

Passive Solar Home Design Checklist

Good passive solar homes are not difficult to design or expensive to build. However, they do require the use of basic, common-sense methods of working with the climate rather than against it. When you build a solar home that responds well to the climate in which it is built, you can count on it being:

- 1 **Comfortable** – warm in the winter and cool in the summer;
- 2 **Economical** – homeowners receive a positive cash flow or excellent return on their investment;
- 3 **Durable** – often built from locally available, long-lasting, low-maintenance materials;
- 4 **Attractive** – full of light and well connected to the outdoors; and
- 5 **Environmentally Responsible** – passive solar homes make efficient use of our energy resources and provide a healthy space for owners.

Passive solar concepts are not difficult to apply, but require consideration from the preliminary stages of design to be most effective. This checklist is presented as a planning tool, with references to other, more complete sources. The *Passive Solar Options for North Carolina Homes* fact sheet is another, more comprehensive fact sheet that works well in tandem with this checklist.

✓ *The longest wall of the home should face within 15 degrees, plus or minus, of true south to receive the most winter solar heat gain and reduce summer cooling costs (Figures 1 and 4).* At 30 degrees east or west of south, winter heat gain is reduced by 15 percent from the optimum. Minimizing east and west facing walls and windows reduces excessive summer

heat gain. See fact sheet *Siting of Active Solar Collectors and Photovoltaic Modules* for more information on determining true south.

✓ *Size south-facing windows and thermal mass appropriately.*

◆ *Suntempered* homes with no internal solar thermal mass should have south facing windows with a glass area of no more than 7 percent of the floor area .

◆ *Direct gain systems* can have south-facing window glass area which is 7-12 percent of the floor area. Every 1 square foot of south-facing glass over the 7 percent suntempering allowance must be accompanied by 5-6 square feet of 4-inch-thick masonry.

◆ *Sunspaces* should include only vertical glass. Sloped glazing can cause serious overheating. Every 1 square foot of south-facing glass must be accompanied by 3 square feet of 4-inch-thick masonry.

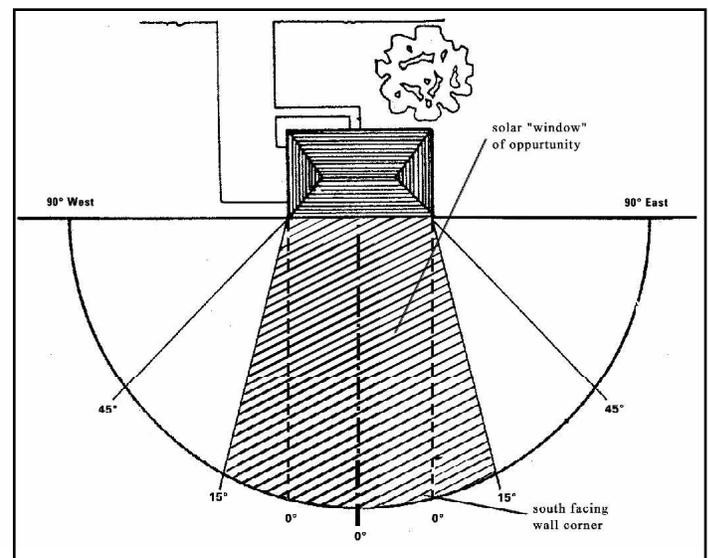


Figure 1. A house can be angled as much as 15 degrees east or west of true south and still collect useful solar heat.

- ◆ *Thermal storage or Trombe walls* should be 8 to 12-inch-thick masonry. The outside of the masonry should be coated with a selective surface and the inside surface should be free of coverings. The outside of the glass should be covered or shaded in summer. In NC, these walls require the least operator involvement in our colder climates.

- ✓ **Size overhangs properly.**

As a rule of thumb in North Carolina to prevent summer gains, the angle " " between a line "S" from edge of the overhang to the bottom of the window and a vertical line "V" should be approximately equal to the latitude minus 18.5 degrees. To prevent winter shading, the angle " " between a line "W" from the edge of the overhang to the top of the window and a vertical line should be approximately equal to the latitude plus 18.5 degrees. An overhang designed with this formula will provide shade all summer and full sun in the coldest part of the winter (Figures 2 and 4). For more detailed calculations, use computer simulation software or procure services of a professional solar designer.

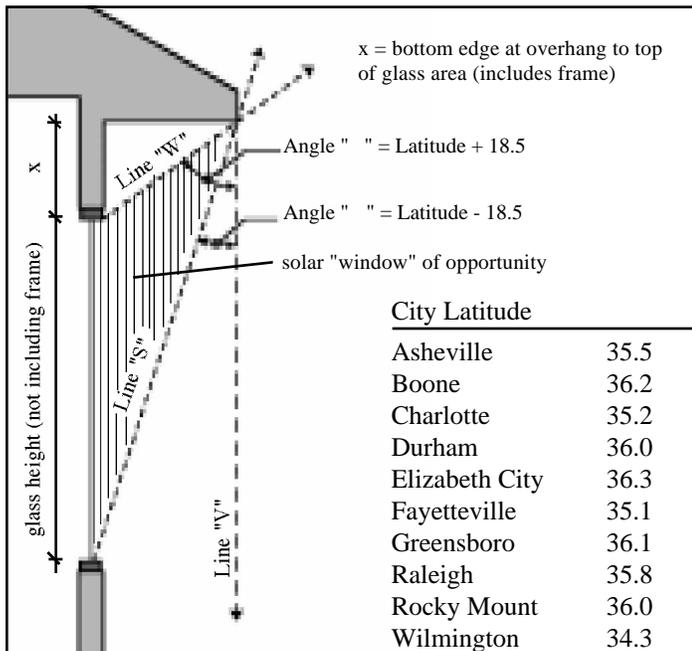


Figure 2. Diagram for sizing overhang

- ✓ **Match the solar heating system to the room use.**

What are the heating, lighting and privacy needs after sunset? A Trombe wall might be a logical choice for a room requiring privacy. A living room, on the other hand, which needs daytime and early evening heat and has a higher lighting requirement, might benefit from a direct gain system or sunspace.

- ✓ **Buffer the north side of the building.**

Place rooms with low heating, lighting, and use requirements, such as utility rooms, storage rooms and garages, on the north side of the building to reduce the effect of winter heat loads. This can reduce the normally higher heat loss through northern walls while not interfering with solar access. Rooms that generate their own internal heat, such as the kitchen, should also be placed on the north side (Figure 3). Landscaping elements, such as evergreen trees on the north and west sides of the house, can buffer against the cold winter winds and strong afternoon summer sun.

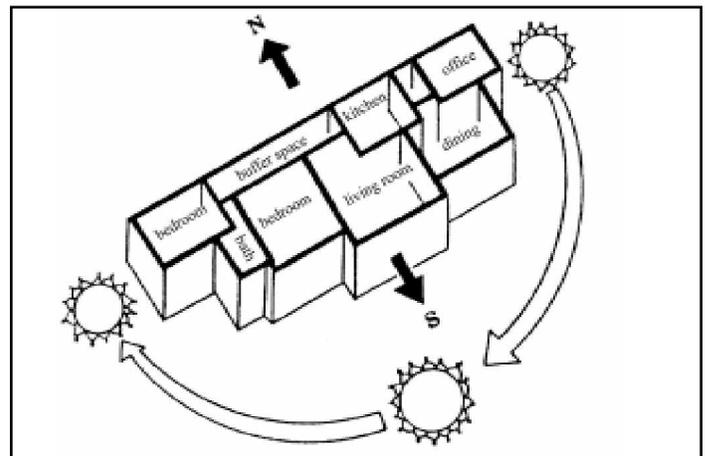


Figure 3. Place rooms where they are compatible with the sun's path. Buffer spaces should be placed to the north.

- ✓ **Lightweight materials should be lighter in color.**

Lighter colors absorb less energy (sunlight) and are more reflective. When light energy is absorbed, it is transferred into heat energy. If the material does not have sufficient storage mass, the material may heat up too quickly and release the excess heat to the room air, causing overheating.

- ✓ **Masonry walls can be any color in direct gain system,** but... actually, it is best to use colors in the middle range of the absorptivity scale to diffuse the solar energy over all the storage mass in the room.

(The absorptivity range of concrete masonry falls in this range without paints or special treatment being necessary). Colors for dense materials such as brick and concrete, need to be somewhat darker than lighter weight materials; however, if the storage mass is too dark, surfaces exposed to the direct rays of the sun will soon reach high temperatures. This can lead to overheating of the air, while other surfaces in the room may receive very little of the day's solar energy.

Trombe walls should always be very dark to increase solar absorption.

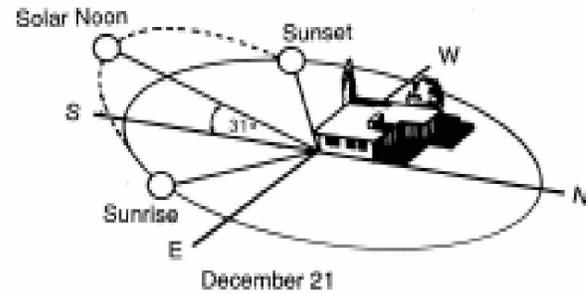
✓ **Do not cover the storage mass with furniture.** Rugs and wall tapestries can also reduce the effect of storage mass. It is wise to plan in advance to match the system to room use. See fact sheet *Decorating Your Passive Solar Home* for additional information.

✓ **Distribute the mass throughout the room.** In direct gain systems, performance is fairly insensitive to the locations of mass in the room. It is relatively the same whether the mass is located on the floor or on the east, west, or north walls. It is important to put some mass in direct sun, but rarely is it possible to expose all the required thermal mass because of furniture and floor coverings. Comfort is improved if the mass is distributed evenly in the room because the increased surface area reduces localized hot or cold spots. Light colored, lightweight materials “bounce” the sun to more massive materials as long as they are in a room with lots of sun. Also, vertical mass surfaces not in direct sunlight can reduce temperature swings by absorbing excess heat in the air.

✓ **Consider night window insulation.** Generally R-9 night insulation over double pane windows provides an approximate 20 to 30 percent increase in annual solar performance over systems using double pane windows without night insulation.

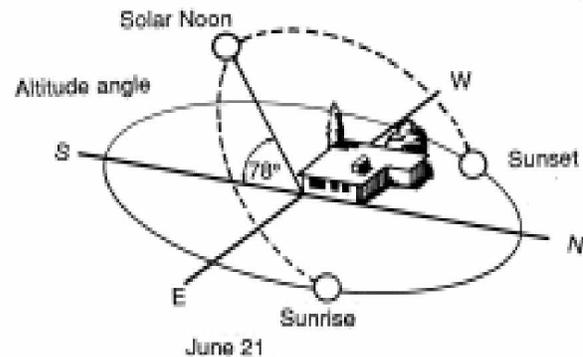
✓ **Integrate ventilation for cooling.** In most parts of North Carolina, just as much energy, if not more, may be used for cooling in summer. Thus, a properly designed home in North Carolina, whether it is solar or not, should require a minimum amount of energy for cooling in the summer. Ventilation, or the movement of air, is one of the most powerful means of achieving a cool home. Ventilation has two goals: to remove heat from the house and to provide air movement within the house to cool its occupants. See the fact sheet *Passive Cooling for your North Carolina Home*, for more detailed information on ventilation and also interior and exterior shading.

Winter Sun



For 36 degrees Northern latitude, the angle of winter sun is 31 degrees from horizon at solar noon.

Summer Sun



For 36 degrees Northern latitude, the angle of summer sun is 78 degrees from horizon at solar noon.

Figure 4. Seasonal path of the sun in horizon in Raleigh, NC.

Once these preliminary design issues are addressed, it is time to consider the finer details. The NC Solar Center has several fact sheets that deal with these issues in a more detailed manner. These are available by mail, via the internet, or by visiting the NCSU Solar House in Raleigh. The Center also offers a free plan review service for people designing or retrofitting a solar home. For more information, or to set up an appointment to talk about your plans, call us at (919) 515-3480 or toll-free in North Carolina at 1-800-33 NC SUN

Other Sources of Information

Computer Simulation Software

The Sustainable Buildings Industry Council offers workshops around the country for builders and architects on guidelines for passive solar building and remodeling and the easy-to-use computer software program, **BuilderGuide**. SBIC developed the “*Passive Solar Design Strategies: Guidelines for Home Builders*” workshops and the *BuilderGuide* software with the National Renewable Energy Laboratory and the US Department of Energy. Climate-specific guidelines are available for more than 2,000 cities and towns around the United States. SBIC also provides the building industry with practical, useful information on passive solar and sustainable technologies for commercial buildings. They distribute a Windows version of BuilderGuide and an advanced

energy simulation program for commercial buildings called Energy-10.

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For additional resources, see the fact sheet *Recommended Reading List for Solar and Renewable Energy Technologies*.

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