PROB. 1-21

\[ A = 150 \text{ m}^2, \quad H = 3 \text{ m}, \quad P_{\text{atm}} = 89.6 \text{ kPa}, \quad T_{\text{in}} = 22^\circ \text{C} \]

0.7 ACH, assume P and T constant, find Q loss

For \( T_{\text{out}} = 5^\circ \text{C} \), find cost for \#0.082/kW·hr

**First Law:** 
\[ Q = m \cdot C_p \cdot (T_0 - T_c) \]

**Perfect gas:** 
\[ P \cdot V = m \cdot R \cdot T, \quad m = \frac{P \cdot V}{R \cdot T} \]

\[ Q = \frac{P \cdot V \cdot C_p}{R \cdot T} \cdot (T_0 - T_c) \]

**Volume exchanged over 24 hrs:**

\[ V = (0.7 \frac{\text{m}^3}{\text{hr}}) \left[ (150 \text{ m}^2) (3 \text{ m}) \right] \cdot (24 \text{ hr}) = 7560 \text{ m}^3 \]

\[ Q = \frac{(89.6 \text{ kPa})(7560 \text{ m}^3)}{(0.287 \frac{\text{m}^3}{\text{kg} \cdot \text{K}})(5 + 273 \text{ K})} \cdot (1.007 \frac{\text{kJ}}{\text{kg} \cdot \text{K}})(5 - 22 \text{ K}) \]

\[ Q = -1.453 \times 10^5 \text{ kJ} \]

**Cost:**
\[ \text{Cost} = \left( 1.453 \times 10^5 \frac{\text{kJ}}{\text{hr}} \right) \left( \frac{\text{kJ}}{\text{hr}} \right) \left( \frac{0.082 \text{ \$/kW·hr}}{3600 \text{ s}} \right) \]

\[ \text{Cost} = \$3.31 \]