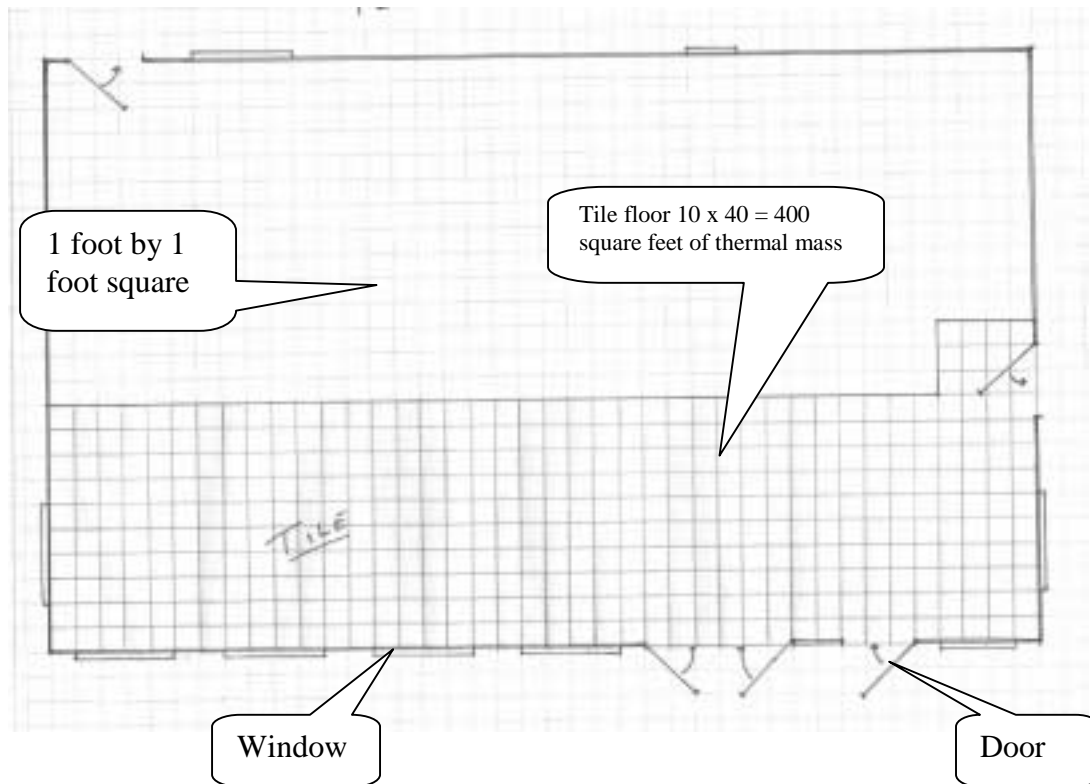


## **Model Solar Home Design Guide**

For designing and building a building it is useful to have 3 or 4 views of the building. In this article we explain the four views that we will use in our project. We also go over how to calculate south facing windows and thermal mass using the drawings you will make. This article uses drawings made for our example solar house: the saltbox.

**Plan View:** The plan view shows the basic outline of a building. You can also draw in the rooms of the building using this view.

This is a view of our example Saltbox style home, 40 x 24 feet. Notice that we have drawn in a tile floor on the southern half of the floor.



Use the plan view to calculate the area of the building in square feet. The south and north sides of this building are 40 feet long. The East and West sides of the building are 24 feet long. To get the AREA of the floor space (first floor), multiply length by width:

$$40 \text{ feet} \times 24 \text{ feet} = 960 \text{ square feet.}$$

## Model Solar Home - Design Guide

We will use this value, 960 square feet to figure out how much south facing glass to put into the first floor of the house.

We will aim for 12 square feet of south facing glass for every 100 square feet of floor area. 12 square feet per 100 square feet can be written as **0.12**.

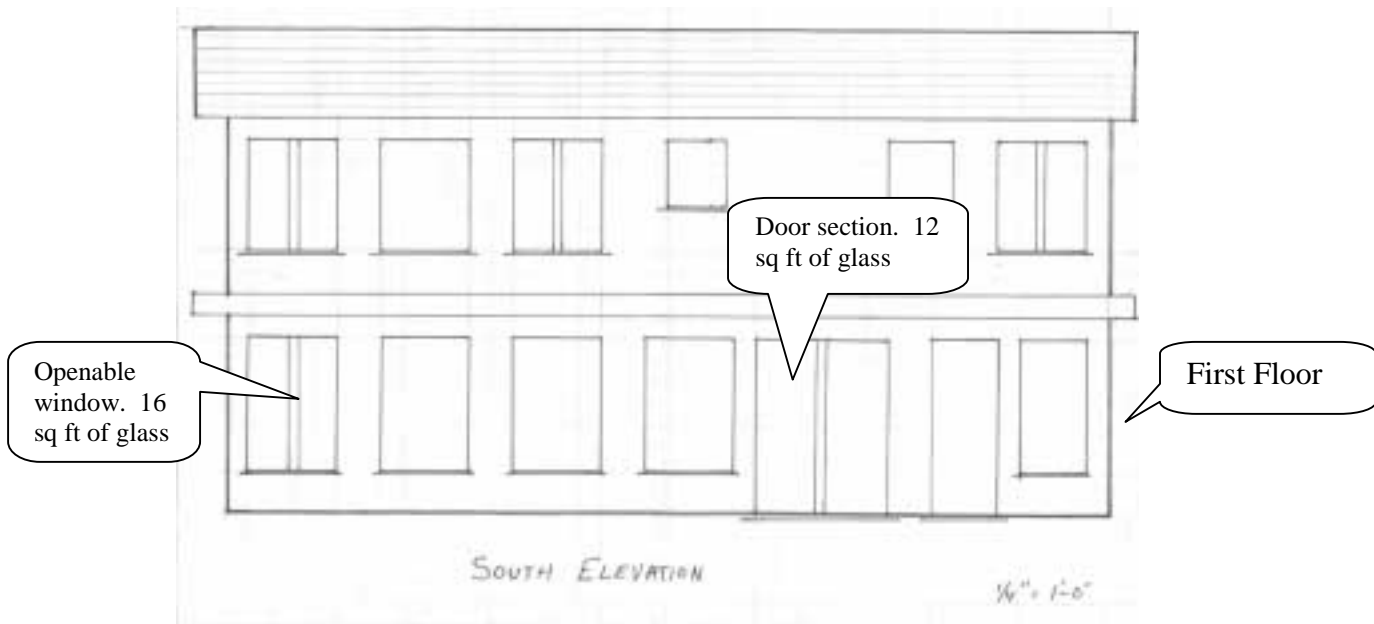
On this floor we have 960 square feet of floor area. So, multiply 960 by 0.12.

$$960 \text{ sq. ft.} \times 0.12 = 115$$

So, we will try to put in about 115 square feet of south facing glass for the first floor of our building. This does not need to be exact. For example, 100 square feet of glass would still do a good job of heating the building with the sun. Sixty square feet of glass would not be as good, but it would still be a lot better than nothing. Each window facing south is a solar heating machine.

### South Elevation:

So, the first floor has 960 square feet. Using the 12 per 100 rule of south facing glass to area, this building could use 115 sq.ft. of glass to heat the first floor. Below is a South Elevation of our example building with an attempt to design in enough windows to fully heat the house.



Looking at this drawing, on the **first floor** we have sketched in 4 windows which have about 16 sq. ft. of glass each, three glass door sections which have about 12 sq.ft. of glass each, and a narrower window which contributes about 12 sq. ft. of glass.

$$4 \text{ [windows]} \times 16 \text{ sq. ft.} = 64 \text{ sq. ft.}; \quad 3 \text{ [doors]} \times 12 \text{ sq. ft.} = 36; \quad 1 \text{ [window]} \times 12 \text{ sq. ft.} = 12.$$

## Model Solar Home - Design Guide

Add the products up:

$$64 \text{ sq ft} + 36 \text{ sq. ft.} + 12 \text{ sq. ft.} = 112 \text{ sq. ft.}$$

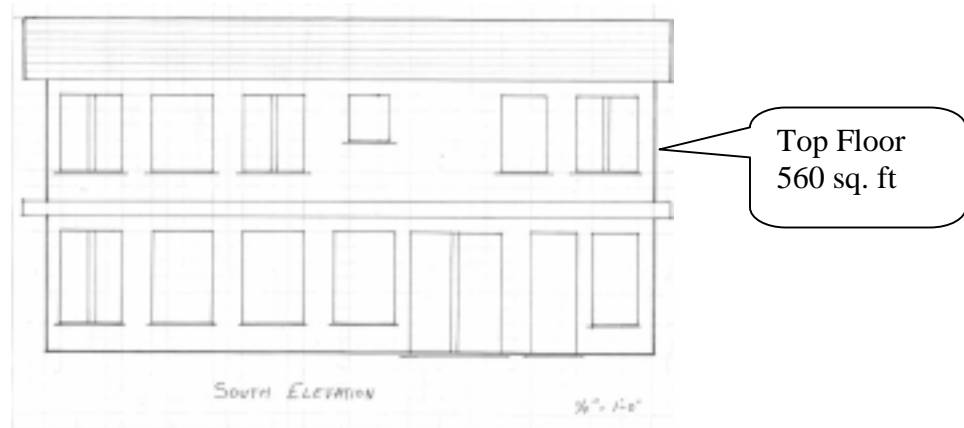
We can be happy with this amount of south facing glass because it is close to our ideal goal of 115 square feet.

The tile floor on the first floor of the house makes an excellent **thermal mass**.

To calculate the thermal mass Area, multiply the length times the width of the thermal mass area.

$$10 \text{ ft} \times 40 \text{ ft} = 400 \text{ sq. ft.}$$

All we really need is 25 square feet of thermal mass for every 100 square feet of south glass (  $960 \text{ sq. ft} \times 0.25 = 240 \text{ sq. ft.}$ ), or 240 sq. ft. Having extra thermal mass is fine. If we want to, we can choose to put in less tile.



The **top floor** has an area of 560 sq. ft.. To calculate the amount of south glass it needs we multiply:

$$560 \text{ square feet} \times 0.12 = 67 \text{ square feet.}$$

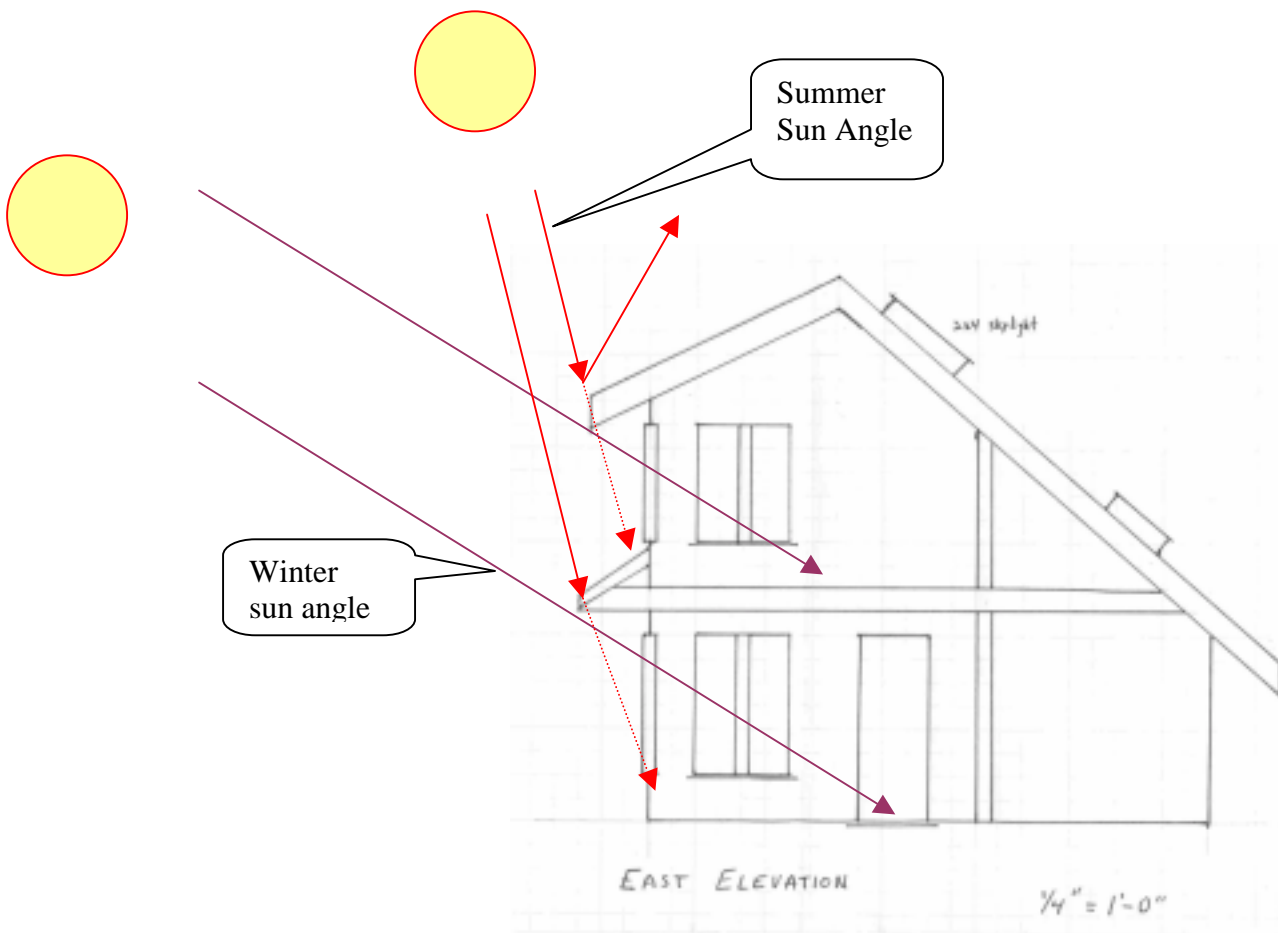
In this elevation the upper windows provide about 80 square feet of south facing glass. If we want to, we can remove windows, reduce their size, or enjoy the extra solar energy they will provide. The floor could get too hot, but we can control this with shades.

## Model Solar Home - Design Guide

The overall design of this house should let in plenty of warmth to both heat the living area and warm up the thermal mass. By having the thermal mass, we increase the warmth of the building in the evening after the sun has gone down. Also, notice in this drawing that several windows are operable casement type windows useful for ventilation.

### East Elevation:

So, the South Elevation enables us to design our solar gain windows and doors. It also let's us work on the look of the house. Next, it is helpful to draw an **East Elevation**. The East Elevation is useful for studying window and eave placement so that we can **maximize** solar penetration into the building in the cooler months and **minimize** solar gain in the warm months.

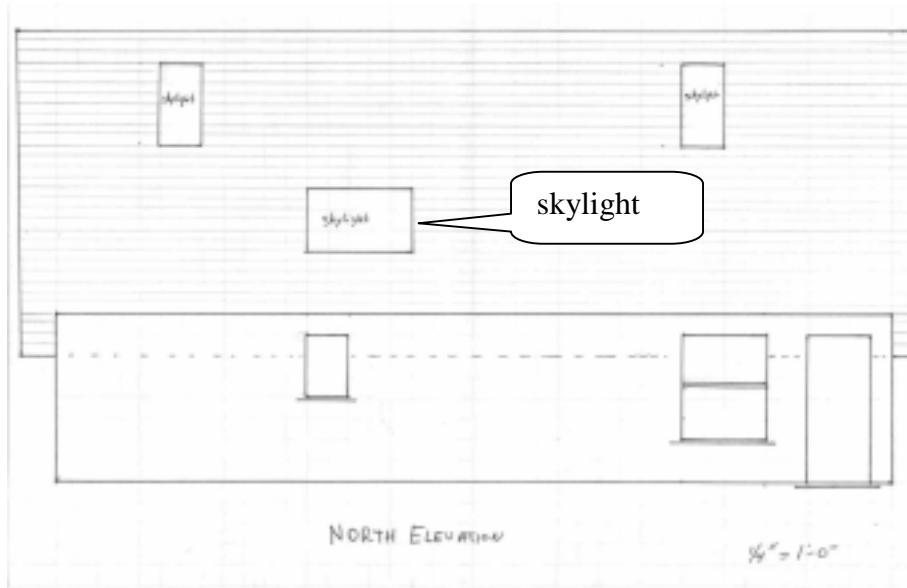


One pair of arrows represents the winter sun at 30 degree angel. It shows that winter sun will enter deeply, about 10 feet into the building. This shows that the tile floor will be heated by direct sun. The other arrows, 74 degree angle, represent summer sun and show that the eaves will effectively block summer sun from entering the building.

## Model Solar Home - Design Guide

### North Elevation:

The main purpose of the North Elevation is to plan to use minimal window space to reduce the energy lost through the glass. One still wants windows for bringing light into the building and for cross-ventilation. Having a drawing of the north side of the building is also helpful for building our models.



Note also the placement of three skylights for daylighting on the north roof. Skylights do cause some heat loss. Avoid skylights on the south facing roof as they may cause the house to over heat in the summer. Openable skylights are useful in warm months for venting off extra heat.



Photograph of a model built using the plans in this article. Note that this is a view of the east facing side of the building, called the “east elevation.”

What solar home features are you able to see in this model?

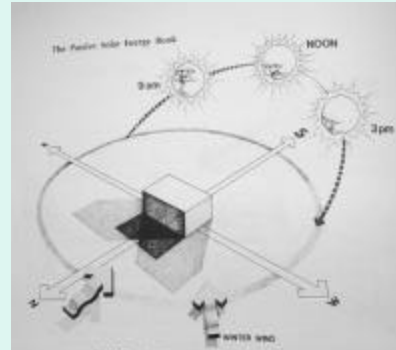
**Rubric for Evaluating Solar Buildings**

<b>Element</b>	<b>Degree to which Accomplished</b>	<b>Design feature choices</b>
Orientation	Make clear which side of the house is designed for solar gain; Show “South” direction on plans and model.	Windows, Trombe walls, solar panels, Hot Air Collectors oriented toward the south.
South Facing Windows	Building should have 12 square feet of south facing glass for every 100 square feet of floor. This is an ideal and can vary. In hotter climates less south facing glass may be used.	Window placement should fit the use of rooms in the building. May use Trombe walls to minimize glare or hide unwanted views.
North facing Windows	Keep heat loss low by using as little window area as is practical on the north side of the building. But, should have some window for light and ventilation.	Small windows may still be used for daylighting. Locate rooms that need less light and warmth on north side of building: bathrooms, laundry, pantry, storage, etc.
Western Windows	Minimize solar gain through western side of house by using less windows or putting in features to shade house.	Use porches, shutters, long eaves, or other devices to keep out the western sun, provide shade, and make outdoors nicer to use.
Thermal Mass	Place thermal mass in building to absorb solar energy.	Best to put thermal mass in path of direct sun light. Can include tile, concrete, adobe, or brick floors, plaster walls, water tubes, Trombe wall.
Shading to keep summer sun out	Will the eaves and/or trees and/or porches effectively shade out the summer	Properly sized eaves; deciduous trees for shading summer sun; porch shade area or trellises...
Weatherization	Hard to show on model, should at least be addressed in description of house.	Use of thick walls showing insulation; use of weather stripping; use of double pane windows.
Ventilation	Are operable windows located on different walls to enable cross ventilation? Do skylights open?	Does it take advantage of prevailing breezes; attractive windows...or house fan...
Solar Electric	Successful installation of Solar Electric Array on Model with a motor that works.	Are solar panels tilted up or flush with roof line? Are panels building integrated (i.e. used as part of the roofing material)
Solar Hot Water	Actual or symbolic solar water heating as part of building	Does the water heating add or detract from the look of the building?

## Principles of Solar Home Design

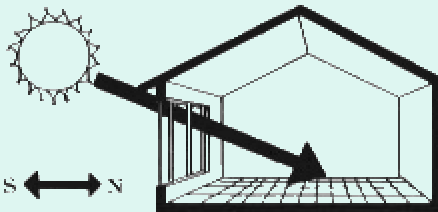
1. **Orientation:** Let the Winter Sun's Energy in. Aim most windows to the south.
2. **Summer:** Keep the Summer Sun Out: Shading...
3. **Storage:** Use thermal mass to store the Solar Energy gained and to "Store Coolness" in the Summer.
4. **Weatherization:** Insulation and sealing house to keep it warm in winter and cool in summer.
5. **Air Circulation:** Locate operable windows to capture cooling breezes, release excess heat.

### #1: Let Sun In: Orientation

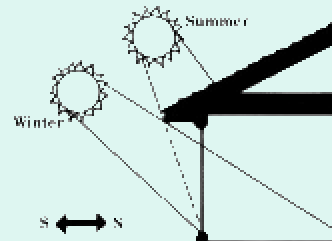


### #1: Let Sun In: Direct Gain

For the East Bay 12 square feet of south facing glass per 100 square feet of floor is ideal (with adequate thermal mass)



### #2 Shading: Strategic Use of Eaves to Let in Winter Sun and Keep Out Summer Sun

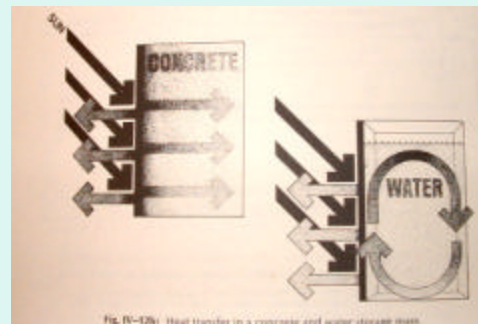


### #2 Shading: Sun Angles

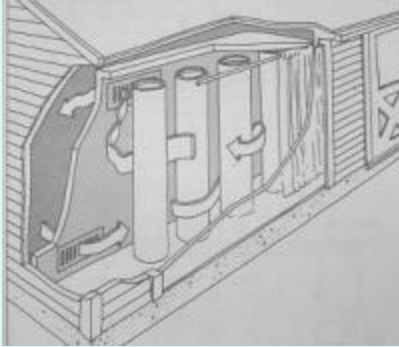


### #3: Storage: Thermal Mass:

25% + of Floor Area (Conduction and Convection)



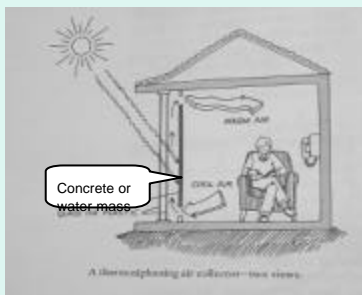
**#3: Thermal Storage: Water Tubes**



**#4: Keep Sun's Energy In: Weatherization:**



**#3 Storage: Trombe Wall: Blocks Glare, Thermal Storage, Heat Control**



**5. Air Circulation: locate operable windows strategically to capture breezes.**

