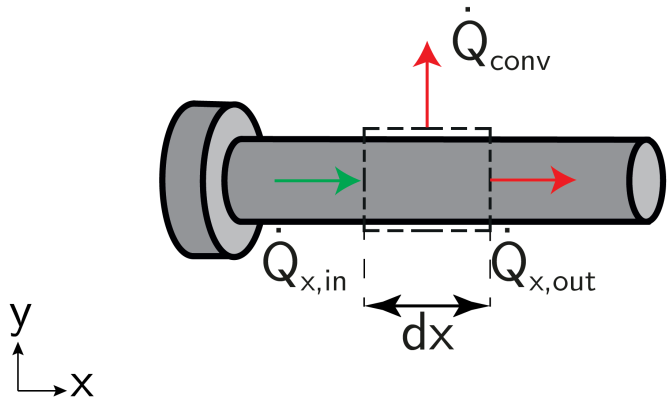
EB - Cond. - IE 10

Specify the energy balance to derive the fin temperature distribution. Assume one-dimensional, steady-state heat transfer in the x-direction with no sources/sinks. A_p is the circumferential area of the given element and A_c is the cross-sectional area of the fin.



Energy balance:

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

Since the heat transfer is characterized as steady-state, the sum of the in- and outgoing heat fluxes for the control volume should equal zero.

Heat fluxes:

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

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

$$\dot{Q}_{conv} = \alpha \cdot A_p \left(T(x) - T_\infty\right)$$

The heat entering the system is transferred from the base by conductive heat transfer. This heat flux is distributed over a convective and conductive heat flux. $\dot{Q}_{x,out}$ can be approximated by use of the Taylor series expansion.