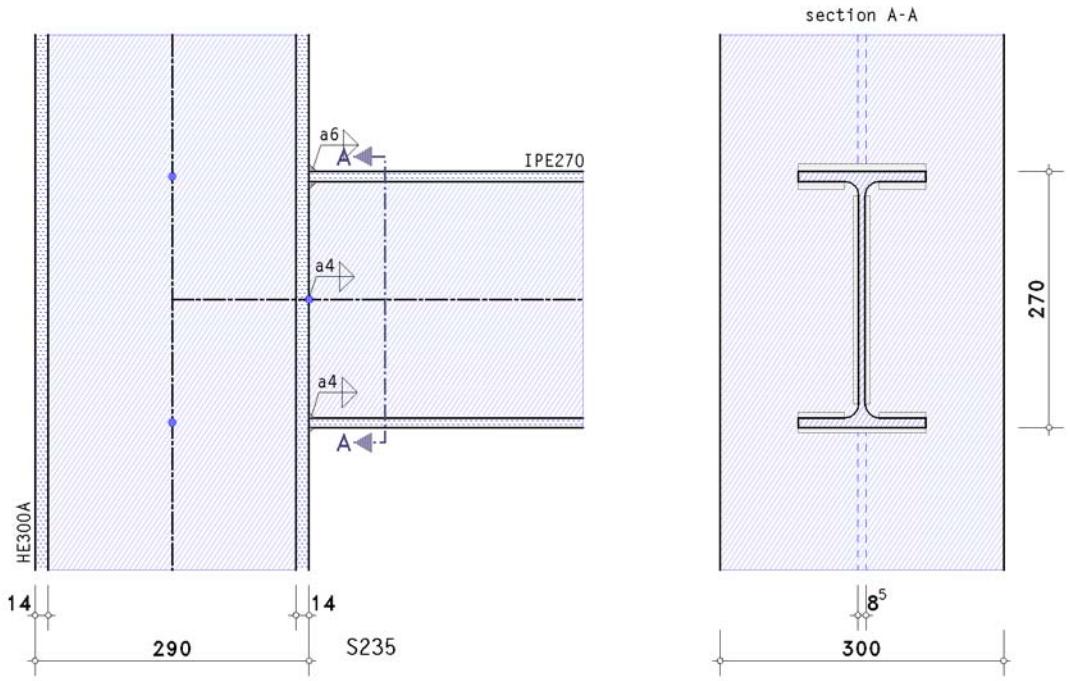
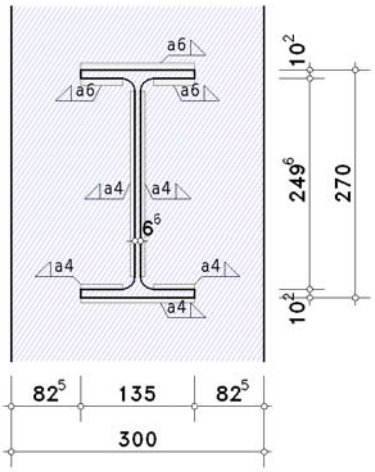
Rigid beam connection EC 3-1-8 (04.25), NA: Deutschland 4H-EC3BT version: 10/2019-2w

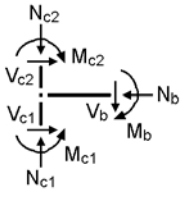
1. input report



details (section A - A)



steel grade
steel grade S235
column parameters
section HE300A
beam parameters
section IPE270
verification parameters
welded connection
welds at the connection point:
beam flange top: fillet weld, weld thickness a = 6.0 mm
beam web: fillet weld, weld thickness a = 4.0 mm
beam flange below: fillet weld, weld thickness a = 4.0 mm
internal forces and moments at the joint periphery refering to the system axes
Lc 1: $M_{b,Ed}$ = 75.00 kNm $V_{b,Ed}$ = 80.00 kN
$N_{c1,Ed}$ = 300.00 kN $M_{c1,Ed}$ = 55.00 kNm (below)



partial safety factors for material
resistance of cross-sections γ_{M0} = 1.00
resistance of members in stability failure γ_{M1} = 1.10
resistance of bolts, welds, plates in bearing γ_{M2} = 1.25

notes
no verification for cross-sections.

welds are not checked.
Die shear resistance of column flange is not respected.

check of data
ok

2. table of results

utilization

Lc	U
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1	1.034*

U: utilization of the connection
*) maximum utilization

3. final result

maximum utilization: max U = 1.034 > 1 not ok !!

resistance not ensured !!

4. Regulations

EN 1990, Eurocode 0: Grundlagen der Tragwerksplanung;
Deutsche Fassung EN 1990:2002 + A1:2005 + A1:2005/AC:2010, Ausgabe Dezember 2010
EN 1990/NA, Nationaler Anhang zur EN 1990, Ausgabe Dezember 2010

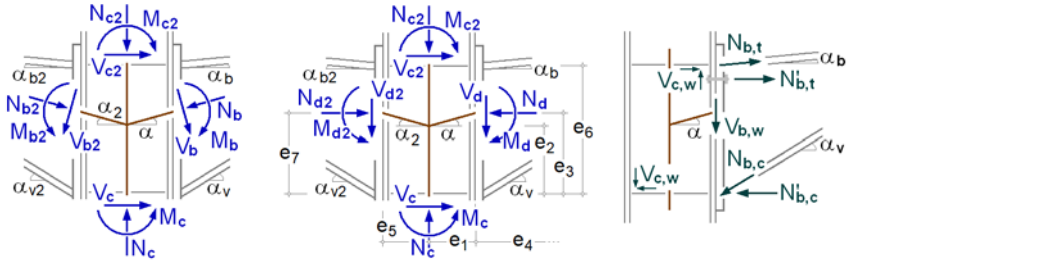
EN 1993-1-1, Eurocode 3: Bemessung und Konstruktion von Stahlbauten -
Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau;
Deutsche Fassung EN 1993-1-1:2022, Ausgabe April 2025
EN 1993-1-1/NA, Nationaler appendix zur EN 1993-1-1, Ausgabe Oktober 2022

EN 1993-1-8, Eurocode 3: Bemessung und Konstruktion von Stahlbauten -
Teil 1-8: Bemessung von Anschlüssen;
Deutsche Fassung EN 1993-1-8:2024, Ausgabe April 2025
EN 1993-1-8/NA, Nationaler appendix zur EN 1993-1-8, Ausgabe November 2020

5. Lc 1 (decisive)

5.1. design values

periphery connection ⊥ zur connection plane partial internal forces and moments



slope angle: $\alpha_b = \alpha = \alpha_v = 0°$
distance: $e_1 = 145.0$ mm, $e_3 = 129.9$ mm, $e_2 = 129.9$ mm, $e_6 = 259.8$ mm

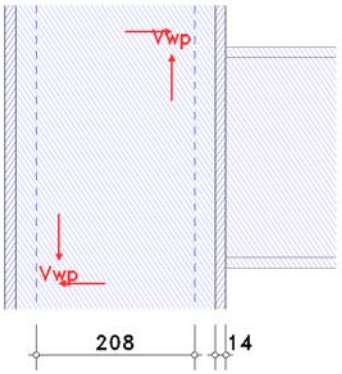
internal forces and moments perpendicular to the connection planes
periphery beam
$M_d = 75.00$ kNm, $V_d = 80.00$ kN
periphery column (below)
$N_c = 300.00$ kN, $M_c = 55.00$ kNm

partial internal forces and moments
$N_{b,t} = -N_d \cdot z_{bu}/z_b + M_d/z_b = 288.68$ kN, $z_b = 259.8$ mm, $z_{bu} = 129.9$ mm
$N_{b,c} = N_d \cdot z_{bo}/z_b + M_d/z_b = 288.68$ kN, $z_b = 259.8$ mm, $z_{bo} = 129.9$ mm
$V_{b,t} = -N_{b,t} \cdot \sin(\alpha_b) = 0.00$ kN, $V_{b,c} = N_{b,c} \cdot \sin(\alpha_v) = 0.00$ kN, $V_{b,w} = V_d - V_{b,t} - V_{b,c} = 80.00$ kN

5.2. basic components

5.2.1. bc 1: Column web panel in shear

transformation parameter (EC 3-1-8, 7.2.3(4)) $\beta_j = 1.00 \le 2$ for $M_{j1} = 75.00$ kNm ($M_{j2} = 0$)

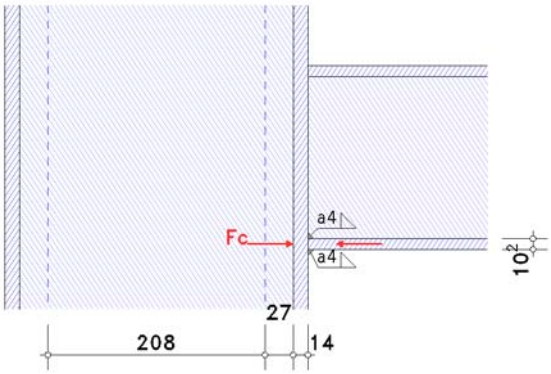


Only the essential sizes are sketched to scale.
The connection geometry is only hinted.

slenderness of column web $h_{wc}/t_{wc} = 30.82 < 72 \cdot \varepsilon/\eta = 60.00 \Rightarrow$ method applicable
plastic shear resistance $V_{wp,Rd} = (0.9 \cdot f_{y,w} \cdot A_{wp}) / (3^{1/2} \cdot \gamma_{M0}) = 301.00$ kN
Beitrag of column flange:
additional resistance $V_{wp,add,Rd} = 4 \cdot M_{pl,fc,Rd}/z_{wp} = 53.2$ kN, $z_{wp} = h_b - t_{fb} = 259.8$ mm
plastic shear resistance plus Beitrag of column flange $V_{wp,Rd} = 354.2$ kN

5.2.2. bc 2: column web in transverse compression

transformation parameter (EC 3-1-8, 7.2.3(4)) $\beta_j = 1.00 \le 2$ for $M_{j1} = 75.00$ kNm ($M_{j2} = 0$)
longitudinal compressive stress in column web $\sigma_{com,Ed} = 57.98$ N/mm²

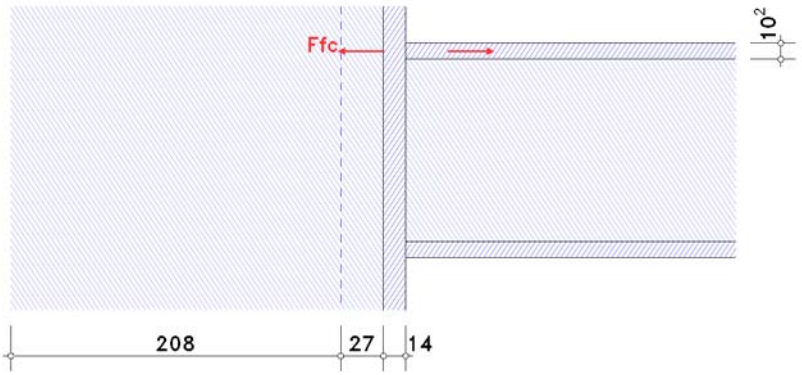


Only the essential sizes are sketched to scale.
The connection geometry is only hinted.

effective width of web in transverse compression $b_{eff,c} = t_{fb} + 2 \cdot 2^{1/2} \cdot a_b + 5 \cdot (t_{fc} + s_c) = 226.5$ mm
reduction factor $k_w = 1.0$ for $\sigma_{com,Ed} = 58.0$ N/mm² $\le 0.7 \cdot f_{y,w} = 164.5$ N/mm²
plate slenderness $\lambda_p = 0.932 \cdot [(b_{eff,c} \cdot d_w \cdot f_y) / (E \cdot t_w^2)]^{1/2} = 0.796$
reduction factor for web buckling $\rho = (\lambda_p - 0.22) / \lambda_p^2 = 0.909$ for $\lambda_p > 0.673$
reduction factor for interaction with shear stress $\beta = 1 \Rightarrow \omega = 0.747$
resistance of an unstiffened web in transverse compression:
$F_{c,w,Rd} = \omega \cdot (k_w \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M0} = 337.89$ kN
$F_{c,w,Rd} = \omega \cdot (k_w \cdot \rho \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M1} = 279.21$ kN (decisive)

resistance of the upper beam flange:
effective width of web in transverse compression $b_{eff,c} = t_{fb} + 2 \cdot 2^{1/2} \cdot a_b + 5 \cdot (t_{fc} + s_c) = 232.2$ mm
reduction factor $k_w = 1.0$ for $\sigma_{com,Ed} = 58.0$ N/mm² $\le 0.7 \cdot f_{y,w} = 164.5$ N/mm²
plate slenderness $\lambda_p = 0.932 \cdot [(b_{eff,c} \cdot d_w \cdot f_y) / (E \cdot t_w^2)]^{1/2} = 0.806$
reduction factor for web buckling $\rho = (\lambda_p - 0.22) / \lambda_p^2 = 0.902$ for $\lambda_p > 0.673$
reduction factor for interaction with shear stress $\beta = 1 \Rightarrow \omega = 0.739$
resistance of an unstiffened web in transverse compression:
$F_{c,w,Rd} = \omega \cdot (k_w \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M0} = 342.52$ kN
$F_{c,w,Rd} = \omega \cdot (k_w \cdot \rho \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M1} = 280.87$ kN (decisive)

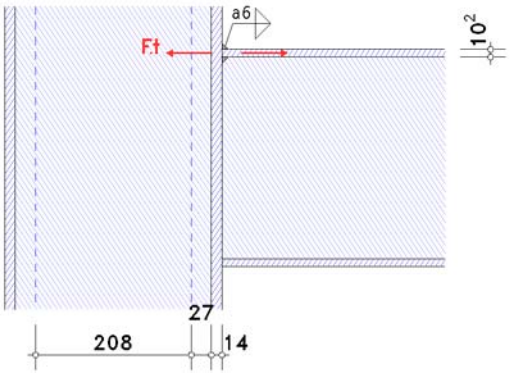
5.2.3. bc 4: column flange in bending



effective width of unstiffened connections to flanges $b_{eff} = t_w + 2 \cdot s + 7 \cdot k \cdot t_f = 160.5$ mm, k = 1.00
$b_{eff} > b_p \Rightarrow b_{eff} = b_p = 135.0$ mm
$b_{eff} = 135.00$ mm $\geq (f_{yp}/f_{up}) \cdot b_p = 88.1$ mm ok
resistance of unstiffened column flange in bending
$F_{t,fc,Rd} = (b_{eff,b,fc} \cdot t_{fb} \cdot f_{y,fb}) / \gamma_{M0} = 323.6$ kN

5.2.4. bc 3: column web in transverse tension

transformation parameter (EC 3-1-8, 7.2.3(4)) $\beta_j = 1.00 \leq 2$ for $M_{j1} = 75.00$ kNm ($M_{j2} = 0$)

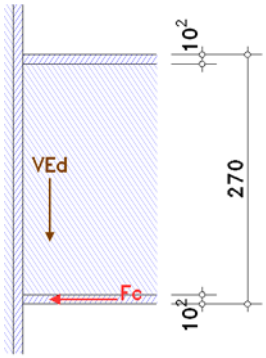


Only the essential sizes are sketched to scale.
The connection geometry is only hinted.

effective width $b_{eff,t,wc} = t_{fb} + 2 \cdot 2^{1/2} \cdot a_b + 5 \cdot (t_{fc} + s_c) = 232.2$ mm
reduction factor for interaction with shear stress $\beta = 1 \Rightarrow \omega = 0.739$
resistance eines unstiffeneden column webs with transverse tension
$F_{t,wc,Rd} = \omega \cdot (b_{eff,t,wc} \cdot t_{wc} \cdot f_{y,wc}) / \gamma_{M0} = 342.52$ kN, $b_{eff,t,wc} = 232.2$ mm

5.2.5. bc 7: beam flange and web in compression

flange below: section class 1
web: section class 1
total: section class 1
section class of the beam: 1
taking into account the moment-shear force-interaction $V_{Ed} = 80.0$ kN



Only the essential sizes are sketched to scale.
The connection geometry is only hinted.

stress due to bending with shear force: $V_{Ed} = 80.0$ kN ≤ 150.2 kN $= 0.5 \cdot V_{pl,Rd}/2 \Rightarrow$ no effect
resistance $M_{c,Rd} = M_{pl,Rd} = (W_{pl} \cdot f_y) / \gamma_{M0} = 113.73$ kNm, $W_{pl} = 483.95$ cm³
resistance of flange and web in compression
$F_{c,f,Rd} = M_{c,Rd} / (h - t_f) = 437.75$ kN

resistance of the upper beam flange:
stress due to bending with shear force: $V_{Ed} = 80.0$ kN ≤ 150.2 kN $= 0.5 \cdot V_{pl,Rd}/2 \Rightarrow$ no effect
resistance $M_{c,Rd} = M_{pl,Rd} = (W_{pl} \cdot f_y) / \gamma_{M0} = 113.73$ kNm, $W_{pl} = 483.95$ cm³
resistance of flange and web in compression

$F_{c,f,Rd} = M_{c,Rd} / (h - t_f) = 437.75$ kN

5.3. shear resistance

shear resistance of column web
decisive basic component: 1
$V_{wp,Rd} = 354.2$ kN

5.4. verifications

5.4.1. verification of the connection capacity with partial internal forces and moments

shear force in column web:
$V_{c,w,Ed} = M_d/z - (V_{c1}-V_{c2})/2 = 288.68$ kN, $z = 259.8$ mm

bc 1: $F_{Rd} = V_{wp,Rd} = 354.2$ kN, $F_{Ed} = |V_{c,w,Ed}| = 288.68$ kN
$F_{Ed} = 288.7$ kN $<$ $F_{Rd} = 354.2$ kN $\Rightarrow$ $U = 0.815 < 1$ ok

bc 2: $F_{Rd} = F_{c,w,Rd} = 279.2$ kN, $F_{Ed} = N_{b,c} = 288.68$ kN
$F_{Ed} = 288.7$ kN $>$ $F_{Rd} = 279.2$ kN $\Rightarrow$ $U = 1.034 > 1$ not ok !!

bc 4: $F_{Rd} = F_{fc,Rd} = 323.6$ kN, $F_{Ed} = N_{b,t} = 288.68$ kN
$F_{Ed} = 288.7$ kN $<$ $F_{Rd} = 323.6$ kN $\Rightarrow$ $U = 0.892 < 1$ ok

bc 3: $F_{Rd} = F_{t,wc,Rd} = 342.5$ kN, $F_{Ed} = N_{b,t} = 288.68$ kN
$F_{Ed} = 288.7$ kN $<$ $F_{Rd} = 342.5$ kN $\Rightarrow$ $U = 0.843 < 1$ ok

bc 7: flange: $F_{Rd} = F_{c,f,Rd} = 437.7$ kN, $F_{Ed} = N_{b,c} = 288.68$ kN
$F_{Ed} = 288.7$ kN $<$ $F_{Rd} = 437.7$ kN $\Rightarrow$ $U = 0.659 < 1$ ok

utilization partial internal forces and moments $U_{bc} = 1.034 > 1$ not ok !!

5.4.2. verification result

maximum utilization: max $U = 1.034 > 1$ not ok !!
failure at verification with partial internal forces and moments: $U = 1.034$