Passive Solar Home Design Checklist

Green Energy Ohio

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.

Benefits

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 environment rather than against it. When you build a solar home correctly, you can count on it being:

1. **Comfortable** - solar homes are warm in the winter and cool in the summer;
2. **Economic** - homeowners receive a positive cash flow or excellent return from their investment;
3. **Durable** - solar homes are usually built from long-lasting, low-maintenance materials;
4. **Attractive** - solar homes are full of light and are well connected to the outdoors; and
5. **Environmentally Responsible** - solar homes make efficient use of our energy resources.

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.

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.

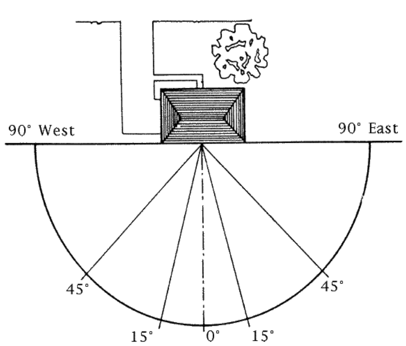

Figure 1. Orientation: A house can be angled as much as 15 degrees east or west of true south and still be energy efficient.

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 heated floor.
- *Direct gain systems* can have up to 12 percent of the floor area in south-facing windows. However, every 1 square foot of south-facing glass over the 7 percent suntempering allowance must be accompanied by 5 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.
- *Thermal storage or Trombe walls* should be 8 to 12-inch-thick masonry. The outside of the masonry wall 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.

Size overhangs properly.

To prevent summer gains, the angle "α" between a line "S" from the 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 "β" 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.

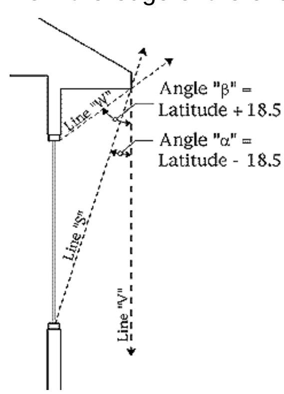

Figure 2. Sizing Overhangs

Match the solar heating system to the room use.

Consider occupancy patterns when choosing a system. 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,

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should also be placed on the north side. 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.

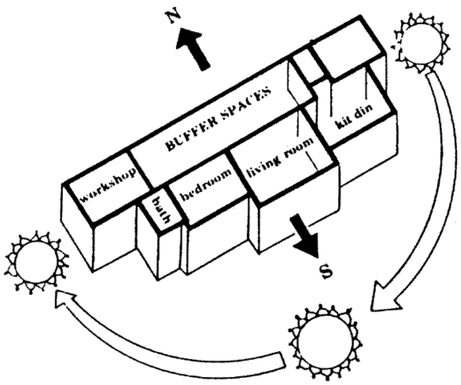

Figure 3. Buffer Spaces: Place rooms where they are compatible with the suns path. Buffer spaces should be placed to the north.

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 systems.

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). These colors 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 to some degree. It is wise to plan in advance to match the system to room use.

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.

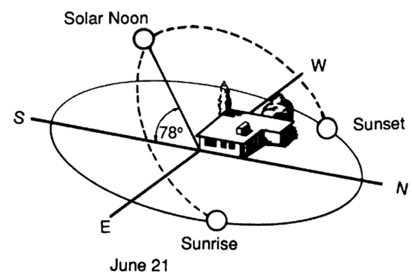

Figure 4. Angle of summer sun is 78 degrees from horizon at solar noon.

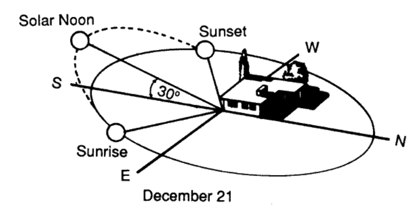

Figure 5. Angle of winter sun is 30 degrees from horizon at solar noon.

Reading List

Buildings for a Sustainable America, Burke Miller, Boulder, CO: American Solar Energy Society, 1997.

Climate Design, Donald Watson and Kenneth Labs, New York, NY: McGraw-Hill Book Co., 1983.

The Climatic Dwelling: An Introduction to Climate-Responsive Residential Architecture, Eoin O. Cofaigh, John A. Olley, J. Owen Lewis, London, UK: James & James (Science Publishers) Ltd., 1997.

The New Solar Home Book, Bruce Anderson and Michael Riordan, Andover, MA: Brickhouse Publishing Co., Inc., 1987.

Passive Solar Energy**,** Bruce Anderson and Malcolm Wells, Andover, MA: Brickhouse Publishing Co., Inc., 1994.

The Passive Solar Design and Construction Handbook, edited by Michael J. Crosbie, New York, NY: John Wiley and Sons Ltd, 1997.

The Passive Solar House: Using Solar Design to Heat and Cool Your Home, James Kachadorian, White River Junction, VT: Chelsea Green Publishing Co., 1997.

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