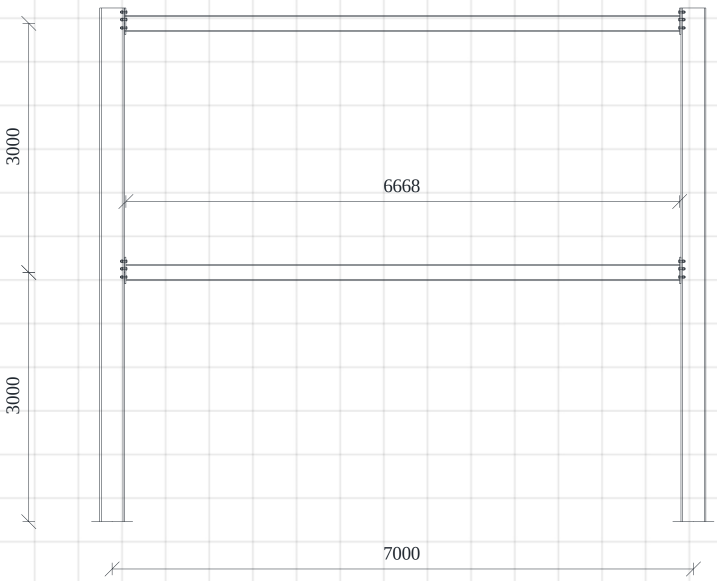
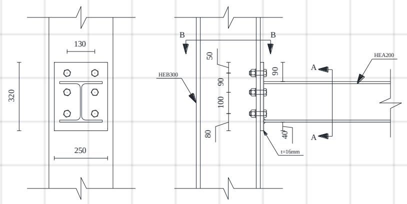
This [playlist](#) series focuses on the rigid connection calculation according to EN 1993-1-8. A comparison is made with Ansys at the end of the series after hand calculation. Finally, tips for applying the semi-rigid connection to RFEM are presented.

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.

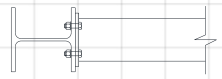
In this [video](#), a simple beam is modeled to be connected to the support with a semi-rigid connection. A rotational spring is used for the analysis, and the elastic method for the calculation is used. Based on two loads on the beam, the bending moment is transferred to the column, and the rotational angle is calculated.

All dimensions are in mm unless otherwise specified.

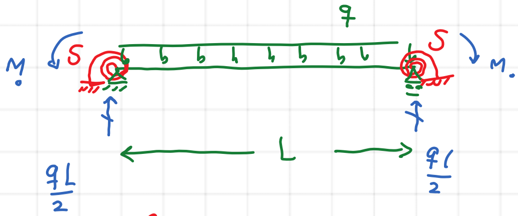


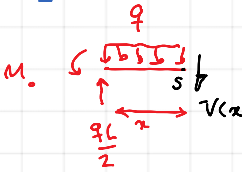


Sec A-A



Sec B-B





$$+\circlearrowleft \Sigma M_s = 0: \quad M(x) + M_0 + \frac{qx^2}{2} - \frac{qL}{2}x = 0$$

$$M(x) = \frac{qL}{2}x - \frac{qx^2}{2} - M_0$$

$$EI\theta(x) = \int M(x)\,dx = \frac{qL}{2}\,\frac{x^2}{2} - \frac{qx^3}{6} - M_0 \cdot x + EI\theta_0$$

$$EI\theta(x) = \frac{qLx^2}{4} - \frac{qx^3}{6} - M_0 \cdot x + EI\theta_0$$

$$x = \frac{L}{2} \Rightarrow \theta = 0 \Rightarrow 0 = \frac{qL}{4}\left(\frac{L}{2}\right)^2 - \frac{q}{6}\left(\frac{L}{2}\right)^3 - M_0\left(\frac{L}{2}\right) + EI\theta_0$$

$$\frac{3 \cdot qL^3}{3 \cdot 16} - \frac{qL^3}{48} - \frac{M_0 L}{2} + EI\theta_0 = 0$$

$$\frac{qL^3}{24} = \frac{M_0 L}{2} - EI\theta_0$$

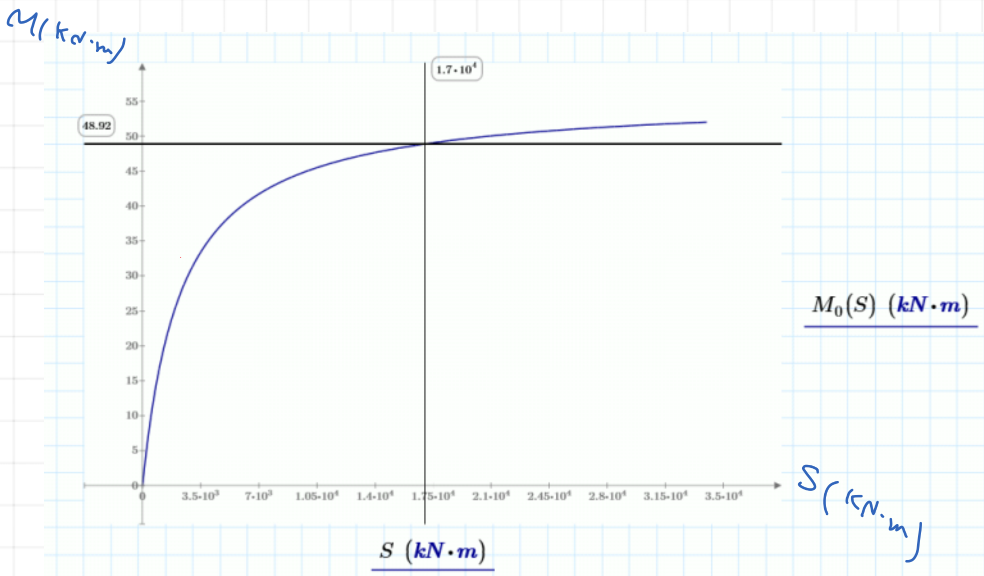
$$M_0 = -S \cdot \theta_0 \Rightarrow \quad \frac{qL^3}{24} = -S \cdot \frac{L}{2}\theta_0 - EI\theta_0$$

$$\left(-\theta_0\left(EI + \frac{SL}{2}\right) = \frac{qL^3}{24}\right) \times -2 \Rightarrow$$

$$\left(\theta_0\left(2EI + SL\right) = \frac{-qL^3}{12}\right) \div L$$

$$\theta_0\left(S + \frac{2EI}{L}\right) = -\frac{qL^2}{12} \Rightarrow \theta_0 = \frac{-qL^2}{12\left(S + \frac{2EI}{L}\right)}$$

$$M_0 = -S \cdot \theta_0 = \frac{qL^2 S}{12\left(S + \frac{2EI}{L}\right)} = \frac{qL^2 \cdot \cancel{S}}{12\cancel{S}\left(1 + \frac{2EI}{L \cdot S}\right)} \Rightarrow \boxed{M_0 = \frac{qL^2}{12\left(1 + \frac{2EI}{SL}\right)}}$$



$S_\gamma = 1.7\times10^4$ kN·m

$\mu = 1$

$M_{j.Rd} := 90\ kN\cdot m$ $\quad \mu := 1$ $\quad q := 15\ \frac{kN}{m}$

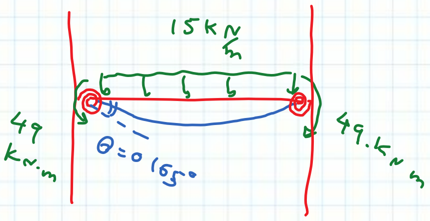
$$S_j := \frac{E\cdot z^2}{\mu\cdot\left(\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_{eq}}\right)} = (1.7\cdot10^4)\ kN\cdot m$$

$$M_0(S) := \frac{q\cdot l^2}{12\cdot\left(1+\frac{2\cdot E\cdot I}{S\cdot l}\right)}$$

$$M_{Ed} := M_0(S_j) = 48.89\ kN\cdot m$$

$$\mu := \begin{array}{|l} \text{if } M_{Ed} \le \frac{2}{3}\cdot M_{j.Rd} \\ \quad \| \ 1 \\ \text{else} \\ \quad \left\| \left(\frac{1.5\cdot M_{Ed}}{M_{j.Rd}}\right)^{2.7} \right. \end{array} = 1$$

$$\theta_0 := \frac{M_{Ed}}{S_j} = 0.165\ °$$



$M_{j.Rd} := 90\ kN\cdot m$ $\quad \mu := 1.18$ $\quad q := 20\ \frac{kN}{m}$

$$S_j := \frac{E\cdot z^2}{\mu\cdot\left(\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_{eq}}\right)} = (1.441\cdot10^4)\ kN\cdot m$$

$$M_0(S) := \frac{q\cdot l^2}{12\cdot\left(1+\frac{2\cdot E\cdot I}{S\cdot l}\right)}$$

$$M_{Ed} := M_0(S_j) = 63.805\ kN\cdot m$$

$$\mu := \begin{array}{|l} \text{if } M_{Ed} \le \frac{2}{3}\cdot M_{j.Rd} \\ \quad \| \ 1 \\ \text{else} \\ \quad \left\| \left(\frac{1.5\cdot M_{Ed}}{M_{j.Rd}}\right)^{2.7} \right. \end{array} = 1.181$$

$$\theta_0 := \frac{M_{Ed}}{S_j} = 0.254\ °$$