

# Passive Solar Worksheet - for Homebuilder Projects

## Passive Solar Space Heating Prescriptive Path

Accurately estimating annual solar savings is difficult and requires detailed computer modeling. The following prescriptive path was developed to ensure your home's eligibility. The term "solar windows" refers only to those windows that face within 30 degrees of *true* south, have a Solar Heat Gain Coefficient (SHGC) of not less than 0.55, and are located in a room with thermal storage. A SHGC value of 0.55 indicates that 55 percent of the sun's energy will pass through the window. Keep the window rating stickers for proof of their SHGC rating. Thermal storage is expressed in units of "diurnal heat capacity" (DHC) which is a function of the materials properties, thickness and location in the house. To be useful as thermal storage, it is important that it *not* be heated by other sources such as by a radiant floor heating system.

### Prescriptive Path Requirements

1. The building layout maximizes passive solar gain and good day lighting.
2. At least half the windows are solar windows.
3. Solar windows are oriented within 30 degrees of true south and have a SHGC not less than 0.55.
4. There is sufficient solar window area. West of the Cascades this is equal to 9 percent of the total floor area. East of the Cascade this is equal to 8 percent of the total floor area. Single story homes should have 1 percent more window area because of their greater heat loss rate per square foot of floor area. Sunspace type systems may use 1 percent less window area because of their more efficient control of heat gain and loss.
5. The area-weighted average window heat loss rate (U-factor) is not greater than 0.35.
6. There is adequate thermal storage to prevent overheating. (storage = 30 times solar window area)
7. Window overhangs shade most of the window during the summer, but allow 100 percent solar gain in the late fall.
8. The passive solar sun chart shows less than 10 percent shading loss from trees or buildings.
9. North windows less are less than 2 percent of the total floor area.
10. Skylights are less than 1 percent of the floor area and have an SHGC of no more than 0.30.
11. West facing windows have a SHGC of 0.35 or less to limit summertime overheating.
12. Passive cooling is possible with an operable window or skylight that is located near the highest point.

### Thermal Storage Considerations

Thermal storage is the ability of materials to store energy in the form of heat. Some materials store more energy than others. Material thickness, density and conductivity, and placement all have an impact on the amount of energy that a given amount of material can store. This worksheet is used to estimate the Diurnal Heat Capacity (DHC) of the passive solar features of your home. Making sure that this value is at least 30 times the area of solar glazing in the house will keep the room temperatures from fluctuating wildly and allow heat to be slowly released into the house once the sun has gone down.

All materials listed must be in rooms with solar windows. Remember, solar windows are windows that are south facing and have a solar heat gain coefficient (SHGC) of at least 0.55. Use the thermal storage capacity values for "in direct sunlight" if the material is in a location that gets direct sunlight for 2 or more hours during an average sunny winter day.

Radiant floors do not provide good thermal storage because they are kept above room temperature during the heating season by the backup (non-solar) heating source. This reduces their ability to store solar energy.

Do not include sheetrock, furniture or other surfaces that are common to average construction. The thermal storage requirement already assumes the presence of these items.

### Passive Solar Sun Chart

The goal of the passive solar sun chart is to quantify what percentage of the available solar resource is available to the passive solar windows on a home. The base assumption of this simplified approach is that the windows are vertical and are facing within 30 degrees of true south.

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Builder: \_\_\_\_\_

Site Address: \_\_\_\_\_

## 2. SYSTEM DESCRIPTION

1a. House floor area: \_\_\_\_\_ ft<sup>2</sup>      1b. Number of Floors: \_\_\_\_\_

**System Type** (check one):

- Direct Gain – sunlight enters living space
- Sun Space – sunlight enters space that can be separated via doors or windows from the rest of the house

**Windows** – Solar windows must face within 30 degrees of true South, and have a SHGC > 0.55)

2. Solar window area: \_\_\_\_\_ ft<sup>2</sup>
3. Percent solar glazing (line 1a ÷ line 2) \_\_\_\_\_
4. Solar window U-value: \_\_\_\_\_ Btuh/ft<sup>2</sup>°F
5. Solar window Orientation: \_\_\_\_\_ (degrees, must be 150° to 210°)
6. Solar window SHGC: \_\_\_\_\_
7. Solar window shading (overhang): \_\_\_\_\_ ft
8. Passive Solar Fraction (line 15, Sun Chart) \_\_\_\_\_ %
9. Are pleated window shades or solar window treatments used on solar windows? (circle) YES NO
10. All Other Windows \_\_\_\_\_ ft<sup>2</sup>      10b. U-value: \_\_\_\_\_ Btuh/ft<sup>2</sup>°F

### Thermal Storage

11. Thermal Storage Needed (DHC target, line 10 x 30): \_\_\_\_\_

Complete the following table:

Room	Material	Type <sup>1</sup>	Thickness	Area	<sup>2</sup> dhc/ft <sup>2</sup>	DHC
_____	_____	_____	_____	_____	x _____ =	_____
_____	_____	_____	_____	_____	x _____ =	_____
_____	_____	_____	_____	_____	x _____ =	_____
_____	_____	_____	_____	_____	x _____ =	_____
_____	_____	_____	_____	_____	x _____ =	_____

12. Total Thermal Storage (DHC):= \_\_\_\_\_

### Thermal Storage Capacity of some common materials (dhc/ft<sup>2</sup>)

Material in direct sunlight?	Wood 1" thick	Tile floor average thickness	Stone or concrete 2" thick	Stone or concrete 4" thick	Stone or concrete 6" thick	Sheet rock 5/8"	Radiant floor (wood)	Radiant floor (concrete)	Carpeted floor	Water 4" thick
Yes	1.6	2.1	4.3	8.8	11.3	1.3	0.5	2.0	0	20.8
No	1.0	1.8	3.0	3.8	3.7	0.7	0.3	.6	0	n/a

## 3. SYSTEM DESIGN DOCUMENTS

Attach the following additional information to the application

- Floor plan drawing(s)
- Elevation drawings (N, S, E, W)

<sup>1</sup> All thermal storage needs to be in the same room as the solar windows, Type refers to if it is "Sun-lit" or "Not-Sun-lit"

<sup>2</sup> dhc/ft<sup>2</sup> values for common materials can be found on the table.

## 4. TAX CREDIT CALCULATION

The tax credit is based estimated annual energy savings times \$0.60 per kWh. The following estimated savings is based on a typical passive solar home design resulting from meeting the prescriptive requirements. Your project's performance will vary substantially different depending on how the house is operated.

13. Estimated annual savings = 1000 kWh + Line 1a : ..... = \_\_\_\_\_ kWh/yr  
conditioned floor area (Sq. Ft.)

14. Tax credit (line 13 x \$0.60,)..... \$ \_\_\_\_\_

## Passive Solar - Sun Chart

**Step 1** – From the midpoint of the solar windows, draw the skyline on the graph below. Use the elevation angles and solar azimuth angles to determine the location of the obstructions. Draw deciduous trees with a dotted outline and fill with light shading. Year-round (solid) obstructions like buildings, or conifer trees should be drawn with solid outlines and filled with heavy shading.

**Step 2** – Add up the numbers in the sections that have shading. Any deciduous tree shading below the Sept 22/March 20 line can be counted at half value to account for the fact that some light will get through these obstructions when the trees lose their leaves. The sum of all these values is the percent of energy lost to external shading for space heating systems. Subtract this number from 100 percent to get the solar resource.

15. Passive Solar Fraction (percent not shaded) = 100% - sum of obstructed areas = \_\_\_\_\_%

