16.050 Thermal Energy

Recitation #12 – Fall 2002

Problem 1:

A house has a composite wall of wood, fiberglass insulation, and plaster board, as indicated in the sketch on the board. On a cold winter day the convection heat transfer coefficients are h_o=*60 W/m²K* and h_i=*30 W/m²K*. The total wall surface area is 350 m².

(a) Determine a symbolic expression for the total thermal resistance of the wall, including inside and outside convection effects for the prescribed conditions.
(b) Determine the total heat loss through the wall.
(c) If the wind were blowing violently, raising h_o to 300 W/m²K, determine the percentage increase in the heat loss.
(d) What is the controlling resistance that determines the amount of heat flow through the wall?

Problem 2:

A thin metallic wire of thermal conductivity *k*, diameter *D*, and length *2L* is annealed by passing an electrical current through the wire to induce a uniform volumetric heat generation $\dot{E}_g$. The ambient air around the wire is at a temperature T_∞, while the ends of the wire at x=+-L are also maintained at T_∞. Heat transfer from the wire to the air is characterized by the convection coefficient *h*. Obtain an expression for the steady-state temperature distribution T(x) along the wire.