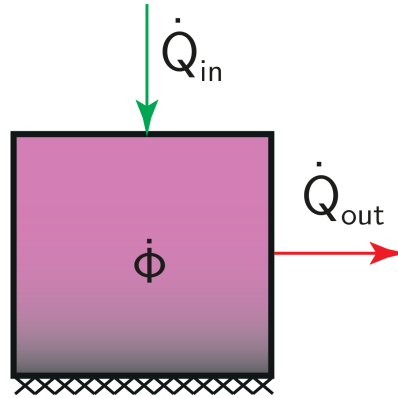


EB - Cond. - Body 5

A steel cube is exposed to a heat flux from the upper side. The bottom is adiabatic. Furthermore all free surfaces are subjected to convection, a sink extracts the remaining heat. Derive an energy balance to determine the heat extraction rate per unit volume. Assume the temperature to be homogeneous and neglect radiation.



Energy Balance:

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

From the context it can be noted that we are dealing with a steady-state problem. Therefore, the sum of the in- and outgoing fluxes should equal zero.

Heat Fluxes:

$$\dot{Q}_{in} = \dot{q}'' L^2$$

$$\dot{Q}_{out} = 5\alpha (T_w - T_\infty) L^2$$

Note that 5 out of 6 sides of the cube are subjected to convection.

$$\dot{\Phi} = \dot{\Phi}''' L^3$$