

Fuel-energy savings by improving thermal insulationd

Heating and Cooling Degree-Days for Rockford Area:

$$\text{HDD} := 6970 \cdot \text{R} \cdot \text{day} \quad \text{CDD} := 750 \cdot \text{R} \cdot \text{day} \quad \text{Therm} := 10^5 \cdot \text{BTU}$$

$$\text{Aw} := 22600 \cdot \text{ft}^2 \quad \text{Ar} := 40692 \cdot \text{ft}^2 \quad \dots \text{ wall and roof areas} \quad \begin{matrix} a := 270 \cdot \text{ft} & b := 150 \cdot \text{ft} \\ c := 26 \cdot \text{ft} \end{matrix}$$

$$\text{SEER} := 10 \cdot \frac{\text{BTU}}{\text{W} \cdot \text{hr}} \quad \text{Seasonal Energy Efficiency Ratio for A/C}$$

Cost of electricity Cc and natural gas Ch in USD=\$

$$\text{USD} := 1 \quad \text{Cc} := 0.1 \frac{\text{USD}}{\text{kW} \cdot \text{hr}} \quad \text{Ch} := 1 \cdot \frac{\text{USD}}{\text{Therm}} \quad \frac{\text{Ch}}{\text{Cc}} = 0.341$$

Classical wall and roof insulation values: $\text{Rw1} := 12 \cdot \frac{\text{hr} \cdot \text{R} \cdot \text{ft}^2}{\text{BTU}} \quad \text{Rr1} := 19 \cdot \frac{\text{hr} \cdot \text{R} \cdot \text{ft}^2}{\text{BTU}}$

ThermalShell wall and roof insulation values: $\text{Rw} := 35 \cdot \frac{\text{hr} \cdot \text{R} \cdot \text{ft}^2}{\text{BTU}} \quad \text{Rr} := 30 \cdot \frac{\text{hr} \cdot \text{R} \cdot \text{ft}^2}{\text{BTU}}$

Differential heating loss saving:

$$\text{Qwh} := \text{Aw} \cdot \text{HDD} \cdot \left(\frac{1}{\text{Rw1}} - \frac{1}{\text{Rw}} \right) \quad \text{Qrh} := \text{Ar} \cdot \text{HDD} \cdot \left(\frac{1}{\text{Rr1}} - \frac{1}{\text{Rr}} \right) \quad \text{Qh} := \text{Qwh} + \text{Qrh}$$

$$\text{Qwh} = 2.07 \times 10^8 \text{ BTU} \quad \text{Qrh} = 1.314 \times 10^8 \text{ BTU} \quad \text{Qh} = 3.384 \times 10^8 \text{ BTU}$$

$$\boxed{\text{Qh} = 3.384 \times 10^3 \text{ Therm}}$$

Differential A/C cooling gain saving:

$$\text{Qwc} := \text{Aw} \cdot \text{CDD} \cdot \left(\frac{1}{\text{Rw1}} - \frac{1}{\text{Rw}} \right) \quad \text{Qrc} := \text{Ar} \cdot \text{CDD} \cdot \left(\frac{1}{\text{Rr1}} - \frac{1}{\text{Rr}} \right) \quad \text{Qc} := \text{Qwc} + \text{Qrc}$$

$$\text{Qwc} = 2.228 \times 10^7 \text{ BTU} \quad \text{Qrc} = 1.414 \times 10^7 \text{ BTU} \quad \text{Qc} = 3.641 \times 10^7 \text{ BTU}$$

$$\text{Qc} = 364.123 \text{ Therm} \quad \text{Qc} = 1.067 \times 10^4 \text{ kW} \cdot \text{hr}$$

Savings in A/C electricity and Energy Cost savings:

$$\text{Ec} := \frac{\text{Qc}}{\text{SEER}} \quad \boxed{\text{Ec} = 3.641 \times 10^3 \text{ kW} \cdot \text{hr}} \quad \text{Mc} := \text{Ec} \cdot \text{Cc} \quad \text{Mc} = 364.123 \text{ USD}$$

$$\text{Mh} := \text{Qh} \cdot \text{Ch} \quad \text{Mh} = 3.384 \times 10^3 \text{ USD}$$

TOTAL COST SAVING at current low energy prices (would be twice a year ago)

$$\text{Mhc} := \text{Mh} + \text{Mc} \quad \boxed{\text{Mhc} = 3748.04 \text{ USD}}$$

$$a \cdot b = 40.5 \times 10^3 \text{ ft}^2 \quad 2 \cdot (a + b) \cdot c = 21.84 \times 10^3 \text{ ft}^2 \quad a \cdot b \cdot c = 1.053 \times 10^6 \text{ ft}^3$$