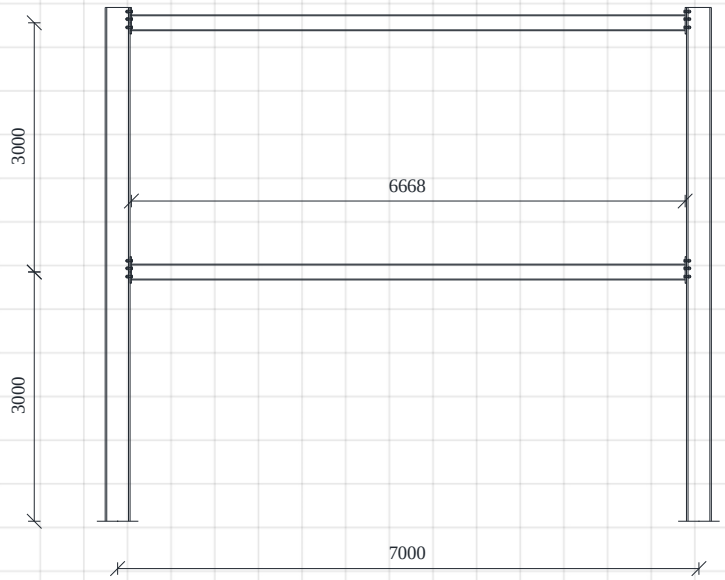
This playlist series focuses on the rigid connection calculation according to EN 1993-1-8. A comparison is made with Ansys at the end of the series after hand calculation. Finally, tips for applying the semi-rigid connection to RFEM are presented.

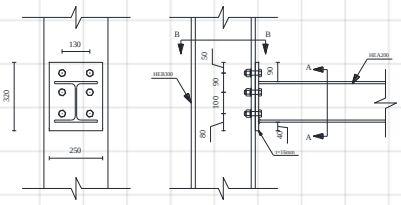
A portal frame with two levels is presented, as shown in the figure below. We went through the connections in this playlist for both ends and beams. The Endplate welded to the HEA200 beam is bolted to a HEB300 column with 6M20 class 8.8, as shown in the figures below. Steel material is S355 for all parties.

This video shows the design moment resistance of the connection presented in this playlist according to EN 1993-1-8. The contents are as follows:

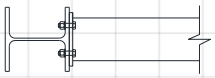
a) Introduction to clause 6.2.7.2.
b) Explanation of items in the mentioned clause.
c) Bending moment resistance calculation of the connection.

All dimensions are in mm unless otherwise specified.

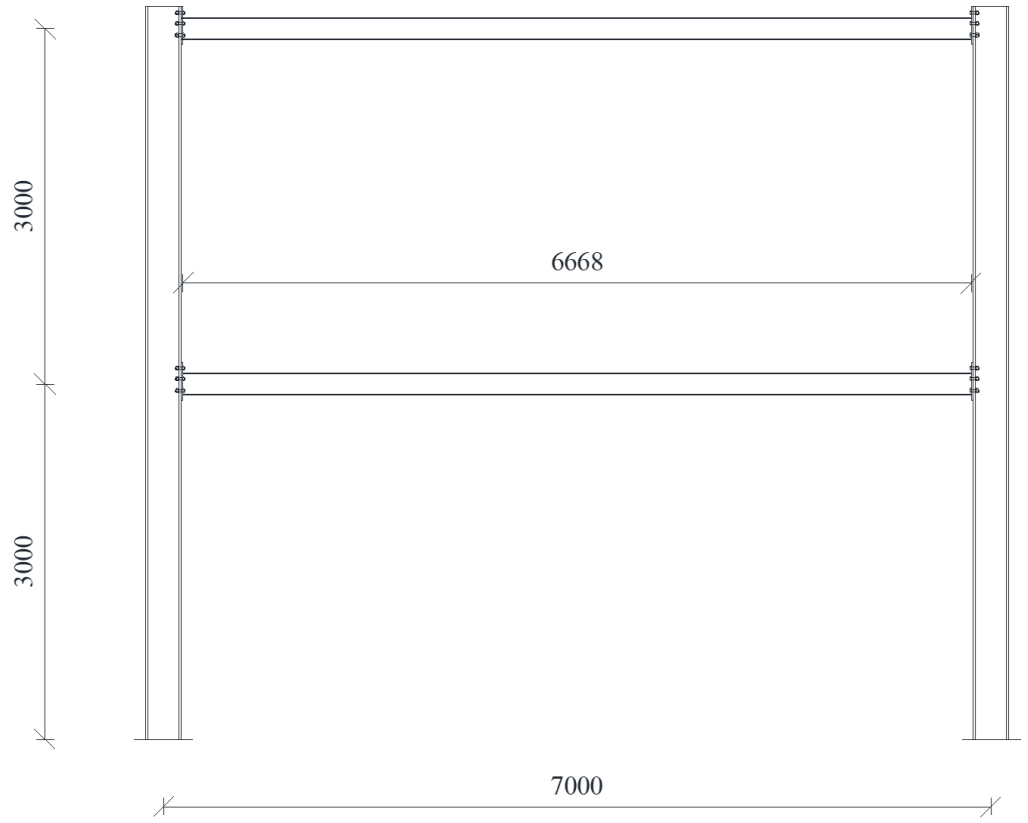


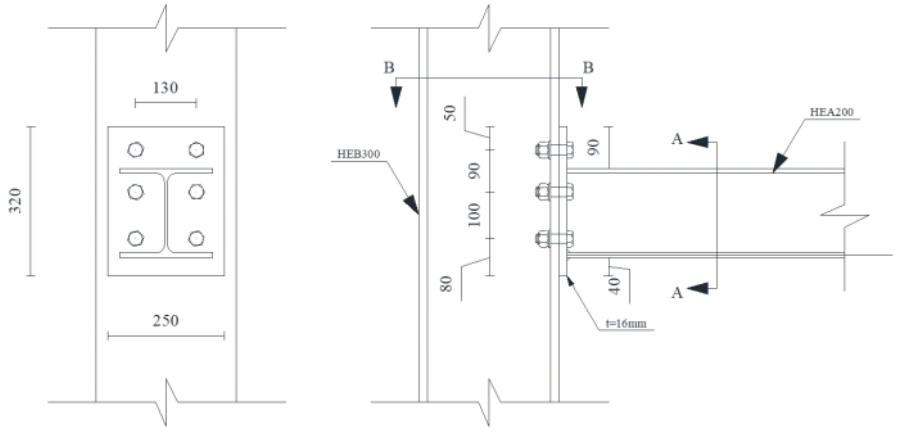


Sec A-A

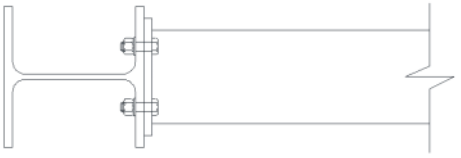


Sec B-B


3000
6668
3000
7000


130
320
250
B
B
50
90
100
80
HEB300
90
A
HEA200
A
40
t=16mm

Sec A-A



Sec B-B

6.2.7.2 Beam-to-column joints with bolted end-plate connections

(1) The design moment resistance $M_{j,Rd}$ of a beam-to-column joint with a bolted end-plate connection may be determined from:

$$M_{j,Rd} = \sum_r h_r F_{tr,Rd} \quad \text{... (6.25)}$$

where:

$F_{tr,Rd}$ is the effective design tension resistance of bolt-row r;

h_r is the distance from bolt-row r to the centre of compression;

r is the bolt-row number.

NOTE: In a bolted joint with more than one bolt-row in tension, the bolt-rows are numbered starting from the bolt-row farthest from the centre of compression.

(2) For bolted end-plate connections, the centre of compression should be assumed to be in line with the centre of the compression flange of the connected member.

(3) The effective design tension resistance $F_{tr,Rd}$ for each bolt-row should be determined in sequence, starting from bolt-row 1, the bolt-row farthest from the centre of compression, then progressing to bolt-row 2, etc.

(4) When determining the effective design tensin resistance $F_{tr,Rd}$ for bolt-row r the effective design tension resistance of all other bolt-rows closer to the centre of compression should be ignored.

		Video#1	Video#2	Video#3	Video#4
Component		Column Flange In Bending	Column Web in Transverse Tension	End Plate in Bending	Beam Web in Tension
Bolt Row #1	F(t.Rd.1)	282	790	232	-
Bolt Row #2	F(t.Rd.2)	282	790	282	850
Bolt Row #1 and #2	F(t.Rd.1&2)	564	1006	-	-

		Component Resistance (kN)	
F(c.wc.Rd)	Video#5	783	Column Web in Transverse Compression
F(c.fb.Rd)	Video#6	847	Beam Flange and Web in Compression
V(wp.Rd)	Video#7	875	Column Web in Shear

6.2.7.2 Beam-to-column joints with bolted end-plate connections

(5) The effective design tension resistance $F_{tr,Rd}$ of bolt-row r should be taken as its design tension resistance $F_{t,Rd}$ as an individual bolt-row determined from 6.2.7.2(6), reduced if necessary to satisfy the conditions specified in 6.2.7.2(7), (8) and (9).

(6) The effective design tension resistance $F_{tr,Rd}$ of bolt-row r ,taken as an individual bolt-row, should be taken as the smallest value of the design tension resistance for an individual bolt-row of the following basic components:

– the column web in tension	$F_{t,wc,Rd}$	-	see 6.2.6.3;
– the column flange in bending	$F_{t,fc,Rd}$	-	see 6.2.6.4;
– the end-plate in bending	$F_{t,ep,Rd}$	-	see 6.2.6.5;
– the beam web in tension	$F_{t,wb,Rd}$	-	see 6.2.6.8.

(7) The effective design tension resistance $F_{tr,Rd}$ of bolt-row r should, if necessary, be reduced below the value of $F_{t,Rd}$ given by 6.2.7.2(6) to ensure that, when account is taken of all bolt-rows up to and including bolt-row r the following conditions are satisfied:

– the total design resistance $\sum F_{t,Rd} \leq V_{wp,Rd}/\beta$ - with β from 5.3(7)		-	see 6.2.6.1;
– the total design resistance $\sum F_{t,Rd}$ does not exceed the smaller of:			
– the design resistance of the column web in compression	$F_{c,wc,Rd}$	-	see 6.2.6.2;
– the design resistance of the beam flange and web in compression	$F_{c,fb,Rd}$	-	see 6.2.6.7.

$\sum F_{t,Rd} = 232 + 282 = 514\,kN \leq \frac{V_{wp,Rd}}{1.5} = \frac{875\,kN}{1} = 875\,kN$

$\sum F_{t,Rd} = 514\,kN \leq \begin{cases} F_{c,wc,Rd} = 783\,kN \\ F_{c,fb,Rd} = 874\,kN \end{cases}$ (OK)

6.2.7.2 Beam-to-column joints with bolted end-plate connections

(8) The effective design tension resistance $F_{tr,Rd}$ of bolt-row r should, if necessary, be reduced below the value of $F_{t,Rd}$ given by 6.2.7.2(6), to ensure that the sum of the design resistances taken for the bolt-rows up to and including bolt-row r that form part of the same group of bolt-rows, does not exceed the design resistance of that group as a whole. This should be checked for the following basic components:

–	the column web in tension	$F_{t,wc,Rd}$	-	see 6.2.6.3;
–	the column flange in bending	$F_{t,fc,Rd}$	-	see 6.2.6.4;
–	the end-plate in bending	$F_{t,ep,Rd}$	-	see 6.2.6.5;
–	the beam web in tension	$F_{t,wb,Rd}$	-	see 6.2.6.8.

(9) Where the effective design tension resistance $F_{tx,Rd}$ of one of the previous bolt-rows x is greater than $1{,}9F_{t,Rd}$, then the effective design tension resistance $F_{tr,Rd}$ for bolt-row r should be reduced, if necessary, in order to ensure that:

$$F_{tr,Rd} \le F_{tx,Rd} h_r / h_x \qquad \text{... (6.26)}$$

where:

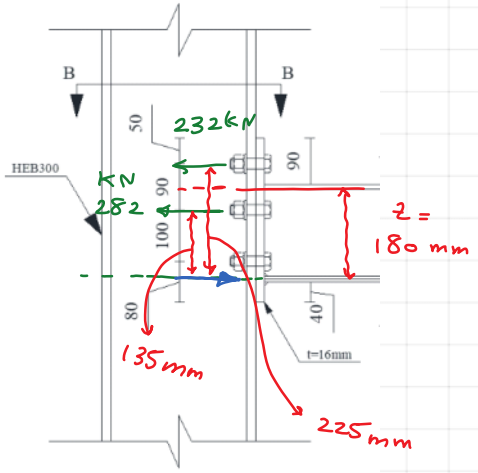
h_x is the distance from bolt-row x to the centre of compression;

x is the bolt-row farthest from the centre of compression that has a design tension resistance greater than $1{,}9F_{t,Rd}$.

NOTE: The National Annex may give further information on the use of equation (6.26).

(kN) 232 ←

282 ← $232 \le 1.9 \times 282$



$\Sigma F_x = 0 \Rightarrow$

$F_c = 232 + 282 = 514\,kN$

$$M_{j,Rd} = \sum_r h_r F_{tr,Rd}$$

$M_{j,Rd} = 232kN \times 225mm + 282kN \times 135mm = 90\ kN \cdot m$