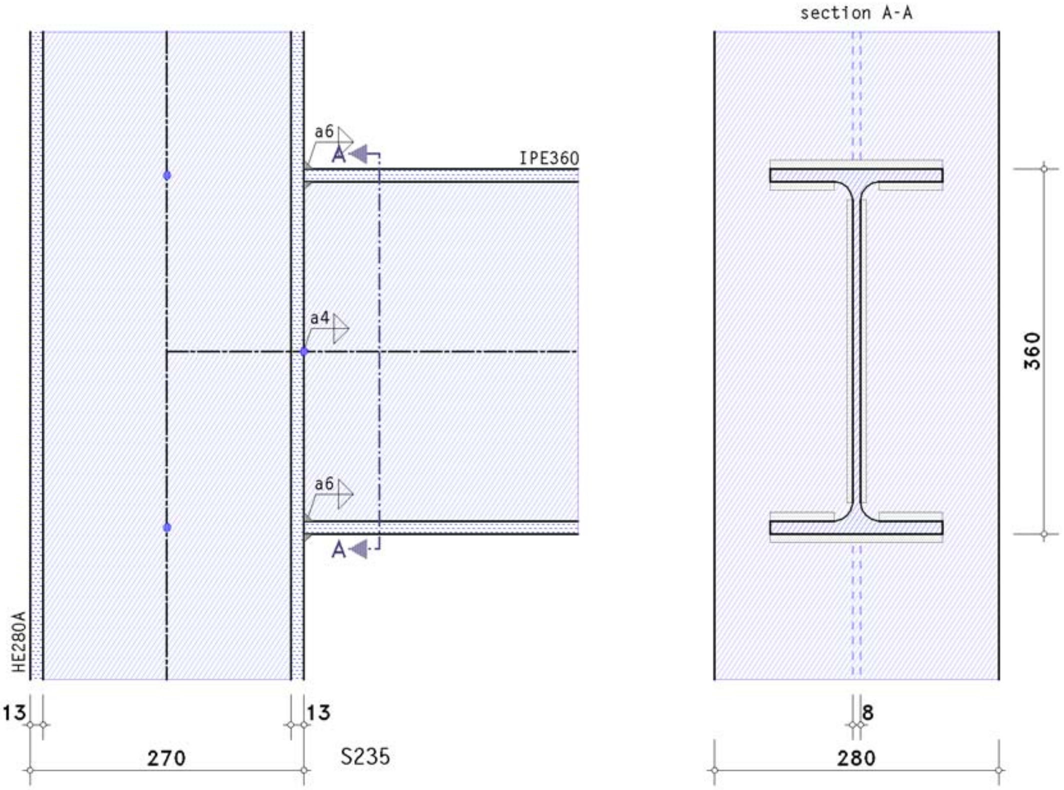
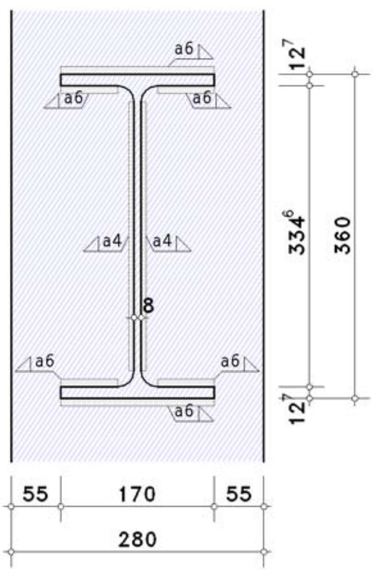
Rigid beam connection EC 3-1-8 (04.25), NA: Deutschland 4H-EC3BT version: 10/2019-2w

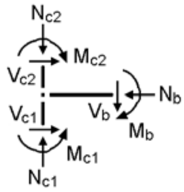
# 1. input report




details (section A - A)




**steel grade**
steel grade S235
**column parameters**
section HE280A
**beam parameters**
section IPE360
**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 = 6.0 mm




**internal forces and moments at the joint periphery refering to the system axes**

Lc 1: $M_{b,Ed}$ = 1.00 kNm

**partial safety factors for material**

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

resistance of members in stability failure $\gamma_{M1}$ = 1.10

resistance of bolts, welds, plates in bearing $\gamma_{M2}$ = 1.25

notes

no verification for cross-sections.

welds are not checked.

Die shear resistance of column flange is not respected.

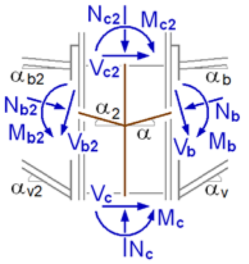
**check of data**

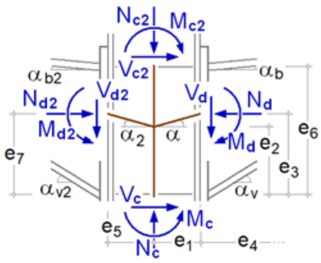
ok

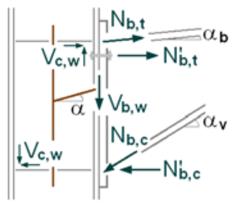
# 2. Lc 1

## 2.1. design values

periphery connection ⊥ zur connection plane    partial internal forces and moments




slope angle: $\alpha_b = \alpha = \alpha_v = 0°$

distance: $e_1$ = 135.0 mm, $e_3$ = 173.6 mm, $e_2$ = 173.6 mm, $e_6$ = 347.3 mm

**internal forces and moments perpendicular to the connection planes**

periphery beam

$M_d$ = 1.00 kNm

**partial internal forces and moments**

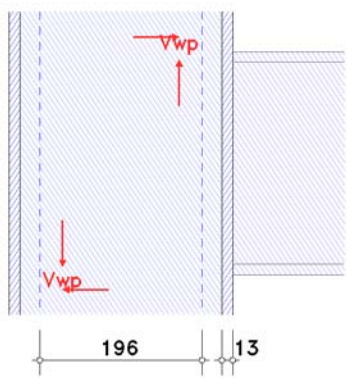
$N_{b,t} = -N_d \cdot z_{bu}/z_b + M_d/z_b$ = 2.88 kN, $z_b$ = 347.3 mm, $z_{bu}$ = 173.7 mm

$N_{b,c} = N_d \cdot z_{bo}/z_b + M_d/z_b$ = 2.88 kN, $z_b$ = 347.3 mm, $z_{bo}$ = 173.7 mm

## 2.2. basic components

### 2.2.1. bc 1: Column web panel in shear

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




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

slenderness of column web $h_{wc}/t_{wc} = 30.50 < 72 \cdot \varepsilon/\eta = 60.00$ ⇒ method applicable

plastic shear resistance $V_{wp,Rd} = (0.9 \cdot f_{y,w} \cdot A_{wp}) / (3^{1/2} \cdot \gamma_{M0})$ = 263.76 kN

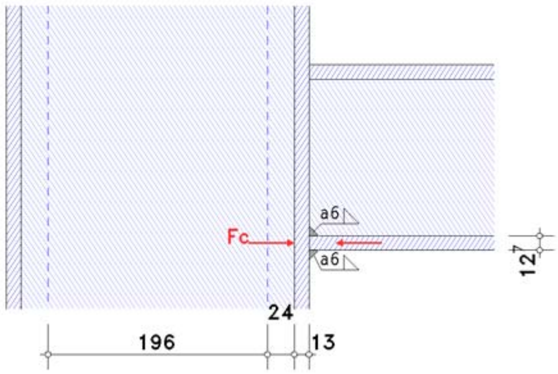
Beitrag of column flange:

additional resistance $V_{wp,add,Rd} = 4 \cdot M_{pl,fc,Rd}/z_{wp}$ = 32.0 kN, $z_{wp} = h_b - t_{fb}$ = 347.3 mm

plastic shear resistance plus Beitrag of column flange $V_{wp,Rd}$ = 295.8 kN

### 2.2.2. bc 2: column web in transverse compression

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




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

effective width of web in transverse compression $b_{eff,c} = t_{fb} + 2 \cdot 2^{1/2} \cdot a_b + 5 \cdot (t_{fc}+s_c) = 214.7$ mm
reduction factor $k_w = 1.0$  ($\sigma_{com,Ed} = 0$)
plate slenderness $\lambda_p = 0.932 \cdot [(b_{eff,c} \cdot d_w \cdot f_y) / (E \cdot t_w^2)]^{1/2} = 0.799$
reduction factor for web buckling $\rho = (\lambda_p - 0.22) / \lambda_p^2 = 0.907$  for $\lambda_p > 0.673$
reduction factor for interaction with shear stress $\beta = 1 \Rightarrow \omega = 0.741$
resistance of an unstiffened web in transverse compression:

$F_{c,w,Rd} = \omega \cdot (k_w \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M0} = 299.01$ kN
$F_{c,w,Rd} = \omega \cdot (k_w \cdot \rho \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M1} = 246.46$ kN (decisive)

**resistance of the upper beam flange:**
effective width of web in transverse compression $b_{eff,c} = t_{fb} + 2 \cdot 2^{1/2} \cdot a_b + 5 \cdot (t_{fc}+s_c) = 214.7$ mm
reduction factor $k_w = 1.0$  ($\sigma_{com,Ed} = 0$)
plate slenderness $\lambda_p = 0.932 \cdot [(b_{eff,c} \cdot d_w \cdot f_y) / (E \cdot t_w^2)]^{1/2} = 0.799$
reduction factor for web buckling $\rho = (\lambda_p - 0.22) / \lambda_p^2 = 0.907$  for $\lambda_p > 0.673$
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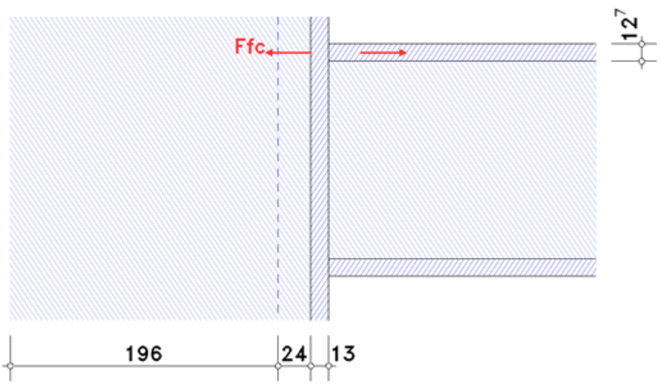
resistance of an unstiffened web in transverse compression:

$F_{c,w,Rd} = \omega \cdot (k_w \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M0} = 299.01$ kN
$F_{c,w,Rd} = \omega \cdot (k_w \cdot \rho \cdot b_{eff,c} \cdot t_w \cdot f_{y,w}) / \gamma_{M1} = 246.46$ kN (decisive)

### 2.2.3. bc 4: column flange in bending



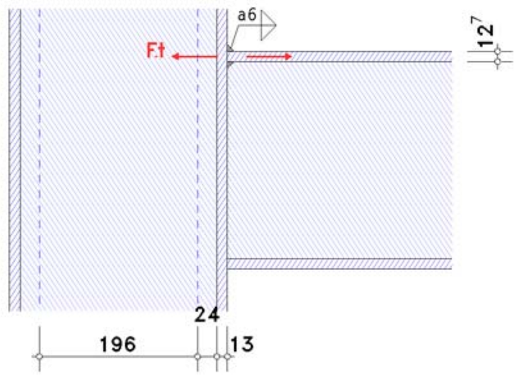

Only the essential sizes are sketched to scale.
The connection geometry is only hinted.

effective width of unstiffened connections to flanges $b_{eff} = t_w + 2 \cdot s + 7 \cdot k \cdot t_f = 147.0$ mm,  $k = 1.00$
$b_{eff} = 147.00$ mm $\geq$ $(f_{yp}/f_{up}) \cdot b_p = 111.0$ mm  ok
resistance of unstiffened column flange in bending

$F_{t,fc,Rd} = (b_{eff,b,fc} \cdot t_{fb} \cdot f_{y,fb}) / \gamma_{M0} = 438.7$ kN

### 2.2.4. bc 3: column web in transverse tension

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

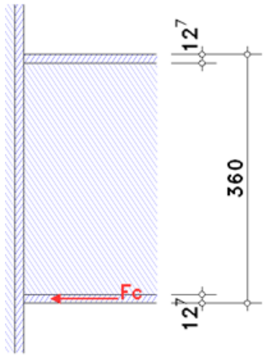



Only the essential sizes are sketched to scale.
The connection geometry is only hinted.

effective width $b_{eff,t,wc} = t_{fb} + 2 \cdot 2^{1/2} \cdot a_b + 5 \cdot (t_{fc}+s_c) = 214.7$ mm
reduction factor for interaction with shear stress $\beta = 1 \Rightarrow \omega = 0.741$
resistance eines unstiffeneden column webs with transverse tension
$F_{t,wc,Rd} = \omega \cdot (b_{eff,t,wc} \cdot t_{wc} \cdot f_{y,wc}) / \gamma_{M0} = 299.01$ kN, $b_{eff,t,wc} = 214.7$ mm

### 2.2.5. 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




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

resistance $M_{c,Rd} = M_{pl,Rd} = (W_{pl} \cdot f_y) / \gamma_{M0} = 239.47$ kNm, $W_{pl} = 1019.04$ cm$^3$
resistance of flange and web in compression
$F_{c,f,Rd} = M_{c,Rd} / (h - t_f) = 689.53$ kN

**resistance of the upper beam flange:**
resistance $M_{c,Rd} = M_{pl,Rd} = (W_{pl} \cdot f_y) / \gamma_{M0} = 239.47$ kNm, $W_{pl} = 1019.04$ cm$^3$
resistance of flange and web in compression
$F_{c,f,Rd} = M_{c,Rd} / (h - t_f) = 689.53$ kN

### 2.3. connection capacity

transformation parameter: $\beta_j = 1.00$

### 2.3.1. moment resistance

distance between tension force and centre of compression: $z = 347.3$ mm

**resistance**
decisive basic components: 3, 4
$F_{t,Rd} = 299.0$ kN

**resistance** (tension)
$F_{t,Rd}^* = 299.0$ kN

**deductions analogical EC 3-1-8, B.3.2.2(7)**
decisive basic components: 1, 2, 7
$F_{Rd} = 246.5$ kN

**resistance** (finally)
$F_{Rd} = 246.5$ kN
potential failure by basic component 2, 3

**resistance of flanges** (compression)

$\Sigma F_{c,Rd}^{*}$ = 492.9 kN

**moment resistance**
$M_{j,Rd} = F_{Rd} \cdot z$ = 85.6 kNm
**tension resistance**
$N_{j,t,Rd} = F_{t,Rd}^{*}$ = 299.0 kN
**compression resistance**
$N_{j,c,Rd} = \Sigma F_{c,Rd}^{*}$ = 492.9 kN

### 2.3.2. shear resistance

**shear resistance of column web**
decisive basic component: 1
$V_{wp,Rd}$ = 295.78 kN

### 2.3.3. total

$M_{j,Rd}$ = 85.6 kNm  $N_{j,t,Rd}$ = 299.0 kN  $N_{j,c,Rd}$ = 492.9 kN  $V_{wp,Rd}$ = 295.8 kN

### 2.4. rotational stiffness

**stiffness coefficients**
$k_1 = 0.38 \cdot A_{vc} / (\beta \cdot z)$ = 3.47 mm
$k_2 = 0.7 \cdot b_{eff,c,wc} \cdot t_{wc} / d_c$ = 6.13 mm
$k_3 = 0.7 \cdot b_{eff,t,wc} \cdot t_{wc} / d_c$ = 6.13 mm,  $b_{eff,t,wc}$ = 214.7 mm
**rotational stiffness**
initial rotational stiffness: $S_{j,ini} = (E \cdot z^2) / \Sigma(1/k_i)$ = 41254.2 kNm/rad,  z = 347.3 mm,  $\Sigma(1/k_i) = 0.614\ mm^{-1}$
$|M_{j,Ed}|$ = 1.00 kNm $\leq$ 2/3 $M_{j,Rd}$ = 57.06 kNm $\Rightarrow$ $\mu = 1$
rotational stiffness: $S_{j,Rd} = S_{j,ini} / \mu$ = 41254.2 kNm/rad
rotation: $\varphi_{j,Ed} = M_{j,Ed} / S_{j,Rd}$ = 0.001°

## 3. 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