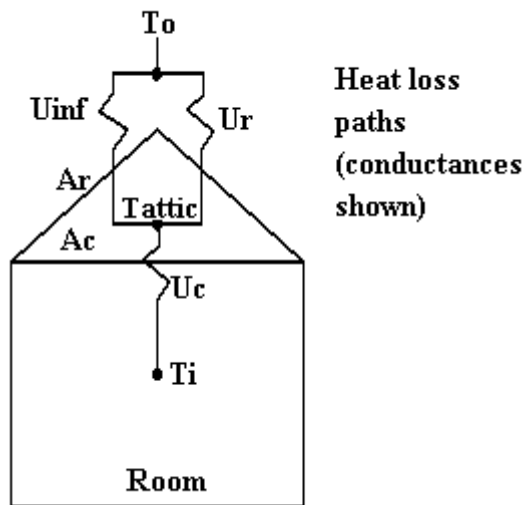


CHAPTER 1 STEADY-STATE HEAT CONDUCTION

1.6 Thermal Analysis of Unheated Spaces

Consider an attic ventilated at a rate Q with outside air at T_o . Given the roof area A_r and U-value u_r , the ceiling area A_c and its conductance value of u_c , determine the ceiling heat loss q_c for a design room temperature T_i .

**Inputs**

$$T_o := -13 \Delta^{\circ}\text{C}$$

$$T_i := 22 \Delta^{\circ}\text{C}$$

$$A_r := 240 \text{ m}^2 \quad A_c := 200 \text{ m}^2$$

$$u_r := 0.9 \frac{\text{W}}{\text{m}^2 \cdot \Delta^{\circ}\text{C}}$$

$$u_c := 1.7 \frac{\text{W}}{\text{m}^2 \cdot \Delta^{\circ}\text{C}}$$

$$Q := 0.007 \frac{\text{m}^3}{\text{s}} \quad \text{air flow rate}$$

Calculations

To calculate the total thermal resistance between T_i and T_o , we first determine the infiltration conductance:

$$U_{inf} := Q \cdot 1200 \frac{J}{\Delta^{\circ}C \cdot m^3}$$

$$R_{tot} := \left(\frac{1}{A_c \cdot u_c} + \frac{1}{A_r \cdot u_r + U_{inf}} \right) = 0.007 \frac{\Delta^{\circ}C}{W}$$

$$q_c := \frac{T_i - T_o}{R_{tot}} = (4.731 \cdot 10^3) W \quad \text{total heat loss}$$

We may also require the attic temperature for condensation calculations.

$$T_{attic} := T_i - \left(\frac{q_c}{A_c \cdot u_c} \right) = 8.084 \Delta^{\circ}C$$