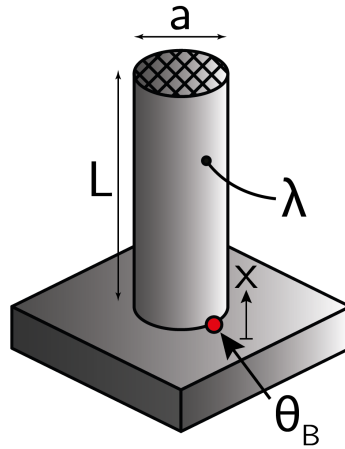


Fins - Flux 1

Calculate the rate of heat transfer for a fin with an adiabatic head.



Given the fin temperature profile:

$$\Theta(x) = \Theta_B \frac{\cosh(m(L-x))}{\cosh(mL)}$$

Where $\Theta(x) = T(x) - T_\infty$ and $m = \sqrt{\frac{4\alpha}{\lambda a}}$.

The rate of heat transfer through the fin can be expressed as:

$$\dot{Q} = -\lambda A_c \frac{\partial T}{\partial x} \Big|_{x=0} = -\lambda \frac{\pi a^2}{4} \frac{\partial \Theta}{\partial x} \Big|_{x=0}$$

Differentiation of $\Theta(x)$ with respect to x yields:

$$\frac{\partial \Theta}{\partial x} = -m \Theta_B \frac{\sinh(m(L-x))}{\tanh(mL)}$$

There for at $x = 0$ gives:

$$\frac{\partial \Theta}{\partial x} \Big|_{x=0} = -\Theta_B \frac{\sinh(mL)}{\cosh(mL)} = -\Theta_B \tanh(mL)$$

Substitution into the expression for the rate of heat transfer yields:

$$\dot{Q} = \lambda \frac{\pi a^2}{4} m \Theta_B \tanh(mL)$$