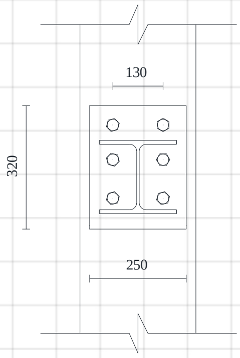
This playlist series focuses on the rigid connection calculation according to EN 1993-1-8. A comparison is made with Ansys at the end of the series after hand calculation. Finally, tips for applying the semi-rigid connection to RFEM are presented.

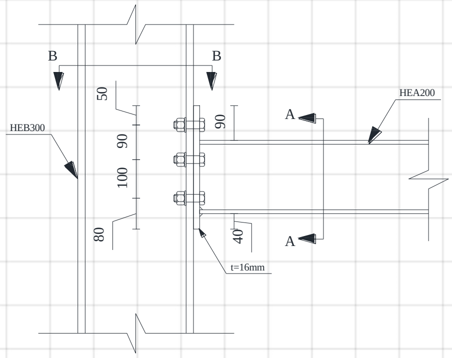
An Endplate welded to a beam, HEA200, is bolted to a HEB300 column with 6M20 class 8.8, as shown in the figures below. Steel material is S355 for all parties.

This video shows the resistance calculation of the Beam flange and web in compression according to EN 1993-1-8. The contents are as follows:

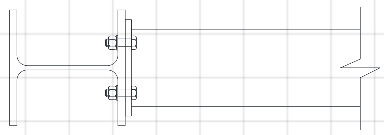
a) Table 6.1 Item 7 explanation.
b) Beam Flange and Web in Compression according to 6.2.6.7.
c) Beam Flange and Web resistance in compression.
d) Introduction to a frame to be checked for the given loads according to the presented connection.

All dimensions are in mm unless otherwise specified.

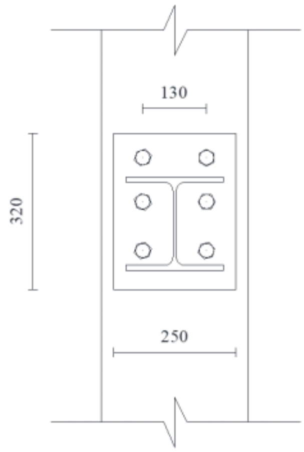




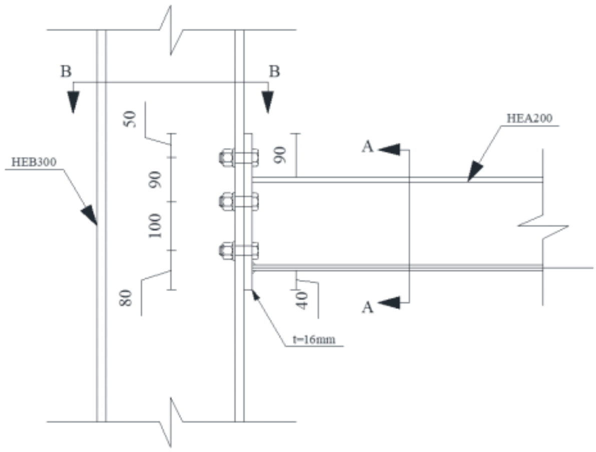
Sec A-A

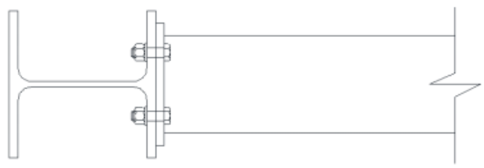


Sec B-B



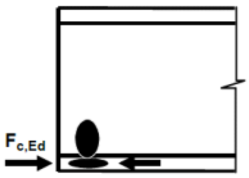
Sec A-A





Sec B-B

Table 6.1: Basic joint components

Component			Reference to application rules		
			Design Resistance	Stiffness coefficient	Rotation capacity
7	Beam or column flange and web in compression		6.2.6.7	6.3.2	*)

6.2.6.7 Beam flange and web in compression

(1) The resultant of the design compression resistance of a beam flange and the adjacent compression zone of the beam web, may be assumed to act at the level of the centre of compression, see 6.2.7. The design compression resistance of the combined beam flange and web is given by the following expression:

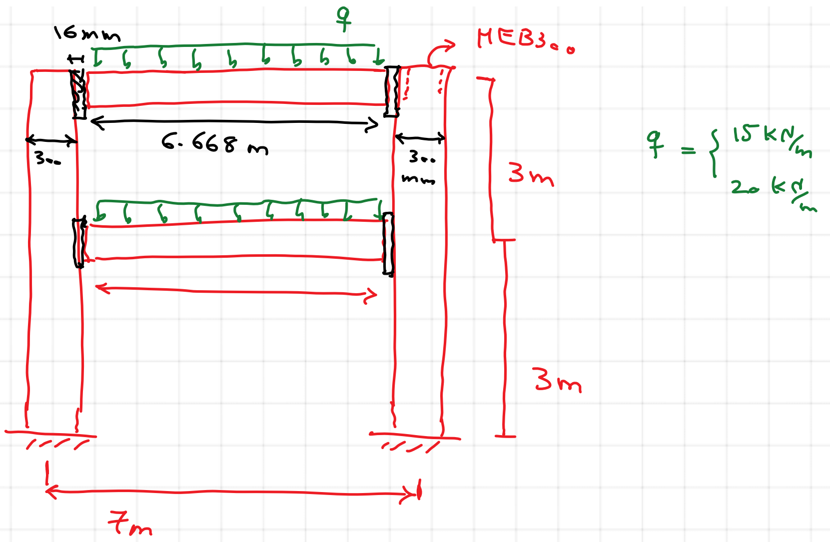
$$F_{c,fb,Rd} = M_{c,Rd}/(h - t_{fb}) \qquad \text{... (6.21)}$$

where:

h is the depth of the connected beam;

$M_{c,Rd}$ is the design moment resistance of the beam cross-section, reduced if necessary to allow for shear, see EN 1993-1-1. For a haunched beam $M_{c,Rd}$ may be calculated neglecting the intermediate flange.

t_{fb} is the flange thickness of the connected beam.



6.2.8 Bending and shear

EN 1993-1-1

(1) Where the shear force is present allowance should be made for its effect on the moment resistance.

(2) Where the shear force is less than half the plastic shear resistance its effect on the moment resistance may be neglected except where shear buckling reduces the section resistance, see EN 1993-1-5.

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

6.2.6 Shear

EN 1993-1-1

(1) The design value of the shear force V_{Ed} at each cross section should satisfy:

$$\frac{V_{Ed}}{V_{c,Rd}} \leq 1,0 \qquad (6.17)$$

where $V_{c,Rd}$ is the design shear resistance. For plastic design $V_{c,Rd}$ is the design plastic shear resistance $V_{pl,Rd}$ as given in (2). For elastic design $V_{c,Rd}$ is the design elastic shear resistance calculated using (4) and (5).

(2) In the absence of torsion the design plastic shear resistance is given by:

$$V_{pl,Rd} = \frac{A_v\left(f_y/\sqrt{3}\right)}{\gamma_{M0}} \qquad (6.18)$$

where A_v is the shear area.

Profile	Drawing	Profile dimensions					Area properties					Inertia properties about major axis y-y			
		Depth h [mm]	Width b [mm]	Web thickness t_w [mm]	Flange thickness t_f [mm]	Root radius r [mm]	Weight m [kg/m]	Perimeter P [m]	Area A [mm²]	Shear area z-z $A_{v,z}$ [mm²] (for η=1.2)	Shear area y-y $A_{v,y}$ [mm²]	Second moment of area I_y [×10⁶ mm⁴]	Radius of gyration i_y [mm]	Elastic section modulus $W_{el,y}$ [×10³ mm³]	Plastic section modulus $W_{pl,y}$ [×10³ mm³]
HEA200	dxf	190	200	6.5	10.0	18	42.3	1.136	5383	1808	4000	36.92	82.8	388.6	429.5

$$V_{pl,Rd} = \frac{1808\,mm^2 \times 355\,MPa/\sqrt{3}}{1} = 370\,kN$$

$$V_{Ed} = 66.7\,kN$$

$$UR = \frac{V_{Ed}}{V_{pl,Rd}} = 18\% < 50\%$$ → the effect of shear force can be neglected

6.2.5 Bending moment

(2) The design resistance for bending about one principal axis of a cross-section is determined as follows:

$$M_{c,Rd} = M_{pl,Rd} = \frac{W_{pl}\, f_y}{\gamma_{M0}} \quad \text{for class 1 or 2 cross sections} \qquad (6.13)$$

EN 1993-1-1

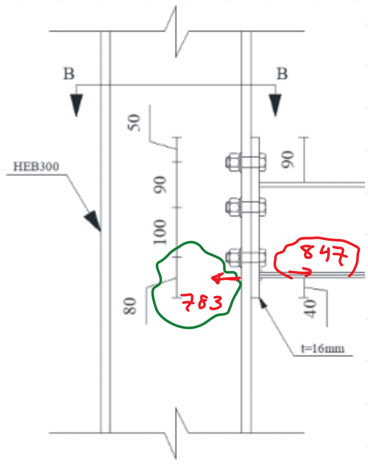
$$M_{c,Rd} = M_{el,Rd} = \frac{W_{el,min}\, f_y}{\gamma_{M0}} \quad \text{for class 3 cross sections} \qquad (6.14)$$

HEA200 → 2 → (pl) → $W_{pl} = 429.5 \times 10^3\,mm^3$

$$M_{c,Rd} = \frac{429.5 \times 10^3\,mm^3 \times 355\,MPa}{1} = 152.5\,kN\cdot m$$

$$F_{c,fb,Rd} = M_{c,Rd}/(h - t_{fb}) = \frac{152.5\,kN\,m}{190\,mm - 10\,mm} = 847\,kN$$

$F_{c,wc,Rd} = 783\,kN$ (From previous video)



Compressive Resistance → 783 kN