

Passive solar design in Wisconsin

FACT SHEET

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Passive solar design uses a building's orientation, structure and materials to capture the sun's energy. Taking advantage of the sun is not a new idea. In Mesa Verde, Colorado, ancient cave dwellings were oriented to the south, using the cave overhang to protect the dwellings from direct summer sun, but receiving its warming rays in the winter. Homes in any climate can take advantage of solar energy by incorporating passive solar design features. Even in Wisconsin's cold winters, passive solar design can help cut heating costs and increase comfort.

HOW DOES IT WORK?

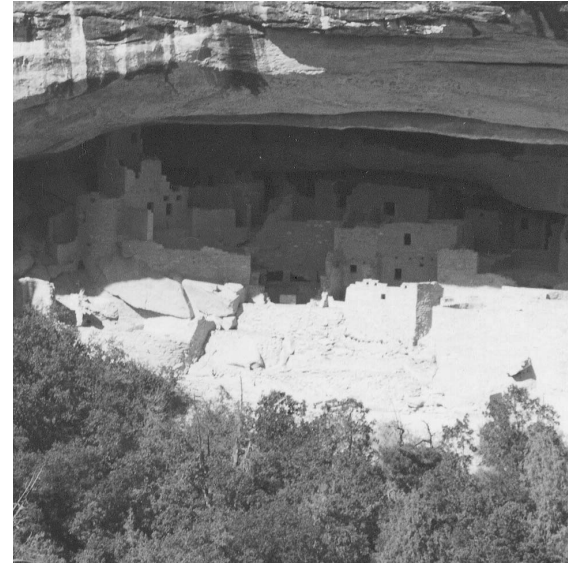
Passive solar design uses the sun's energy for heat, light and ventilation by using particular design strategies and materials rather than mechanical equipment. Such buildings are designed to absorb solar heat during winter days and contain it to provide warmth at night. Overhangs are used to block excessive heat gain during the summer. Natural convection currents can be employed to move air through the building for ventilation and heat distribution.

Passive solar design can be incorporated into an existing building, particularly where there is good orientation to the south. The addition of an attached greenhouse or sunspace, for example, offers a number of passive solar advantages. Air warmed by the sun can be blown into the house during the day, and a concrete or tile floor will soak up heat to provide some warmth at night. The space can also provide an extended growing season for vegetables and flowers!

To take best advantage of the possibilities of passive solar, however, these features should be part of the original building design. Two important aspects of a passive solar building—orientation and energy efficiency—are most successfully and economically addressed in new construction.

BENEFITS OF PASSIVE SOLAR ENERGY

Comfort. Because a well-designed passive solar home or building is highly energy efficient,



Cave overhang shades ancient dwellings from the summer sun at Mesa Verde, Colorado.

it is free of drafts. Extra sunlight from the south windows makes it more cheerful and pleasant in the winter than a conventional house.

Economy. If addressed at the design stage, passive solar construction doesn't have to cost more than conventional construction, and it should save money on fuel bills.

Aesthetics. Passive solar buildings can have a conventional appearance on the outside, but the passive solar features make them light and pleasant inside.

Environmentally responsible. Passive solar homes can significantly cut use of heating fuel and electricity used for lighting. If passive cooling strategies are used in the design, summer air conditioning costs can be reduced as well.

IMPORTANT COMPONENTS

Siting

To soak up the winter sun, the building should be oriented with the longest wall facing within 15 degrees of true south. Living spaces

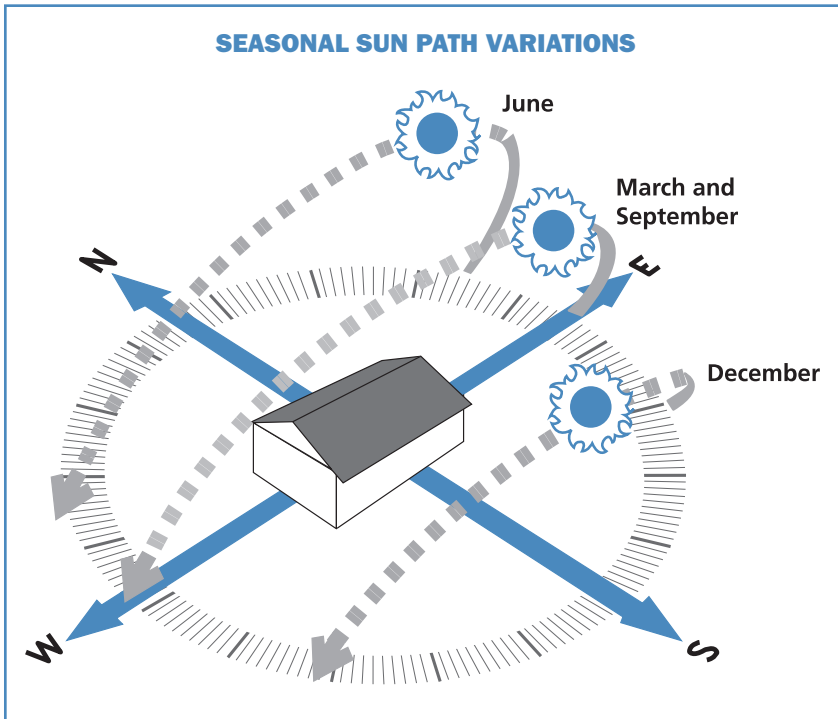


Contrary to popular belief, Wisconsin receives enough sunshine to make passive solar design worth considering when building or remodeling.



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should be placed on the south side to take advantage of natural heating and lighting. Place rooms with low heating, lighting and use requirements (e.g., storage and utility rooms) on the north side of the building.

Landscaping can be used to provide natural insulation. Evergreen trees can be planted on the north and west sides as a buffer against cold winter winds. The south side of the building should be kept clear of trees and shrubs that would block the sun.

Building Envelope

In passive solar homes and buildings, energy efficiency should come first. The structure should be built tight with good ventilation. Storm windows and movable window insulation can be used in the winter to help reduce heat loss. A home performance specialist can help identify cost effective measures.

Moisture Control

With a tight home, working ventilation is imperative. There are several ventilation strategies that can work. Ventilation is used to dilute the moisture and other pollutants in the air. The important thing is to have the ventilation tested to see that the needed air exchange actually occurs.

Windows and Overhangs

In a passive solar building design, most of the windows are located on the south wall.



(above) The passive solar features designed into the Midwest Renewable Energy Association's headquarters in Custer, Wisconsin, would also work well for a residence. Shown here is the building's southern facade with its many windows. Note the clerestory windows at the top that bring solar energy into the rear of the building. Also, note the small skylights that admit abundant light during the day, but lose a minimum of heat at night. A house with passive solar features like these would not be out of place among conventionally designed houses.

(left) The movement of the sun through the seasons is well illustrated in this diagram. Correct placement of a home on a specific site is an important part of passive solar design.

However, it is important at the design phase to not oversize the amount of south facing windows. Oversizing can lead to overheating. Multi-pane glass with low-e coatings is recommended to maximize incoming heat while minimizing heat loss. Windows on the north wall should be small to reduce heat loss, and those located on the east and west might need shading from vegetation to reduce heat from morning or evening sun. Money invested in high-quality windows and insulation usually offers a quick payback, and the building will require a smaller heating system in Wisconsin's cold climate.

Exterior overhangs are required on the south side of the building to block direct summer sun. Ideal proportions for an overhang are calculated by latitude and have become established standards used by passive solar designers. The overhang needs to be enough to block summer sun, but not so much that it blocks the sun desired in the winter.

Thermal Mass

Thermal mass is material that soaks up heat when the sun is shining and then slowly radiates that heat at night. Good examples of thermal mass are stone, brick, concrete and adobe brick. These materials are not good insulators. However, if they are located inside well-insulated outer walls (as flooring), the heat they collect during the day will be captured for nighttime distribution inside the

structure. The amount of thermal mass inside the building must be balanced with the window area to ensure that the building is not too hot or too cold. Computer programs are available to calculate the proper amount of thermal mass needed, or a good passive solar designer can make the calculations.

OTHER CONSIDERATIONS

- Working with a good designer or architect is worth the investment. Solar home tours are available and offer the opportunity to visit successful examples of passive solar design.
- Passive solar design works best in open floor plans that allow heat to flow throughout the home.
- A back-up heating system will be needed for Wisconsin winters.

Living in a passive solar home brings greater awareness of the seasons and the climate and requires some operation to mitigate the changes. For example, if summer ventilation has been incorporated it will be necessary to open and close vents as the seasons change. Also, it is advisable to use heavy drapes or window insulation at night during the coldest months to keep heat loss to a minimum.

FOR MORE INFORMATION

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Passive Solar Energy: The Homeowner's Guide to Natural Heating and Cooling. Bruce Anderson. Amherst, NH: Brick House Publishing Company, 1994.

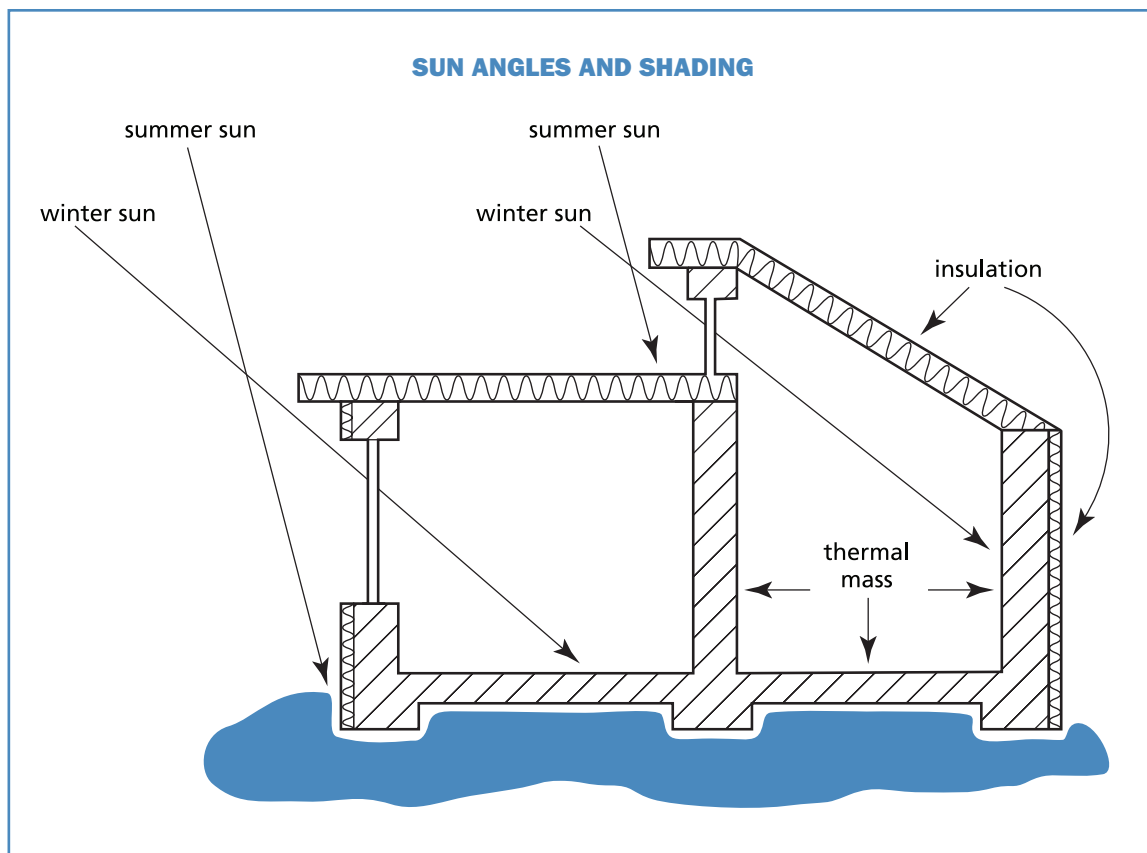
The Passive Solar Energy Book. Edward Mazria. Emmaus, PA: Rodale Press, 1979.

Other sources for information on passive solar energy

www.greenbuilder.com/sourcebook

www.eren.doe.gov/erec/re/solar_passive.html

www.nrel.gov/learning/re_passive_solar.html



Passive solar design takes advantage of the differing positions of the sun in summer and winter. This diagram shows how the winter sun can enter the windows and be soaked up by the thermal mass of walls and floors. In summer, overhangs at the windows keep the sun's heat out.

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