



# The Entropy Police

Geothermal heat pump design program

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# Problem Statement

Geothermal heat pumps are a complex systems that are difficult to design, analyze and optimize. The use of thermal analysis programs can ease this design process.

An application for this process is not currently available.

# Objectives

**To design a program in Engineering Equation Solver (EES) that:**

- Analyzes a geothermal system
- Utilizes engineering economics to optimize pipe dimensions and flow
- Has a simple user interface to allow easy design modifications

# Heating Load

$$\Delta T = 69\text{ }^{\circ}\text{F}$$

$$\text{Wall area} = 35,018\text{ ft}^2$$

$$\text{Roof area} = 18,880\text{ ft}^2$$

$$\text{Window area} = 4700\text{ ft}^2$$

To find the heat loss the following equation was used for each unique portion of the building.

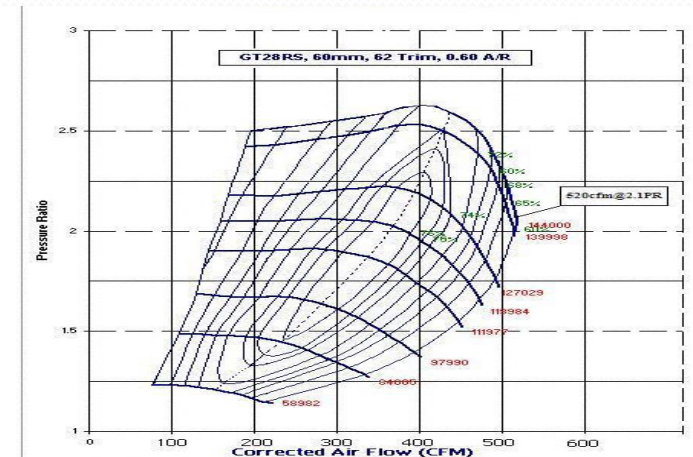
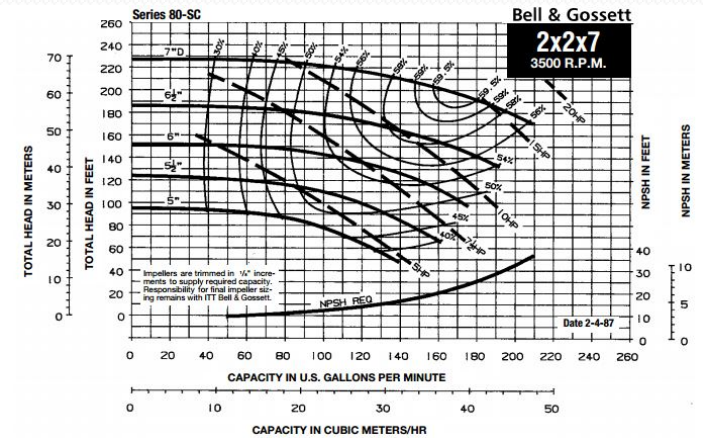
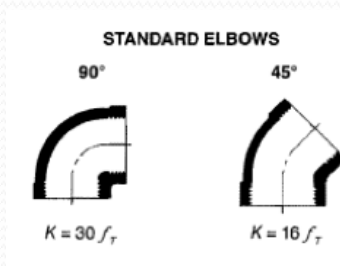
$$\text{Heat loss} = (U)(A)(\Delta T)$$

where U is the overall heat transfer coefficient, A is the surface area, and T is the difference in temperature.

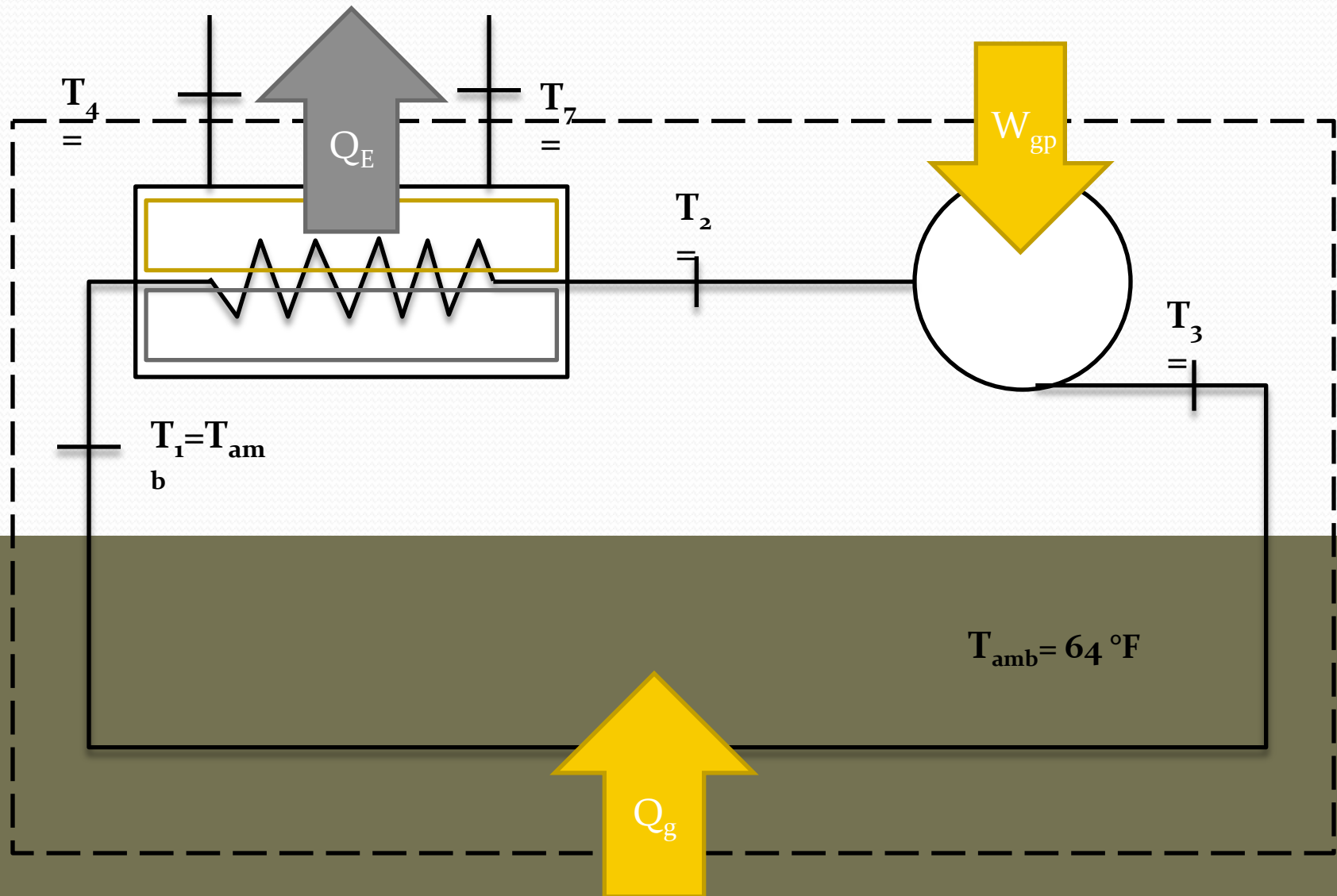
$$\text{Max heating load}_{\text{hand calc}} = 594\text{ kBtu/hr}$$

# Pump/Compressor

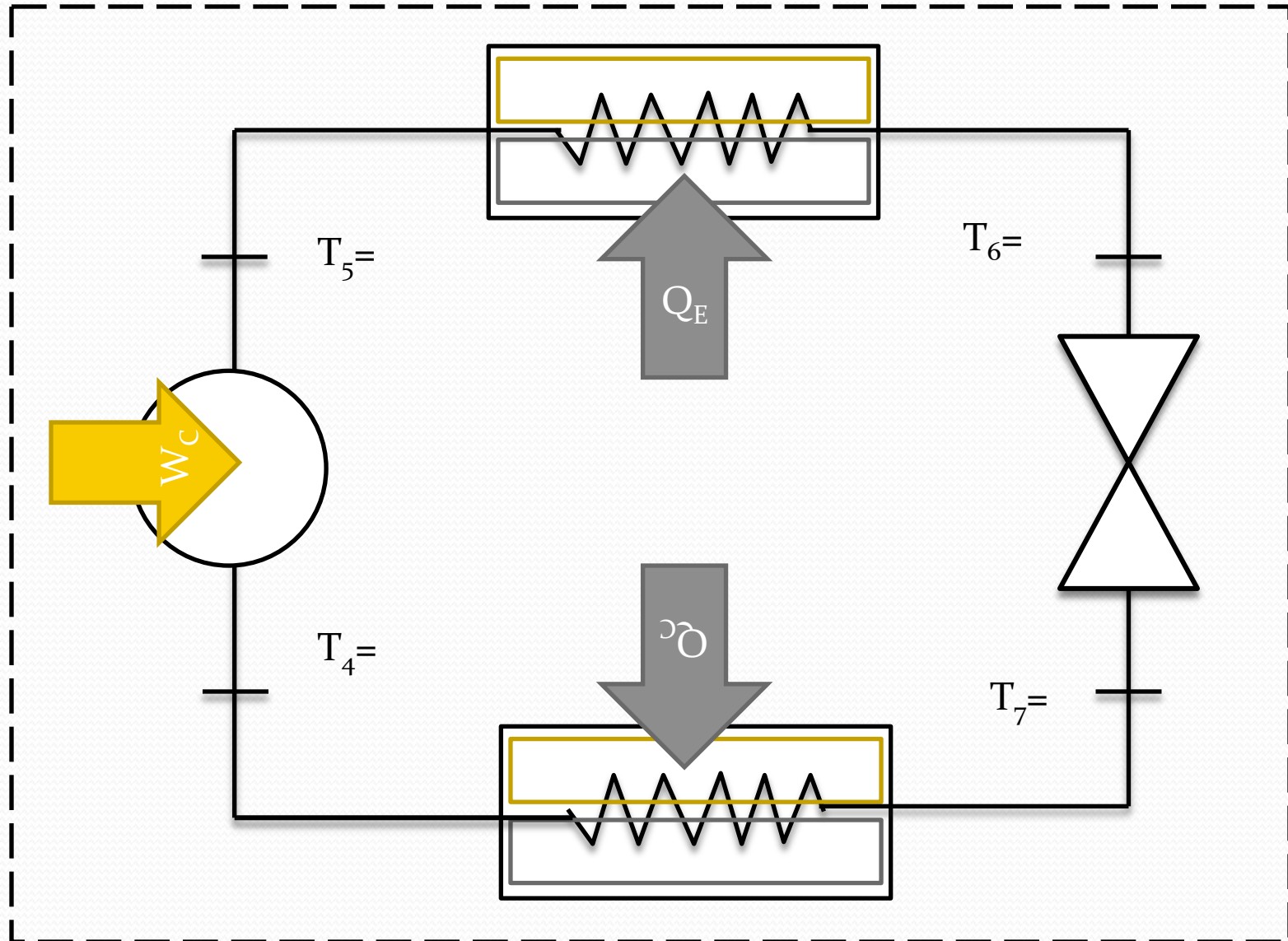
- Needs to overcome system losses (pipe flow, bends, valves)
- Pump curves
  - Operating level of pump
- System curve
  - Operating level of system



# Ground-Loop Model



# Heat Exchanger Model



# House Loop

