Conduction in a rod with internal heat production

This is a derivation of the temperature distribution function $T(x)$ for a steady-state heat conduction in a rod of length L. We assume that the internal heat production is present in every point inside the rod volume. The rod is perfectly insulated along its length and it loses heat only through its endpoints which in a steady-state case are kept at a fixed temperature T_0.

We will take for the control volume a slice dx from the rod.

The energy balance for the rod element:

$$\frac{dE}{dt} = E_{in} + E_{out} + E_{production} \tag{1}$$

$$T(x) = -\frac{Q}{2\lambda}(x^2 - Lx) + T_0 \tag{2}$$

Computational example

As a computational example we will draw the graph of the temperature distribution in a copper rod $200m$ long. We take that the thermal conductivity for this rod is $400\frac{W}{m\cdot^oC}$. The internal heat production is $20W$.

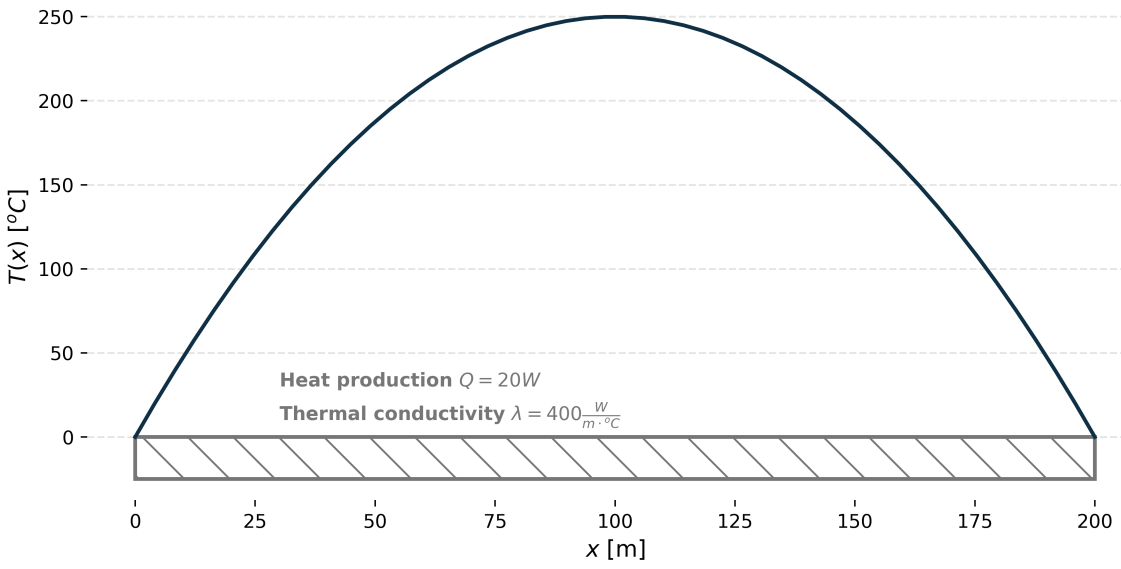

Figure 1: Temperature distribution in a rod with internal heat production of $20W$

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