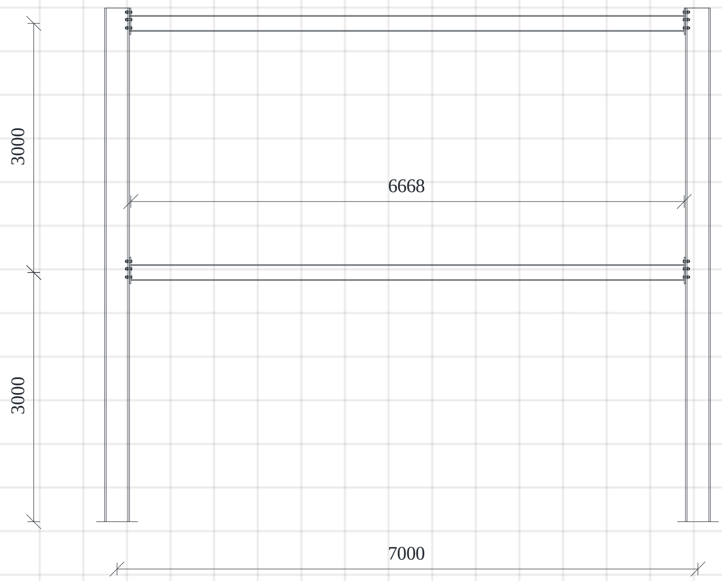
This playlist series focuses on the rigid connection calculation according to EN 1993-1-8. A comparison is made with Ansys at the end of the series after hand calculation. Finally, tips for applying the semi-rigid connection to RFEM are presented.

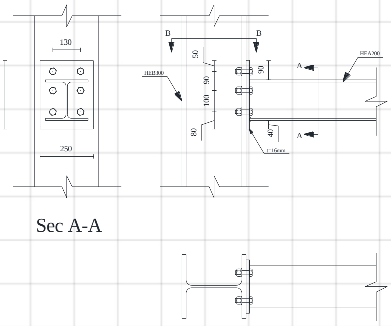
A portal frame with two levels is presented, as shown in the figure below. We went through the connections in this playlist for both ends and beams. The Endplate welded to the HEA200 beam is bolted to a HEB300 column with 6M20 class 8.8, as shown in the figures below. Steel material is S355 for all parties.

This video shows the resistance column web panel in shear according to EN 1993-1-8. The contents are as follows:

a) Table 6.1 Item 1 explanation.
b) Column web panel in shear according to 6.2.6.1.
c) The lever arm of the connection, according to Figure 6.15.
d) Calculation of utilization ratio of the column web panel in shear.

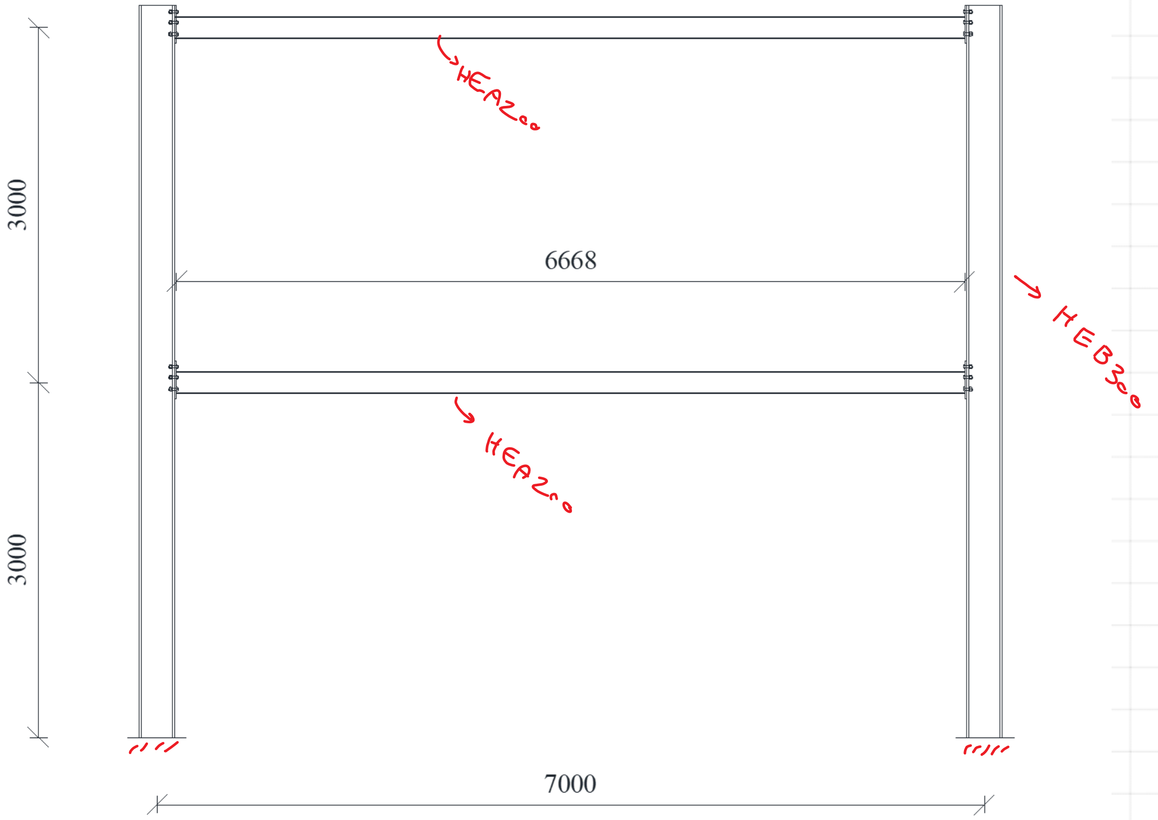
All dimensions are in mm unless otherwise specified.

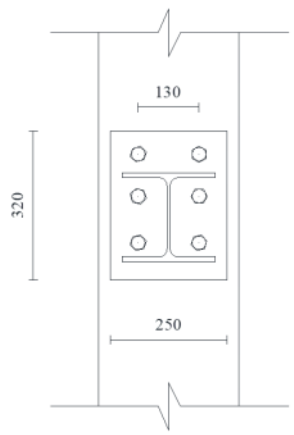




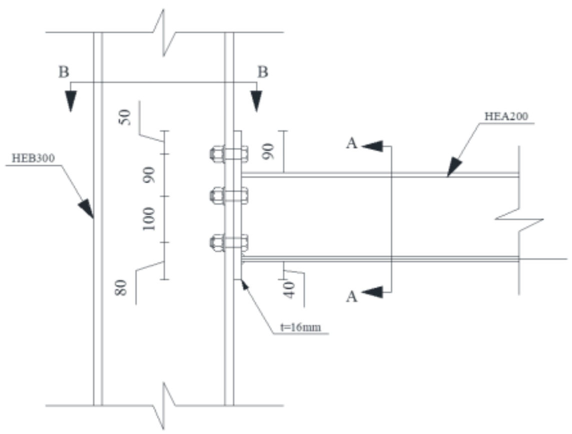
Sec A-A

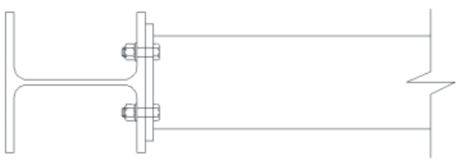
Sec B-B


3000
3000
6668
7000
HEA200
HEA200
HEB300


130
320
250

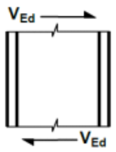
Sec A-A


B
B
HEB300
HEA200
50
90
100
80
90
40
A
A
t=16mm



Sec B-B

Table 6.1: Basic joint components

Component			Reference to application rules		
			Design Resistance	Stiffness coefficient	Rotation capacity
1	Column web panel in shear		6.2.6.1	6.3.2	6.4.2 and 6.4.3

6.2.6 Design Resistance of basic components

6.2.6.1 Column web panel in shear

(1) The design methods given in 6.2.6.1(2) to 6.2.6.1(14) are valid provided the column web slenderness satisfies the condition $d/t_w \leq 69\varepsilon$.

(2) For a single-sided joint, or for a double-sided joint in which the beam depths are similar, the design plastic shear resistance $V_{wp,Rd}$ of an unstiffened column web panel, subject to a design shear force $V_{wp,Ed}$, see 5.3(3), should be obtained using:

18) Modification to 6.2.6.1

Paragraph "(1)", replace "$d/t_w \leq 69\varepsilon$" with: "$d_c/t_w \leq 69\varepsilon$".

$$V_{wp,Rd} = \frac{0{,}9\, f_{y,wc} A_{vc}}{\sqrt{3}\,\gamma_{M0}} \qquad \text{... (6.7)}$$

where:

A_{vc} is the shear area of the column, see EN 1993-1-1.

$$\begin{cases} d_c = h - 2t_f - 2r_c = 300\text{ mm} - 2 \times 19\text{mm} - 2 \times 27\text{mm} = 208\text{ mm} \\ t_w = 11\text{mm} \end{cases}$$

$$\sqrt{\frac{f_y}{235\text{Mpa}}} = 0.81$$

$$\frac{d_c}{t_w} = 18.9 \leq 69\varepsilon = 56 \quad (\text{ok})$$

$$V_{wp,Rd} = \frac{0.9 \times 355\text{ Mpa} \times 4743\text{ mm}^2}{\sqrt{3} \times 1} = \boxed{875\text{ kN}}$$

5.3 Modelling of beam-to-column joints

(1) To model the deformational behaviour of a joint, account should be taken of the shear deformation of the web panel and the rotational deformation of the connections.

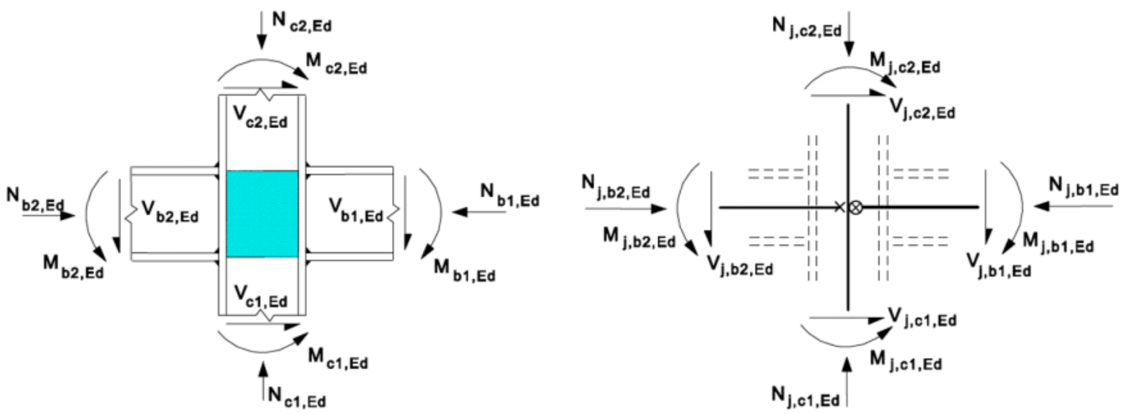
(2) Joint configurations should be designed to resist the internal bending moments $M_{b1,Ed}$ and $M_{b2,Ed}$, normal forces $N_{b1,Ed}$ and $N_{b2,Ed}$ and shear forces $V_{b1,Ed}$ and $V_{b2,Ed}$ applied to the joints by the connected members, see Figure 5.6.

(3) The resulting shear force $V_{wp,Ed}$ in the web panel should be obtained using:

$$V_{wp,Ed} = (M_{b1,Ed} - \cancel{M_{b2,Ed}})/z - (V_{c1,Ed} - \cancel{V_{c2,Ed}})/2 \quad \text{... (5.3)}$$

where:

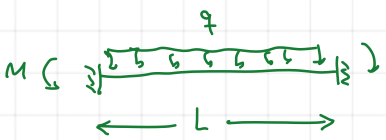
z is the lever arm, see 6.2.7.



a) Values at periphery of web panel b) Values at intersection of member centrelines

Direction of forces and moments are considered as positive in relation to equations (5.3) and (5.4)

Figure 5.6: Forces and moments acting on the joint



$$M_{Ed} = \frac{qL^2}{12} = \frac{20\,\text{kN/m} \times (6.668\,\text{m})^2}{12} = 74\,\text{kN m}$$

$$V_{Ed} = \frac{qL}{2} = \frac{20\,\text{kN/m} \times 6.668\,\text{m}}{2} = 66.7\,\text{kN}$$

6.2.7 Design moment resistance of beam-to-column joints and splices

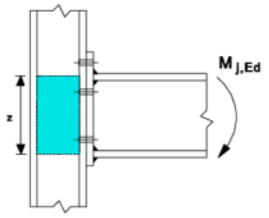
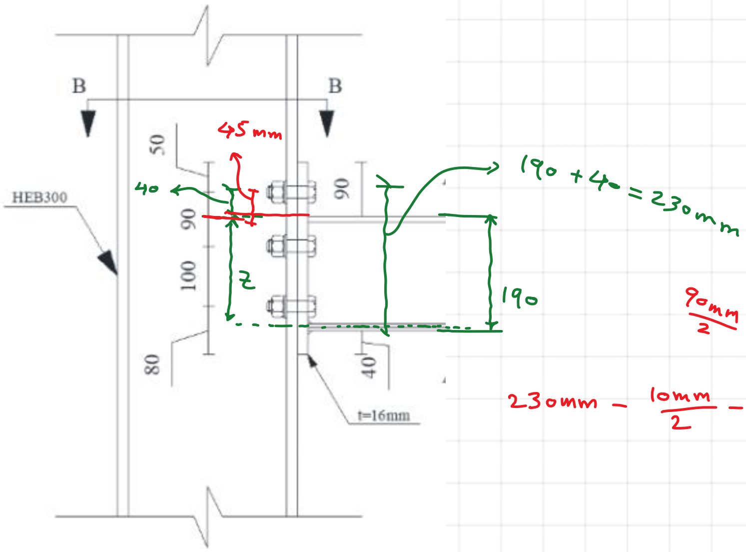
Type of connection	Centre of compression	Lever arm	Force distributions
d) Bolted extended end-plate connection with only two bolt-rows active in tension 	In line with the mid-thickness of the compression flange	Conservatively z may be taken as the distance from the centre of compression to a point midway between these two bolt-rows	

Figure 6.15: Centre of compression, lever arm *z* and force distributions for deriving the design moment resistance $M_{j,Rd}$



$230 mm - \frac{10 mm}{2} - 45 mm = 180 mm = z$

$$V_{wp,Ed} = (M_{b1,Ed} - \cancel{M_{b2,Ed}})/z - (V_{c1,Ed} - \cancel{V_{c2,Ed}})/2$$

$$V_{wp,Ed} = \frac{74 kN\cdot m}{180 mm} - \frac{66.7 kN}{2} = 378 kN$$

$$V_{wp,Rd} = 875 kN$$

$$UR = \frac{V_{wp,Ed}}{V_{wp,Rd}} = \frac{378 kN}{875 kN} = 43\% \quad (ok)$$