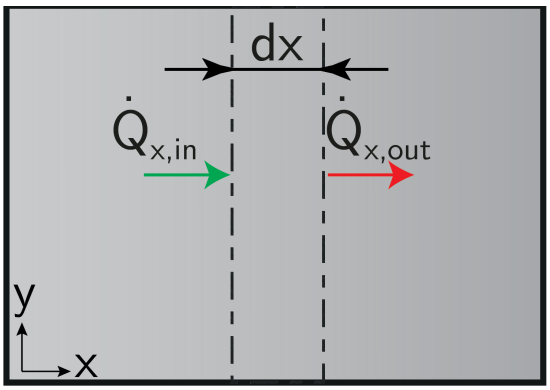
EB - Cond. - IE 3

Develop an energy balance to calculate the temperature profile inside the wall. Assume one-dimensional steady-state heat transfer in x-direction.



Energy Balance:

$$\dot{Q}_{x,in} - \dot{Q}_{x,out} = 0$$

The sum of the in- and outgoing fluxes should equal zero, because of steady-state conditions.

Heat Fluxes:

$$\dot{Q}_{x,in} = -\lambda A \frac{\partial T}{\partial x}$$

$$\dot{Q}_{x,out} = -\lambda A \frac{\partial T}{\partial x} + \frac{\partial \dot{Q}_{x,in}}{\partial x} dx$$

The ingoing flux can be described by use of Fourier's law. The outgoing flux can be approximated by the use of the Taylor series expansion.

Substituting and rewriting:

$$\dot{Q}_{x,in} - \dot{Q}_{x,out} = 0$$

$$-\lambda A \frac{\partial T}{\partial x} + \lambda A \frac{\partial T}{\partial x} - \frac{\partial}{\partial x}\left(-\lambda A \frac{\partial T}{\partial x}\right) dx = 0$$

$$\Rightarrow \lambda \frac{\partial^2 T}{\partial x^2} = 0$$