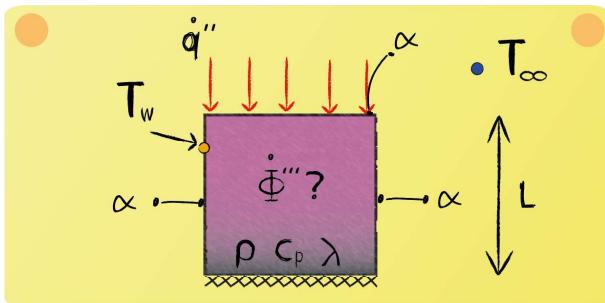


Lecture 13 - Question 10



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, the remaining heat is extracted by a sink. Derive an energy balance to determine the rate of heat being extracted per unit volume. Assume the temperature to be homogeneous and neglect radiation.

Energy Balance:

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

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

Heat Fluxes:

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

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

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

