

Heating Calculation Example (Winter)

$$T_{inside.W} := 72$$

IECC C302.1

$$T_{outside.W} := 10$$

ASHRAE 2013 FUNDAMENTALS
HANDBOOK. AMARILLO
HEATING DB 99.6%

$$\Delta T_w := (T_{inside.W} - T_{outside.W}) \Delta^\circ F = 62 \Delta^\circ F$$

$$R_{roof.typ} := 30 \cdot \frac{hr \cdot ft^2 \Delta^\circ F}{Btu}$$

IECC C402.1.3 CLIMATE
ZONE 4

$$U_{roof.typ} := \frac{1}{R_{roof.typ}} = 0.033 \frac{Btu}{hr \cdot ft^2 \cdot \Delta^\circ F}$$

$$R_{wall.typ} := 19 \cdot \frac{hr \cdot ft^2 \Delta^\circ F}{Btu}$$

CONSERVATIVE VALUE

$$U_{wall.typ} := \frac{1}{R_{wall.typ}} = 0.053 \frac{Btu}{hr \cdot ft^2 \cdot \Delta^\circ F}$$

$$U_{window.metal.2p} := 0.8 \cdot \frac{Btu}{hr \cdot ft^2 \cdot \Delta^\circ F}$$

IECC C303.1.3(1).
CONSERVATIVE DEFAULT
VALUE FROM IECC

$$A_{roof} := 1000 ft^2 = 1000 ft^2$$

$$A_{windows} := 100 ft^2$$

$$A_{walls} := 300 ft^2 \cdot 4 - A_{windows} = 1100 ft^2$$

$$Q_{roof.W} := U_{roof.typ} \cdot A_{roof} \cdot \Delta T_w = 2066.667 \frac{Btu}{hr}$$

$$Q_{walls.W} := U_{wall.typ} \cdot A_{walls} \cdot \Delta T_w = 3589.474 \frac{Btu}{hr}$$

$$Q_{windows.W} := U_{window.metal.2p} \cdot A_{windows} \cdot \Delta T_w = 4960 \frac{Btu}{hr}$$

$$Q_{env.W} := Q_{roof.W} + Q_{walls.W} + Q_{windows.W} = 10616.14 \frac{Btu}{hr}$$

$$vent_{CFM} := 100$$

$$alt := 3600 \text{ ft}$$

$$AF := e^{-0.0000362 \cdot \frac{alt}{ft}} = 0.878$$

ASCE 7-16 Ke, 26.9 elevation factor

$$Q_{vent.W} := 1.1 \cdot vent_{CFM} \cdot \frac{\Delta T_w}{\Delta F} \cdot AF \cdot \frac{Btu}{hr} = 5986.695 \frac{Btu}{hr}$$

ASHRAE 1997 Fundamentals 28.40 (eq 25)

$$Q_{tot.W} := Q_{env.W} + Q_{vent.W} = 16602.835 \frac{Btu}{hr}$$

$$Heat_{needed} := \frac{Q_{tot.W}}{AF} = 18913.831 \frac{Btu}{hr}$$

Cooling example - Start with 28.40 Table 29 within ASHRAE 1997 Fundamentals

$$T_{inside.S} := 75$$

IECC C302.1

$$T_{outside.S} := 97.3$$

$$T_{wb.S} := 66.2$$

ASHRAE 2013 fundamentals for amarillo

$$\Delta T_s := (T_{outside.S} - T_{inside.S}) \Delta F = 22.3 \Delta F$$

$$Q_{roof.S} := U_{roof.typ} \cdot A_{roof} \cdot \Delta T_s = 743.333 \frac{Btu}{hr}$$

$$Q_{walls.S} := U_{wall.typ} \cdot A_{walls} \cdot \Delta T_s = 1291.053 \frac{Btu}{hr}$$

$$Q_{cond.windows.S} := U_{window.metal.2p} \cdot A_{windows} \cdot \Delta T_s = 1784 \frac{Btu}{hr}$$

$$SHGC := 0.7$$

IECC 2015 Table C303.1.3(3)

$$SC := \frac{SHGC}{0.87} = 0.805$$

ASHRAE 1997 Fundamentals 29.23 (eq 37)

$$SCL_N := 40 \quad SCL_E := 185 \quad SCL_S := 97 \quad SCL_W := 192$$

SCL values from ASHRAE 1997 Fundamentals p28.50 (Table 36)

$$Q_{rad.windows} := A_{windows} \cdot SC \cdot SCL_W \cdot \frac{Btu}{hr \cdot ft^2} = 15448.276 \frac{Btu}{hr}$$

ASHRAE 1997 Fundamentals 28.41 (eq 43)

$$Q_{windows.S} := Q_{cond.windows.S} + Q_{rad.windows} = 17232.276 \frac{Btu}{hr}$$

$$Q_{sens.vent.S} := 1.1 \cdot vent_{CFM} \cdot \frac{\Delta T_s}{\Delta F} \cdot AF \cdot \frac{Btu}{hr} = 2153.279 \frac{Btu}{hr}$$

$$h_{outside.S} := 32.4 \frac{Btu}{lb}$$

$$h_{inside.S} := 24.9 \frac{Btu}{lb}$$

$$Q_{tot.vent.S} := 4.5 \cdot vent_{CFM} \cdot \frac{(h_{outside.S} - h_{inside.S})}{\frac{Btu}{lb}} \cdot \frac{Btu}{hr} = 3375 \frac{Btu}{hr}$$

$$Q_{lat.vent.S} := Q_{tot.vent.S} - Q_{sens.vent.S} = 1221.721 \frac{Btu}{hr}$$

$$Q_{sens.env.S} := Q_{roof.S} + Q_{walls.S} + Q_{windows.S} + Q_{sens.vent.S} = 21419.941 \frac{Btu}{hr}$$

People Loads

$$N_{people} := 10$$

$$Q_{sens.sitting} := 225 \frac{Btu}{hr}$$

ASHRAE 2013 fundamentals
Table 1 18.4

$$Q_{lat.sitting} := 105 \frac{Btu}{hr}$$

$$Q_{sens.S} := Q_{sens.env.S} + Q_{sens.vent.S} + N_{people} \cdot Q_{sens.sitting} = 25823.22 \frac{Btu}{hr}$$

$$Q_{lat.S} := Q_{lat.vent.S} + Q_{lat.sitting} = 1326.721 \frac{Btu}{hr}$$

$$Q_{tot.S} := \frac{(Q_{sens.S} + Q_{lat.S})}{AF} = 30929.019 \frac{Btu}{hr}$$

$$Q_{tons.S} := \frac{Q_{tot.S}}{12000 \frac{Btu}{hr}} = 2.577$$

$$SHR := \frac{Q_{sens.S}}{Q_{tot.S}} = 0.835$$