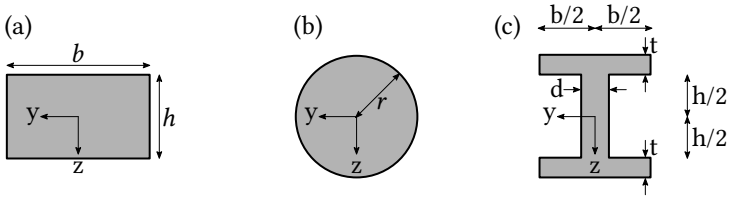
Exercise 9: Bending

Jan. 10, 2022 - Jan. 14, 2022

Question 1

Calculate the second moment of area I_y for the following profiles:

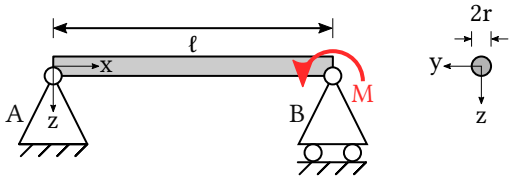


Hints:

- For the solution of (b) it is useful to consider the polar moment $I_r = \int r^2 dA = \int (y^2 + z^2) dA$. From the symmetry of the problem it follows that $I_y = I_z$.
- For the solution of (c) you can use the result from (a). Decompose the cross-section into rectangles and sum their respective I_y to get I_y of the whole cross-section. You will need the parallel axis theorem (Huygens-Steiner theorem), which says that the moment $I_{\bar{y}}$ for bending about an axis $\bar{y}$ that is parallel to y but separated by a distance l is $I_{\bar{y}} = I_y + l^2 A$, where A is the area.

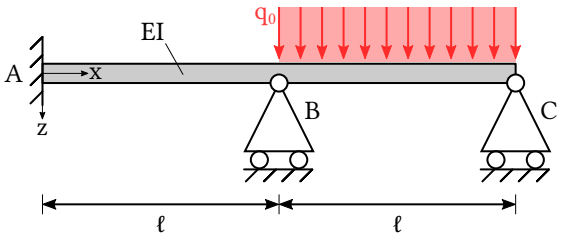
Question 2

A beam with cylindrical cross-section (radius r) is supported by two bearings, see below. A moment M is applied at one end. Calculate the maximum deflection! Where does it occur?



Question 3

The beam shown below has the bending stiffness EI and is subjected to a line load q_0. Calculate the reaction forces and the deflection of the beam!



Hint: If a system is hyperstatic it might be helpful to start from the Euler-Bernoulli equation before trying to determine the reaction forces.