fu} = 30.0 mm, top fillet weld a_o = 6.0 mm, bot
loading
internal forces and moments at limit state of resistance (ULS):
Lk 1: $M_{y,Ed}$ = 267.0 kNm, $V_{z,Ed}$ = 175.0 kN
transverse loading on bottom flange:
vertical single load $F_{z,Ed,ULS}$ = 180.00 kN an einem Auflager, effective Lagerlänge b_{eff} = 80.0 mm
verification at end of beam at c = 5.0 mm
partial safety factors for material
resistance of cross-sections γ_{M0} = 1.00



2. verification der local loading

assumption: flange induced web buckling is excluded.
assumption: plated structures-/shear buckling is excluded.

cross-sectional properties: A = 155.00 cm², z_s = 191.5 mm, I_y = 22968.40 cm⁴, y_s = 0.0 mm, I_z = 8085.42 cm⁴

feed length of load by das Auflager $s_s = b_{eff}$ = 80.0 mm
effective loading length $l_{eff} = s_s + 2 \cdot t_f$ = 140.0 mm
length of local loading:
refering to outer edge of flange $s_s = l_{eff} - 2 \cdot t_f$ = 80.0 mm / auf den webanschnitt $s_w = l_{eff}$ = 140.0 mm

2.1. compression of web (ULS)

permissible stresses: $\sigma_{Rd} = f_y/\gamma_{M0}$ = 235.0 N/mm², $\tau_{Rd} = f_y/(3^{1/2} \cdot \gamma_{M0})$ = 135.7 N/mm²

compression of single load at first cut of web:
local stresses $\sigma_{oz,Ed}$ = -128.6 N/mm², $\tau_{oxz,Ed}$ = 0.0 N/mm²
$|\sigma_{oz,Ed}|$ = 128.6 N/mm² < σ_{Rd} = 235.0 N/mm² ⇒ U = 0.547 < 1 ok

stresses at first cut of web:
Lk 1: $M_{y,Ed}$ = -267.0 kNm, $V_{z,Ed}$ = -175.0 kN
stresses $\sigma_{x,Ed}$ = -128.6 N/mm², $\tau_{xz,Ed}$ = 0.0 N/mm²
$|\sigma_{x,Ed}|$ = 91.3 N/mm² < σ_{Rd} = 235.0 N/mm² ⇒ U = 0.389 < 1 ok
$|\tau_{xz,Ed}|$ = 70.0 N/mm² < τ_{Rd} = 135.7 N/mm² ⇒ U = 0.516 < 1 ok
σ_v = 226.5 N/mm² < σ_{Rd} = 235.0 N/mm² ⇒ U = 0.964 < 1 ok

maximum utilization: max U_{ULS} = 0.964 < 1 ok

2.2. buckling of transverse loading (ULS)

slenderness $\lambda_F = (F_y/F_{cr})^{1/2} = 0.419$, $F_y = 538.1$ kN
reduction factor $\chi_F = 1.000$
resistance of buckling $F_{z,Rd} = f_y \cdot L_{eff} \cdot t_w/\gamma_{M1} = 489.15$ kN, $L_{eff} = \chi_F \cdot l_y = 229.0$ mm, $l_y = 229.0$ mm
verification: $F_{z,Ed}/F_{z,Rd} = 0.368 < 1$ ok

interaction (without plated structures-/shear buckling):
transverse loading and equivalent stress $(\eta_2 + 0.8 \cdot \eta_1) / 1.4 = 0.814 < 1$ ok
with $\eta_2 = F_{z,Ed}/F_{z,Rd} = 0.368$, $\eta_1 = \max U_{ULS} = 0.964$

3. final result

maximum utilization: max U = 0.964 < 1 ok

verification succeeded