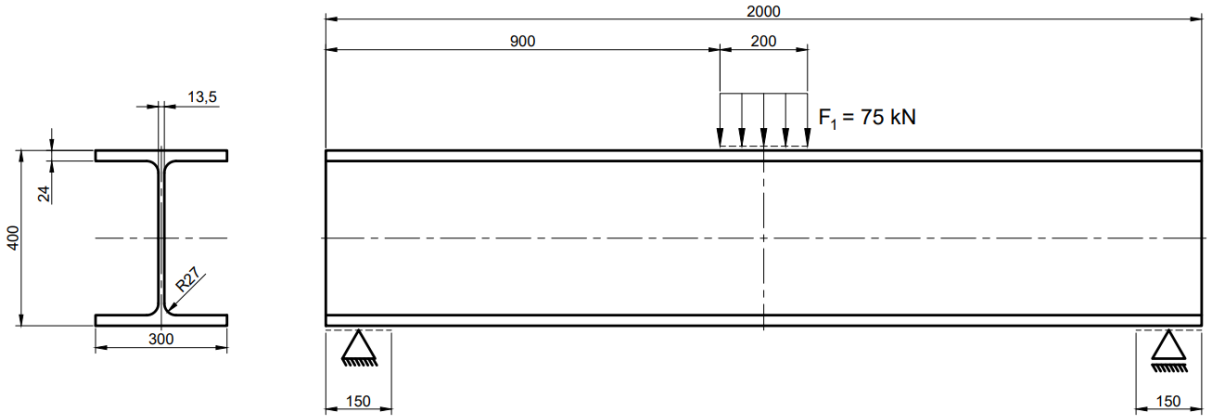
List 12

Task 1

Create a solid model of an HEB 400 I-beam (according to DIN: IPB 400) with a length of L = 2000 mm, in accordance with the dimensions shown in the drawing below. Assume the element is made of structural steel (Young's modulus E = 200 GPa; Poisson's ratio υ = 0,3; thermal conductivity coefficient λ = 60,5 W/(m·K)). One end of the I-beam is fixed over a length of 150 mm, while the other end is supported with a sliding support over a length of 150 mm. Prepare a FEA computational model for the beam subjected to a force F_1 = 75 kN applied over a 200 mm segment of the top flange. For the analyzed beam, determine the total displacements, the support reaction forces, and the reduced stresses according to the Huber-von Mises hypothesis.



Examine how the total displacements, support reaction forces, and reduced stresses (according to the Huber-von Mises hypothesis) change when an element at a temperature of 800°C is placed on a 200 mm segment of the top flange, causing a load of F_1 = 75 kN due to its weight. Additionally, assume that the surface of the I-beam is cooled by the surrounding air at a temperature of 22°C, and that heat exchange occurs through natural convection, with a heat transfer coefficient of α = 10 W/(m^2·K).