Exercise 1

We consider a loaded beam with a cross-section in T-shape (fig. 1). The beam is characterized by the following values: $E = 20\,\text{GPa}$, $\nu = 0.2$, $t_1 = 2\,\text{cm}$, $t_2 = 1\,\text{cm}$, $\omega_1 = 1\,\text{cm}$, $\omega_2 = 4\,\text{cm}$, $L = 21\,\text{cm}$ and $F = 100\,\text{N}$. We define $z = 0$ at the top of the beam.

a) Find the moment of area (I_y) at the centroid. *Hint: you may quite literally find this result in the exercises of a previous week.*

b) Determine the expression of $q(x)$.

c) Calculate the bending line $\omega(x)$ of the beam. *Hint: a good engineer should be both smart and lazy. You can save yourself a lot of time and troubles here: re-use results from the previous exercises and apply the superposition principle.*

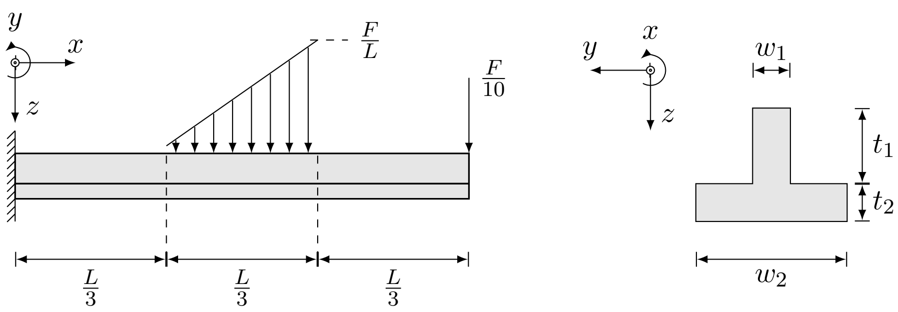

Figure 1: Schematic of the loaded bar and its cross-section.

Exercise 2

The two beams in figure 2 are identically loaded with two forces and bend under that load. The beams have the same bending stiffness EI. Calculate the bending line of the beams with the help of singularity functions. You can neglect the effect of any axial forces (forces in x-direction).

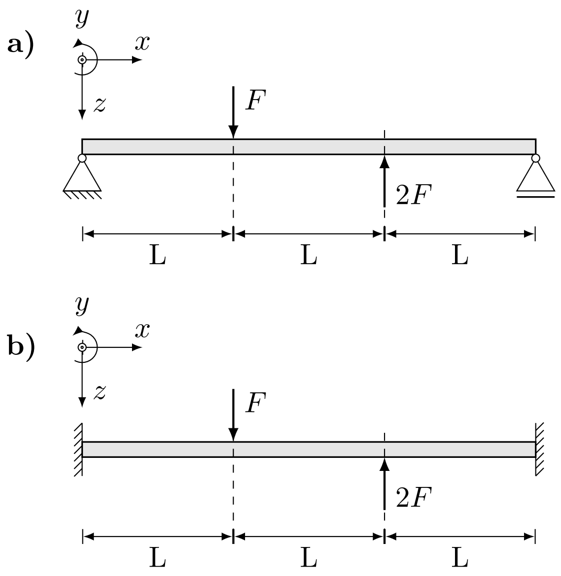

Figure 2: Double-supported beam under load.

Exercise 3

For the beam with bending stiffness EI in figure 3, calculate the bending line with singularity functions. The distributed force $q_0(x)$ is linearly decreasing from $\frac{2F}{L}$ at point C to point D where it becomes zero.

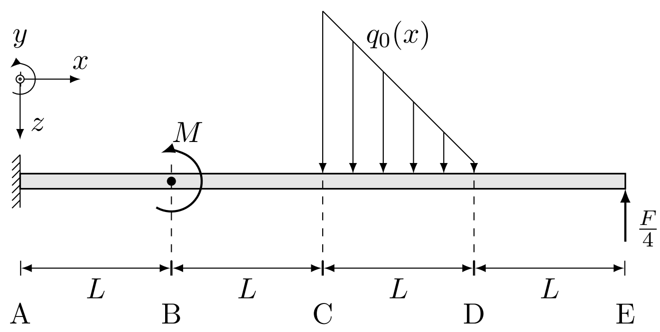

Figure 3: Single clamped beam under complex bending loads.

Exercise 4

The supported beam shown in figure 4 is loaded by a uniform load between its two supports and a point force at point C. Using the singularity function method, find the bending moment $M(x)$ and shear force $V(x)$, the bend angle $\theta(x)$ and the deflection $w(x)$ as a function of F.

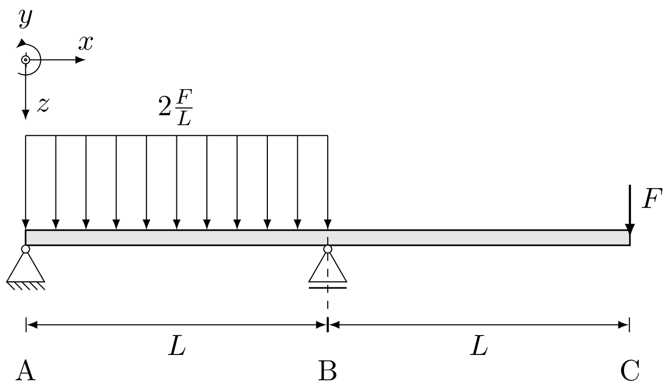

Figure 4: Supported beam with a distributed load and a pointload.