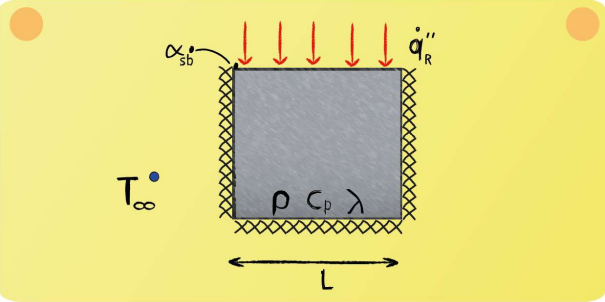
Energy Balance - Radiation 1



Setup the energy balance to compile a differential equation for the temporal variation of the homogeneous temperature T_w of the grey cube (absorptivity α, transmissivity $\tau = 0$). Convective heat transfer towards the environment is described by the heat transfer coefficient α_{sb}. The body is exposed to a radiative heat flux $\dot{q}'' - R$.

Energy balance:

$$\frac{dU}{dt} = \dot{Q}_{absorption} - \dot{Q}_{convection} - \dot{Q}_{emission}$$

The heat transfer can be classified as transient, for that reason the change of internal energy over time equals the sum of the in and outgoing fluxes.

Change of internal energy over time:

$$\frac{dU}{dt} = \rho \cdot c_p \cdot L^3 \cdot \frac{dT_w}{dt}$$

The internal energy of the control volume can be described as: $U = m \cdot c_p \cdot T$.

Heat fluxes:

$$\dot{Q}_{absorption} = \alpha \cdot q''_R \cdot L^2$$

$$\dot{Q}_{convection} = \alpha_{sb} \cdot L^2 \cdot (T_w - T_\infty)$$

$$\dot{Q}_{emission} = \alpha \cdot \sigma \cdot T_w^4 \cdot L^2$$

It should be noted that we are dealing with a grey body, therefore $\epsilon = \alpha$.