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XV- Optional finishes for your SunCatcher PSG

There are several design components that should not be altered such as:

- The East-West direction of the long axis;
- Laying the south-facing glazing back less than 60° up from the horizontal position;
- Having a good solar access site; and
- Eliminating the upper end vents.

Components that can be easily adjusted include things like eliminating the north wall vents; exterior colors; varying the type and amount of insulation used in the exterior shell; varying the amount and type(s) of thermal mass used; the long axis facing within 30° of due south; the type of glazing and flooring. While the finish of the exterior walls and roof can vary, the interior walls and ceiling perform much better when they are white or a very light color.

While not working with and collecting extensive data on other applications and designs, we believe the information we shared in this book can be adapted and applied to other season-extension structures such as traditional glass, hoop, earth berm, attached, and pit greenhouses. You see some examples of such adaptions we have experimented with in Chapter IV.

We have not done work on aquaponics and hydroponics which are popular methods in modern greenhouse operations, as we have concerns about the large amount of moisture (and heat) released from open water containers or watering systems. There is a need for additional research and development using hydro-/aquaponics, especially in greenhouses using a GAHT system for heating and cooling about ways to deal with high humidity levels.

Greenhouse flooring and drainage

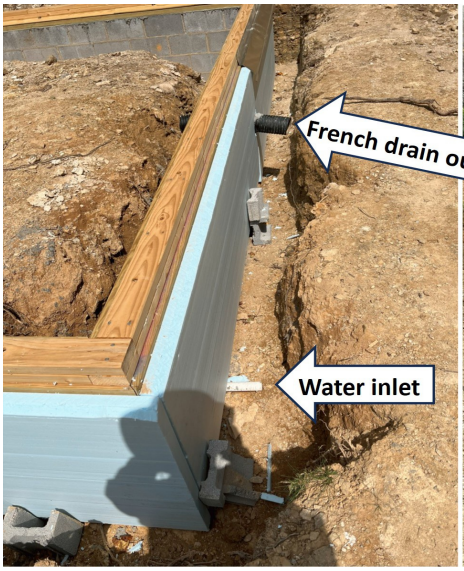
There are several greenhouse floor options to consider, ranging from leaving it bare to grow crops in the soil or in raised beds, to gravel, concrete tile or pavers or a full concrete slab. Make sure to insulate the foundation at least to code, as well as allow for pipes and/or conduit to bring water and electrical in and drainage water out through the foundation.

The type of drainage system to be used in the greenhouse depends on what you intend to grow and how (in-ground, raised beds, in pots placed on the ground or on tables, hanging from the rafters, ...). All plants need regular watering, and the type of watering system you use determines how much spillage there will be. For example, watering hoses and cans create more spillage than drip tape, soaker hose, micro-sprinklers or individual pot drip emitters. You do not want that water to mess up the floor and make a (muddy) mess, and raise the humidity in the greenhouse unnecessarily. Contractors should be an excellent source of information about options, costs, code requirements and what might work best for your situation, so we will not go into detail on various drainage options.

Let's briefly look at some of the possibilities.

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The least expensive type of floor is of course just leaving it as dirt. If the ground perks and large amounts of water do not go onto the floor in short periods of time, a water drainage system may not be required. This arrangement can be enhanced with slightly elevated paver/tile walkways within the structure. Raised beds can be easily constructed and moved if need be. If the soil at your site does not perk well (or at all), you may need to consider drainage to manage excess water. We generally like the French drain system because it can be much less expensive and works well with most of the flooring options. We chose this the option for the Hawks' Nest SunCatcher, combined with a gravel floor as shown in the photos below.







A middle ground approach that works well with a French drain system is using pavers or decorative tiles. This has the advantages of a solid floor, movable raised beds etc., and they can be made to look really nice. The photos (next page) show the use of concrete tiles in the Laurel Ridge SunCatcher and pavers inside a 12' x 24' stick-built SunCatcher under construction.







A slab floor has all the well-known advantages of any slab but can add a lot of expense to the project and allows less flexibility in use of the space. The slab will need to be slightly sloped toward an appropriate number of floor drains and piping to evacuate the drain water outside and away from the greenhouse. The slab has to be thicker along the north wall to carry the load of the thermal mass, an extra expense not required with dirt or gravel floors.

If the pavers, tiles, concrete or gravel are dark in color, they can supply some thermal mass for the greenhouse. If they are light in color, they will reflect more of the sunlight. A benefit either way!

Finally, if water is used for thermal mass, the weight of the water containers needs to be taken into consideration when laying the floor, especially on slab and paver floors! The weight of one 55-gallon barrel filled with water is 506.7 lbs (230 kg). Make sure the floor can support the weight where the thermal mass will be located. In making these decisions, a contractor should be helpful in what works best for you.

Finishing colors

Exterior walls and roof color

Remember our emitters and absorbers from the example of asphalt vs. concrete road surfaces in Chapter VI: In the summer, dark surfaces get hotter and in the winter they cool quicker! The same is true for the color of any structures, whether your home or your passive solar greenhouse. So, a PSG's light-colored exterior walls and roof reduce nighttime heat loss and summertime overheating. They do not have to be white, any light shade of whatever color you fancy is OK as shown below for the Parkway PSG (left) and the Laurel Ridge PSG (right). So, a PSG's light-colored exterior walls and roof reduce nighttime heat loss and summertime overheating.

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The Parkway School (left) and Laural Ridge SunCatchers (right) were painted in light non-white colors.



Interior walls, ceiling and rafters

To finish your interior walls, you should discuss waterproof non-toxic sheathing and paint options with your local building supplies folks. The interior walls, ceiling and rafters should be painted a light color, preferably a glossy white. It is best and easiest to paint the rafters and ceiling before installing the glazing. In addition to direct sunlight, your plants will receive reflected sunlight from all directions as can be seen in the photo of the Hawk's Nest SunCatcher taken on the 2024 winter solstice (left). This will reduce phototropism (=bending of plants toward the main source of light). Compare the brightness of this PSG with the much darker interiors of the SunCatchers pictured on the previous page whose interiors appear much darker with their unpainted rafters.

We found that the white rafters under the glazing reflect the incoming early morning and late afternoon sunlight toward the plants (photo next page). At those times, light comes in at smaller horizontal angles. The extra light is especially beneficial in the short days of late Fall to early Spring.



The early morning sun streams in at an approximately 43^0 horizontal angle, reflecting off the east facing side of the rafters but not their west face (photos taken in November 2024, before the glazing was installed). Note that rafters and ceiling were painted before installing the glazing.

Utilities

Although the SunCatcher PSG is designed to operate without any fossil fuel powered heaters, there is still a need for some power supply for lights, fans and, perhaps, automated vent openers and shade cloth/insulating curtain openers. This can be supplied by the grid or solar/wind energy and a battery bank. If you choose to go the renewable way, there are 12VDC options for fans, vent openers and shade cloth/insulating curtain openers, LED overhead and grow lights. This is the way we plan to go for the Hawk's Nest SunCatcher - a passive solar greenhouse can/should not have to depend on grid energy! Make the system truly PASSIVE solar!!!

Water is essential for plants, and it is best to install a yard hydrant inside your greenhouse. In order to prevent you having to drag a hose the length of the greenhouse (with the risk of knocking over pots or damaging plants), we suggest placing it in the center along the south facing wall.

Monitoring equipment

In order to help you manage your SunCatcher, you need a basic set of data to figure out when to open and close vents, use shade cloth or night-time curtains. A basic set of data to manage your greenhouse include interior and ambient temperature, humidity levels. At present, we use SensorPush water-resistant sensors and a mobile app that sends the information on temperature, humidity and barometric pressure to your smart phone at regular intervals.

Automation

Note: The electrical service used to power the PSG will impact what automation equipment will be compatible for that voltage (AC or DC) and amperage!

SunCatcher understands that not all folks can dedicate the time needed to manually operate their greenhouse. Sensors can deliver real-time data to a SunCatcher user including min/max temperature, humidity, CO_2, light levels, and soil moisture. The user can then adjust vents, shades, grow lights, fans, watering systems, etc. to maintain the desired microclimate for the plants growing in the SunCatcher. For example, the convective ventilation system may be fully automated and controlled remotely such that the vents may be opened and closed as needed depending on interior or exterior conditions.

Moreover, sensors and monitors may be used to fully automate the system wherein modifications and adjustments are programmed and automatically made upon satisfaction of a specific parameter, such as humidity, CO_2, or temperature levels with minimal or no manual input. A user can track temperature, light, soil moisture, etc. and make operational changes to vents, lights, and fans while at work or on vacation! In addition, cameras, alarm and smoke detectors can be added to this system for the utmost security. The electricity requirement for these systems is very low and can be driven by a simple photovoltaic panel and battery system, making SunCatcher's off-grid growing technology independent of the electrical grid and fuel supply companies.

Suggested sources for monitoring and automation equipment

https://rollertrol.com/store/en/ for 12V motorized window/vent openers and tubular motorized shades/blinds with remote control or controlled via phone, PC or tablet.

Bidirectional RV ceiling fans (12 V) - 32 and 42", 3 or 4 blade