

POS. 165: SEESSELBERG, 12.4.3 (ULS)

detailed problems acc. to Eurocode 3

EC 3-6 (12.10), NA: Deutschland

steel grade

steel grade S 235

cross-section

beam: section HE360A

loading

Lk 1: EK 1 (ULS)

$$M_{y,Ed} = 174.7 \text{ kNm}, M_{z,Ed} = 6.2 \text{ kNm}$$

transverse loading on lower edge of cross-section:

design value of vertical wheel load $F_{z,Ed} = 14.78 \text{ kN}$ (per side)

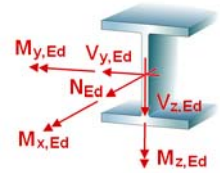
distance of wheel axes $a_R = 100.0 \text{ cm}$

distance of wheel from lateral edge of flange $n_y = 14.0 \text{ mm}$

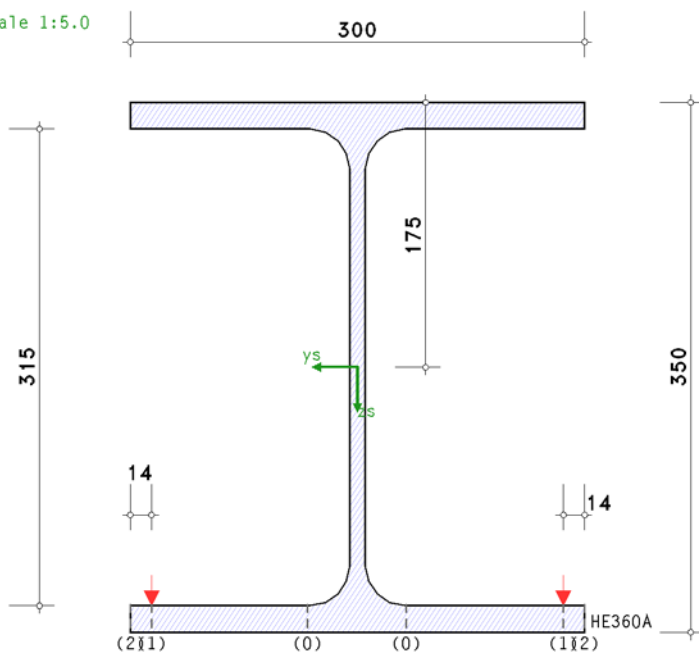
wheel at end of beam (unsupported lower flange, reinforced)

partial safety factors for material

resistance of cross-sections $\gamma_{M0} = 1.00$



scale 1:5.0



Verification of Local Loading due to Crane Gantry

reinforcement of lower flange at end of beam: minimum dimensions $t_p = 17.5 \text{ mm} \times b_p = 300.0 \text{ mm}$

cross-sectional properties

$A = 142.76 \text{ cm}^2$, $z_s = 175.0 \text{ mm}$, $I_y = 33090.11 \text{ cm}^4$, $y_s = 0.0 \text{ mm}$, $I_z = 7886.85 \text{ cm}^4$

effective loading length from crane gantry

wheel at unsupported end of flange

effective length $l_{eff} = 2 \cdot (m+n) = 246.8 \text{ mm}$, $m = 109.4 \text{ mm}$, $n = 14.0 \text{ mm}$

local stresses from crane gantry at lower flange

$\sigma_{ux,Ed}(0) = 9.3 \text{ N/mm}^2$, $\sigma_{ux,Ed}(1) = 112.1 \text{ N/mm}^2$, $\sigma_{ux,Ed}(2) = 106.6 \text{ N/mm}^2$

$\sigma_{uy,Ed}(0) = -91.9 \text{ N/mm}^2$, $\sigma_{uy,Ed}(1) = 25.7 \text{ N/mm}^2$, $\sigma_{uy,Ed}(2) = 0.0 \text{ N/mm}^2$

75% of local stresses from crane gantry:

$\sigma_{ux,Ed}(0) = 6.9 \text{ N/mm}^2$, $\sigma_{ux,Ed}(1) = 84.1 \text{ N/mm}^2$, $\sigma_{ux,Ed}(2) = 79.9 \text{ N/mm}^2$

$\sigma_{uy,Ed}(0) = -68.9 \text{ N/mm}^2$, $\sigma_{uy,Ed}(1) = 19.3 \text{ N/mm}^2$, $\sigma_{uy,Ed}(2) = 0.0 \text{ N/mm}^2$

design resistance of lower flange

permissible stress: $\sigma_{Rd} = f_y / \gamma_{M0} = 235.0 \text{ N/mm}^2$

Lk 1:



normal stress $\sigma_{x,Ed} = 87.8 \text{ N/mm}^2$

$F_{z,Rd} = (I_{eff} \cdot t_{fu}^2 \cdot \sigma_{Rd}) / (4 \cdot m) \cdot [1 - (\sigma_{x,Ed} / \sigma_{Rd})^2] = 34.9 \text{ kN}$

$F_{z,Ed} = 14.8 \text{ kN} < F_{z,Rd} = 34.9 \text{ kN} \Rightarrow U = 0.423 < 1 \text{ ok.}$

Final Result

maximum utilization: $\max U = 0.423 < 1 \text{ ok.}$

verification succeeded