Thermal Solar

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Solar Thermal Radiant Heating System

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Radiant Flooring Design

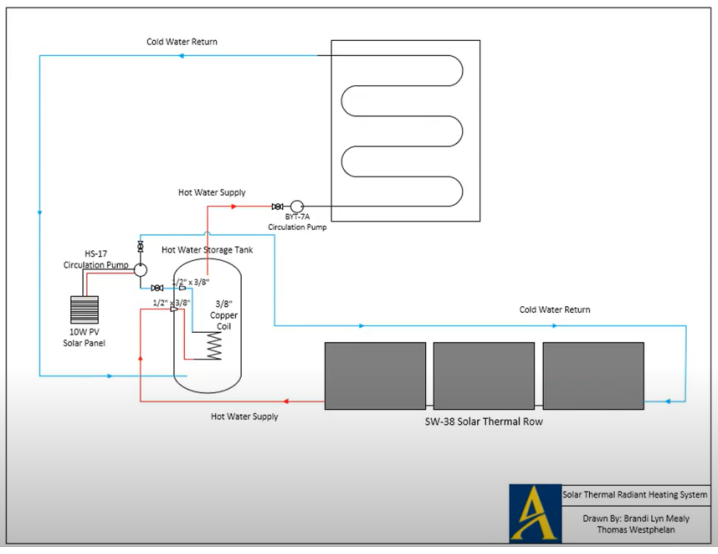
The radiant floor design uses temperature rated pex pipe that is installed in the floor of the coop to allow the radiant heat to start heating the floor and then the air space in the coop. Push-to-connect brass SharkBites were used to assemble the piping with ease.

- Water temperature of approximately 130°F is required to keep the chicken coop at 60°F
- Max heat transfer rate of 9,621.32BTU/hr
- Hot water piping was insulated

Project Origination

Typical chicken coops are heated using infrared heating lamps. To prevent the event of a fire, a radiant floor heating system powered by solar thermal panels is implemented.

- Heat gain analyses – HVAC Course
- Heat transfer through conduction and radiation – Heat Transfer Course
- Fluid Mechanics - Determining pump specifications



Design Criteria

- Closed loop system
- Panels shall face south in direction and be 45 degrees in angle placement
- Desired coop internal temperature at 60 degrees Fahrenheit
- Hot water piping must be insulated, and temperature rated
- Valves shall be used for pressure protection
- Heat exchanger shell side shall be held at atmospheric pressure conditions

Testing and Troubleshooting

- After initially priming the solar circulation pump it would not continue to pump water after being installed in the solar thermal panel loop
  - The connection to the solar circulation pump was faulty
  - Alligator clamps were installed onto the pump wires and connected to the 10W solar PV panel
- Temperatures were taken using a temperature laser at the inlet/outlet of the copper coil, inlet/outlet of the coolers (coop), and the internal temperature of the coolers (coop).
- Testing began, but the weather limited the potential of the results
  - The results were taken on gloomy days

Coop Heat Loss Analysis

Heat Transfer Q =	U	A (ft^2)	TD (F)	= BTU/hr	
Roof	0.72	57.6	20	834.78	
Walls					
North	1.06	48	20	1021.28	
South	1.06	48.97	20	1041.84	
East	1.06	48	20	1021.28	
West	1.06	46.22	20	983.45	
Windows	1.01	15.03	20	303.68	
Doors	0.49	17.78	20	174	
Floor	3.32	48	20	3187.20	
			Heat Transfer Subtotal	8567.73	
			$CFM_{leakage}$	13.00	CFM
			Q_{inf}	285.92	BTU/hr
			Total Required Heat Load	**8853.65**	BTU/hr
			Total Required Heat Load	2.59	kWh

Chicken Coop Energy Demand

Design Changes and Difficulties

- Coolers were used to demonstrate the heating ability of the solar panel due to limited time
- The solar circulation pump was changed from a connected 12V power source to a PV panel power source

Design of the Heat Exchanger

The heat exchanger uses a 3/8”x50’ copper coil (tube) that is submerged into a 55-gallon drum (shell) that is specified to meet the heating requirements for the coop.

- 3/8" copper tubing in coil like design is used for optimum heat exchange
- Placed in the center of the tank for an even amount of heating
- The coil heat exchanger has a maximum heat transfer of 9,621.32 BTU/hr
- The heat effectiveness of the exchanger is 42%

Delivered Energy

- The maximum internal temperature recorded inside of the coolers was 55.7°F
- A maximum amount of heat transfer of 1831.84 BTU/hr was supplied to the chicken coop

These results conclude that thermal solar panels are not capable of supplying the required energy to the radiant heating system to properly heat the coop during the colder months.