Current Situation

The current greenhouse has been used for the past 3 winters to help store our tropical plants. To help maintain temperature, a small electric space heater was plugged in and left on with a thermostat setting of around 55-60 degrees. This obviously caused the electric bill to soar during the winter months. For the winter of 2018-19, 4 15-gallon water barrels (link) were included in the space. These barrels were painted black and placed in each corner of the greenhouse. They did help store some heat during the winter months and did reduce the electric bill slightly.

In the spring of 2019, we decided to keep the greenhouse up for regular growing season. We will attempt to grow tomatoes, peppers and zucchini along with various herbs. Growing these in the greenhouse will help prevent the area wildlife from eating the produce before we have an opportunity.

If the growing season is successful, we have the intention replacing the current foldable greenhouse (Amazon link), with a more permanent structure, (Amazon link). To help reduce the expense of winter warming of the space, I put a plan together to utilize hot water to help keep the space warm.

There are two places the water will flow. Through a series of PEX tubing running through the floor and the barrels currently holding water. The barrels will need to be modified to include connections.

Greenhouse Floor

After the location of the greenhouse has been determined, the space will be excavated to a depth of 3". Pressure treated lumber that is suitable for burying will be leveled and set as a frame for the floor. The frame will be double 2x4 on each side with the centers measuring 6' x 8'. This frame will assist with holding the floor material and provide some framing for the greenhouse to be attached.

The bottom of the excavated area will be lined with a EPDM membrane. This will prevent weeds and ground moisture from coming up through the floor. It will also help retain any humidity within the space.

The next layer in the floor will be a heat reflective material. This material is typically found under a concrete slab when installing a radiant floor system. From Home Depot: 24 in. x 25 ft. Double Reflective Insulation Roll (link)

On top of the reflective barrier will be a basic aluminum wire mesh. The mesh is used to provide a measured grid for the PEX tubing to be spaced properly and for the tubing to be tied in place with twist ties. The PEX tubing will be spaced 4" away from the next closest tube. It allows for an 8" U-turn at the center.

There will be two zones of PEX tubing totaling approximately 160'. Each zone will be rung in a spiral formation under the floor. (Figure 1). Each end of the tubing will have a basic manifold attached (Amazon link) (Figure 2)This will allow the zones to be turned on and off as needed. A bypass valve will also be needed to allow the floor to be bypassed completely.

Figure 1.

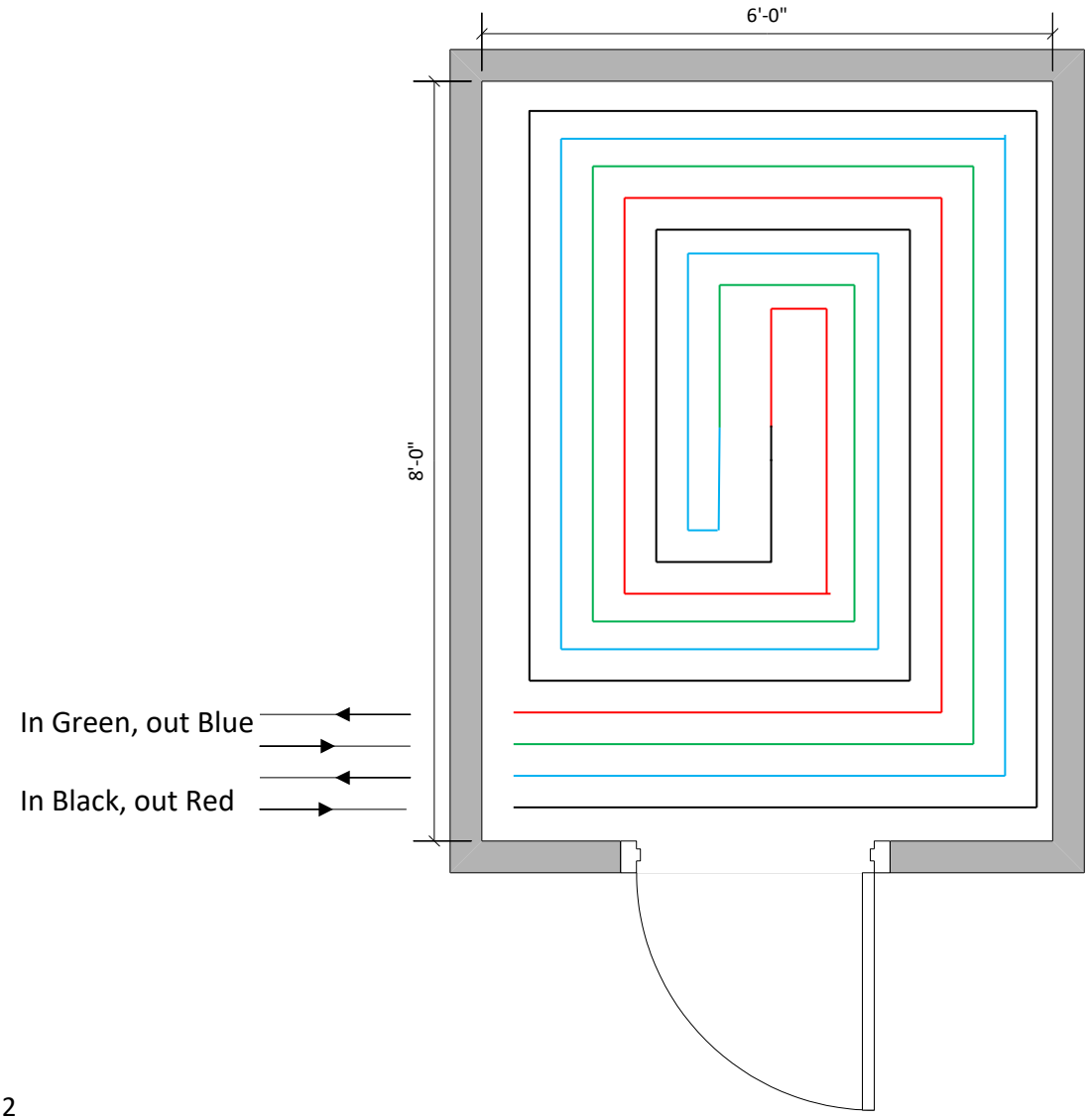
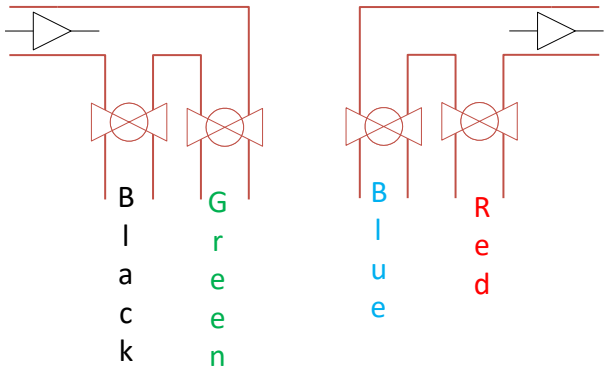


Figure 2



After the tubing has been attached and tested for leaks, the frame will then be filled in with decomposed granite. This is laid down ½"-1" at a time. Each layer is tamped down and then wet. The layer will be allowed to dry over night before the next layer is added until the decomposed granite is level with the frame.

The Water Barrels

The barrels will be set in a single line on the northern side of the greenhouse. They will be placed upside down so the existing holes will be on the bottom. The small port on the barrel will be used as a gravity fed exhaust port. The larger port will be modified to have a fill tube. This tube will run to almost the bottom of the barrel, leaving an inch or so to let the water fill. The fill ports and the exhaust ports will be attached to a PVC pipe manifold. This will hopefully allow the barrels to fill and drain equally.

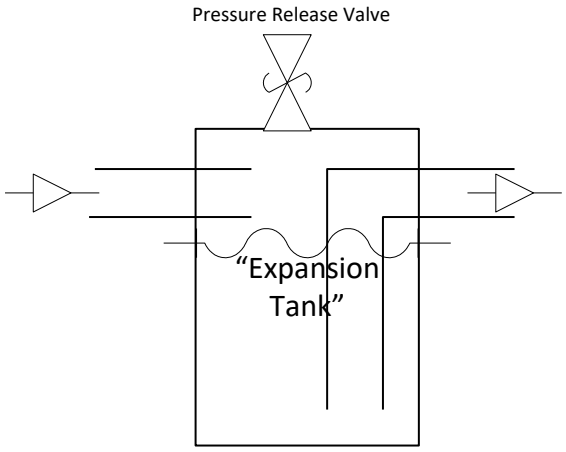
The Heater

The main component of the system will be a solar powered solar water heater unit (Link). The solar water heater and the solar panel will sit outside of the greenhouse facing the southern sky. Two pipes or hoses will need to be connected from the water heater's input and output. The unit has ½" adapters and would easily connect to piping to move the water through the space.

Since the unit is solar powered, the pump will only run during the day. This is the only time the water will be flowing through the system.

Flow Direction

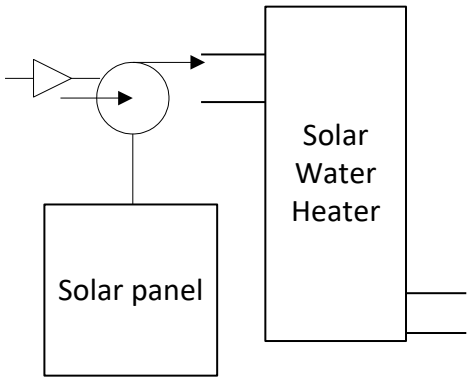
Since this is a closed system, a pressure release valve will be necessary someplace along the line. One option for this was to use a simple 5-gallon container as an expansion tank with a relief valve attached:



The pump would be placed just after this tank and feed into the solar water heater. After the water is heated, it will flow back into the greenhouse and through a valve to include the floor and/or the tanks. Based on information found here: https://ag.umass.edu/print/9377:

> When evaluating heat storage, the storage medium needs to be considered. Heat capacity is measured as specific heat. Water has a specific heat of 1.0 Btu/sq. ft - °F, whereas concrete, crushed rock and sand are approximately 0.2 Btu/sq. ft - °F. On a volume basis, water holds about three times as much heat as the concrete, rock and sand.

The water barrels will hold more heat than the floor. By splitting the output of the water heater both the water barrels and the floor receive the hot water to transfer the heat to the storage medium.



Questions

Will the pump be strong enough to push water through the water heater and up the fill tubes of each barrel?

Could the gravity of the water be strong enough to force the water through the system without a pump or while the pump is not running.

Materials

Palram HG5508G Hybrid Greenhouse, 6' x 8' x 7', Forest Green $613.78
Palram Heavy Duty Greenhouse Shelf Bundle (4 piece) 155.00
Palram Automatic Roof Vent Opener $42.00
Severe Weather (Common: 2-in x 4-in x 8-ft) #2 Prime Treated Lumber 8 @ 4.67=37.36
70 square feet EPDM liner (base and up sides)
48 sq. ft heat reflecting material
metal grate to hold tubing 4@14.98=59.92
12 cu ft Decomposed Granite 24 .5cu ft bags @ 4.48 = 107.52
Solar Water Heater with Solar Powered Pump 449.00
160 ft 1/2" PEX tubing 108.00
PEX Guy on Amazon 2 loop Manifold $37.99

5-gallon barrel for expansion tank