Sun Plans

Sun-Inspired House Design

www.sunplans.com

Passive Solar House Design

Debbie Coleman, Architect, AIA, Sun Plans

SOLAR 2023, Industry Roundtable, August 2023

Debbie Coleman, AIA, Sun Plans

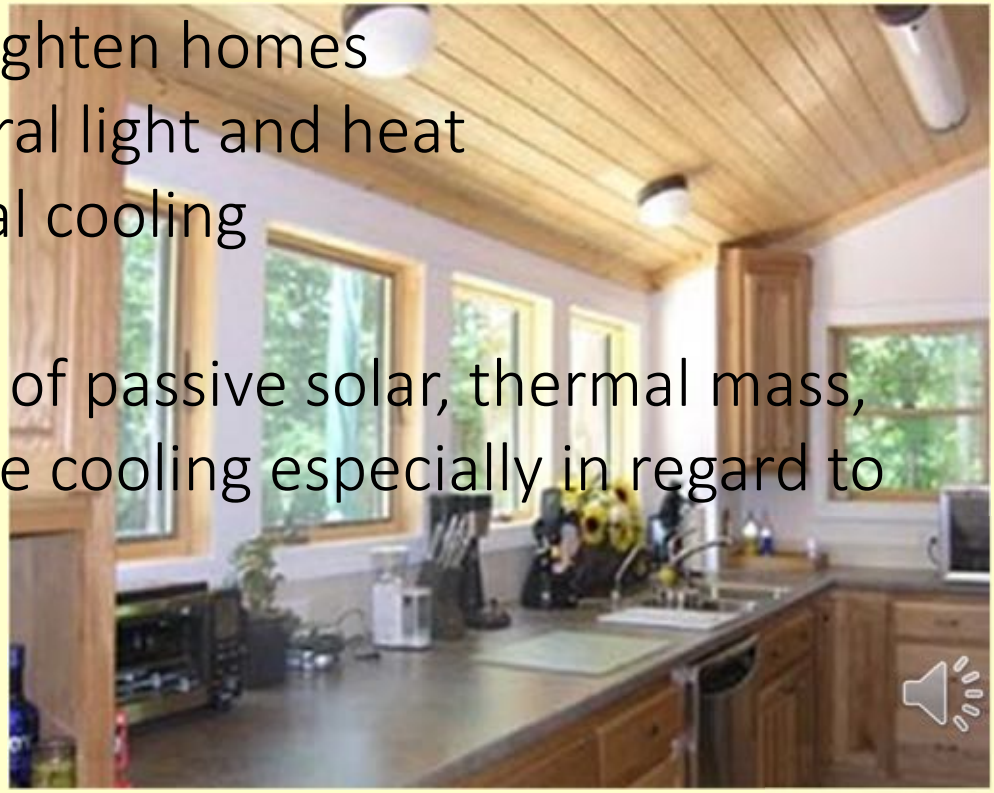
- Registered architect for over 30 years
- Specialize in sun-inspired house design
- Designed 100’s of passive solar homes
- Hot and cold climate zones
- United States and Canada

American Solar Energy Society (ASES)

- Board Member, Vice-Chair Solar Buildings Division
- Committees for SOLAR 2023 & National Solar Tour

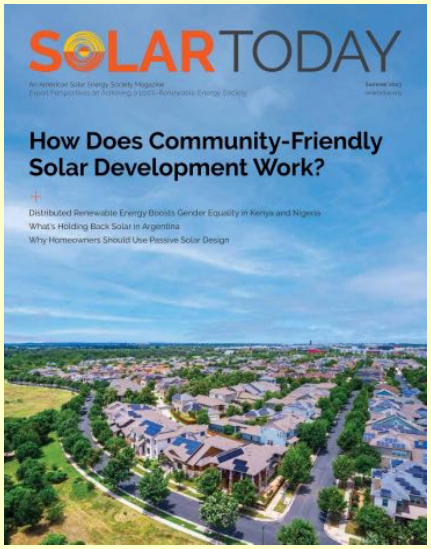
What is Sun-Inspired Home Design?

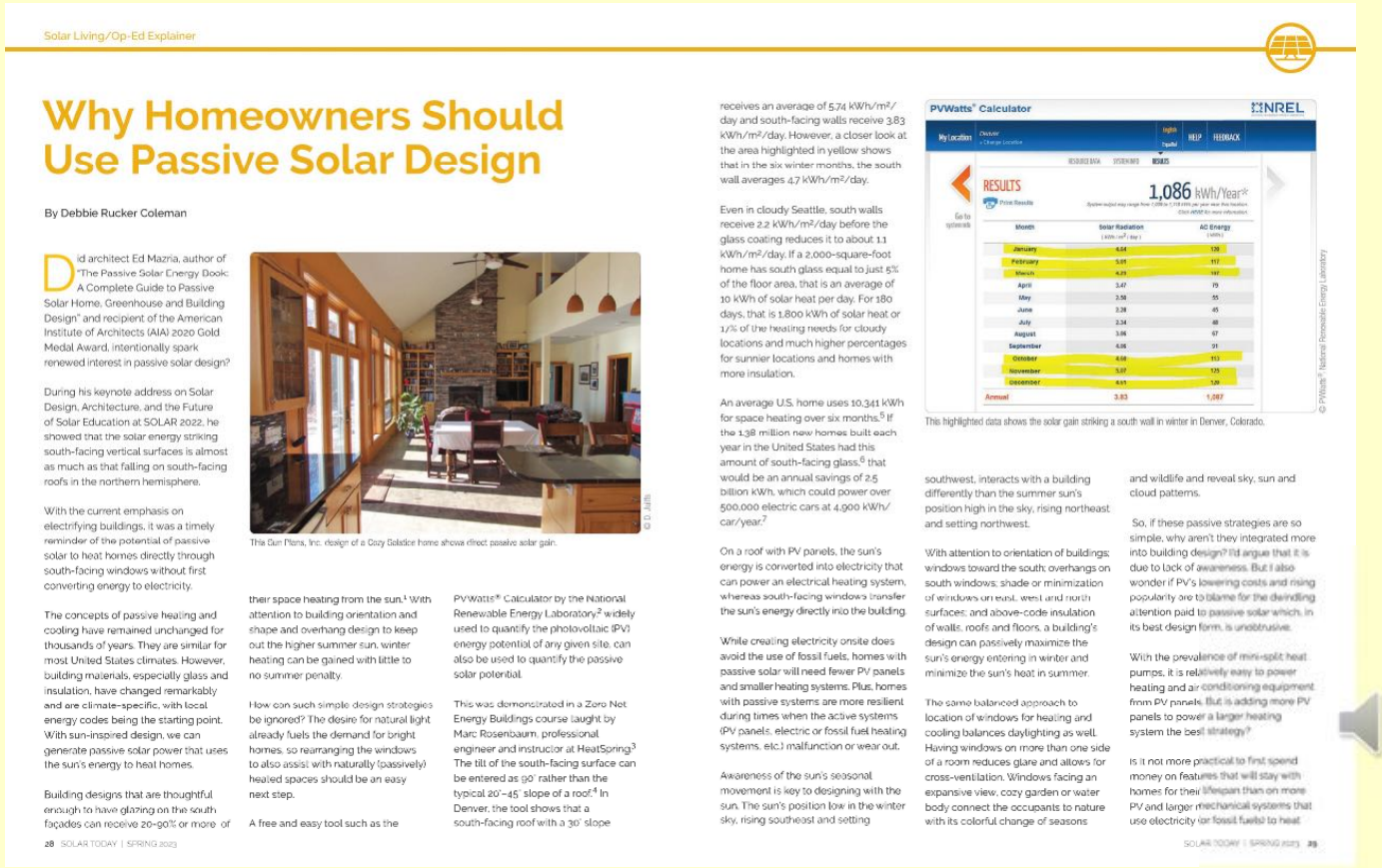
- Using the sun to warm & brighten homes
- Designing for the sun's natural light and heat
- Integrating shading & natural cooling
- Combining art and science
- Incorporating fundamentals of passive solar, thermal mass, overhang design, and passive cooling especially in regard to blocking the sun in summer



Solar Today - Summer 2023 Issue

https://ases.org/passivesolardesign/





Solar Living/Op-Ed Explainer

Why Homeowners Should Use Passive Solar Design

By Debbie Rucker Coleman

Did architect Ed Mazria, author of "The Passive Solar Energy Book: A Complete Guide to Passive Solar Home, Greenhouse and Building Design" and recipient of the American Institute of Architects (AIA) 2020 Gold Medal Award, intentionally spark renewed interest in passive solar design?

During his keynote address on Solar Design, Architecture, and the Future of Solar Education at SOLAR 2022, he showed that the solar energy striking south-facing vertical surfaces is almost as much as that falling on south-facing roofs in the northern hemisphere.

With the current emphasis on electrifying buildings, it was a timely reminder of the potential of passive solar to heat homes directly through south-facing windows without first converting energy to electricity.

The concepts of passive heating and cooling have remained unchanged for thousands of years. They are similar for most United States climates. However, building materials, especially glass and insulation, have changed remarkably and are climate-specific, with local energy codes being the starting point. With sun-inspired design, we can generate passive solar power that uses the sun's energy to heat homes.

Building designs that are thoughtful enough to have glazing on the south façades can receive 20–90% or more of their space heating from the sun.[1] With attention to building orientation and shape and overhang design to keep out the higher summer sun, winter heating can be gained with little to no summer penalty.

This Sun Plans, Inc. design of a Cozy Solstice home shows direct passive solar gain.

How can such simple design strategies be ignored? The desire for natural light already fuels the demand for bright homes, so rearranging the windows to also assist with naturally (passively) heated spaces should be an easy next step.

A free and easy tool such as the PVWatts® Calculator by the National Renewable Energy Laboratory[2] widely used to quantify the photovoltaic (PV) energy potential of any given site, can also be used to quantify the passive solar potential.

This was demonstrated in a Zero Net Energy Buildings course taught by Marc Rosenbaum, professional engineer and instructor at HeatSpring.[3] The tilt of the south-facing surface can be entered as 90° rather than the typical 20°–45° slope of a roof.[4] In Denver, the tool shows that a south-facing roof with a 30° slope receives an average of 5.74 kWh/m²/day and south-facing walls receive 3.83 kWh/m²/day. However, a closer look at the area highlighted in yellow shows that in the six winter months, the south wall averages 4.7 kWh/m²/day.

Even in cloudy Seattle, south walls receive 2.2 kWh/m²/day before the glass coating reduces it to about 1.1 kWh/m²/day. If a 2,000-square-foot home has south glass equal to just 6% of the floor area, that is an average of 10 kWh of solar heat per day. For 180 days, that is 1,800 kWh of solar heat or 17% of the heating needs for cloudy locations and much higher percentages for sunnier locations and homes with more insulation.

An average U.S. home uses 10,341 kWh for space heating over six months.[5] If the 1.38 million new homes built each year in the United States had this amount of south-facing glass,[6] that would be an annual savings of 2.5 billion kWh, which could power over 500,000 electric cars at 4,900 kWh/car/year.[7]

On a roof with PV panels, the sun's energy is converted into electricity that can power an electrical heating system, whereas south-facing windows transfer the sun's energy directly into the building.

While creating electricity onsite does avoid the use of fossil fuels, homes with passive solar will need fewer PV panels and smaller heating systems. Plus, homes with passive systems are more resilient during times when the active systems (PV panels, electric or fossil fuel heating systems, etc.) malfunction or wear out.

Awareness of the sun's seasonal movement is key to designing with the sun. The sun's position low in the winter sky, rising southeast and setting southwest, interacts with a building differently than the summer sun's position high in the sky, rising northeast and setting northwest.

This highlighted data shows the solar gain striking a south wall in winter in Denver, Colorado.

With attention to orientation of buildings: windows toward the south; overhangs on south windows; shade or minimization of windows on east, west and north surfaces; and above-code insulation of walls, roofs and floors, a building's design can passively maximize the sun's energy entering in winter and minimize the sun's heat in summer.

The same balanced approach to location of windows for heating and cooling balances daylighting as well. Having windows on more than one side of a room reduces glare and allows for cross-ventilation. Windows facing an expansive view, cozy garden or water body connect the occupants to nature with its colorful change of seasons and wildlife and reveal sky, sun and cloud patterns.

So, if these passive strategies are so simple, why aren't they integrated more into building design? I'd argue that it is due to lack of awareness. But I also wonder if PV's lowering costs and rising popularity are to blame for the dwindling attention paid to passive solar which, in its best design form, is unobtrusive.

With the prevalence of mini-split heat pumps, it is relatively easy to power heating and air conditioning equipment from PV panels. But is adding more PV panels to power a larger heating system the best strategy?

Is it not more practical to first spend money on features that will stay with homes for their lifespan than on more PV and larger mechanical systems that use electricity (or fossil fuels) to heat

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By Debbie Rucker Coleman, Architect, Sun Plans

Webinars

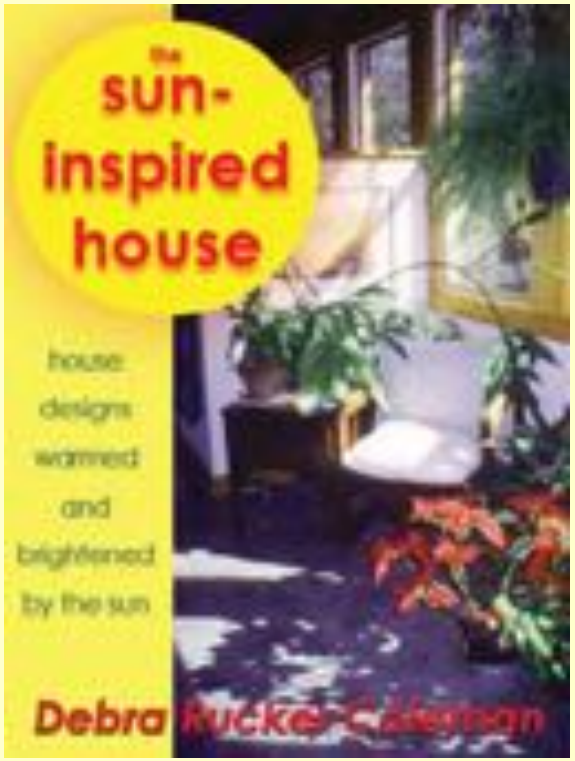
ASES: https://ases.org/webinars/ 1.0 hour

GreenHome Institute: 1.5 hours with CEU

https://greenhomeinstitute.thinkific.com/collections

The Sun-Inspired House

(eBook version comes with almost 200 house designs)



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The starting point for building a sun-inspired, high-performance home based on budget, location, design style, and energy priorities

(if no local design professional experienced in passive solar)

- Select a Pre-Designed Plan (choose from over 100 plans)
- Adapt a Sun Plan (change per the homeowner's desires)
- Create a Sun Plan (create a design from the family's wish list)

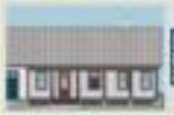
Select a Pre-Designed Plan

Sort based on:

- Entry Faces
- % of South Glass
- First Floor S.F.
- Etc.

Options:

- Study Plans
- Review Sets
- CAD Files
- Construction Prints
- Custom Energy Specs

SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY	SORT BY
Plan Name	1st + 2nd S.F.	Entry Faces	% South Glass	1st Floor S.F.	2nd Floor S.F.	Daylt. Bsmt. S.F.	S.F. inc. Bsmt.	1st Floor BR	2nd Floor BR	Daylt. Bsmt. BR	Total BR	Gar.	Width	Plan Complex
 Sunburst Cabin	784	South	7%	784			784	1			1	attached	36'	simple
 Midnight Sun	1797	North	10%	945	852	945	2742	1	3	1	5	detached	44'	average
 Eco Soleil 2	1852	South	8%	956	896	956	2808	1	3		4	attached	34'	average
 NEW Magic Farmhouse	2016	West	8%	1008	1008		2016	1	3		4	detached	28'	average
 NEW Light Farm	1064	North	8%	1064		1064	2128	1		2	3	attached	62'	average
 Eco Soleil	1927	South	8%	1067	860		1927	1	3		4	attached	43'	average

Adapt a Sun Plan

To:

Options for Adapting a Sun Plan:

- Local Design Professional to Adapt from Computer Aided Design (CAD) Files from Sun Plans
- Adaptations by architect, house designer, draftsman, builder, structural engineer, or owner with construction drawings skills
- Sun Plans can make adaptations based on customer's location, energy priorities, comfort levels, site, topography, etc.

Create a Sun Plan

Process:

- Consulting and Review of extensive information from homeowner including site and a long questionnaire from Sun Plans
- Reviewing existing designs on and off the website to see if all or parts of an existing design might be a good starting point
- Concept diagrams, block 3D models, preliminary design showing furniture to allow for space evaluation
- Construction drawing 10-16 pages with Custom Energy Specs

Every Building is a Solar Building

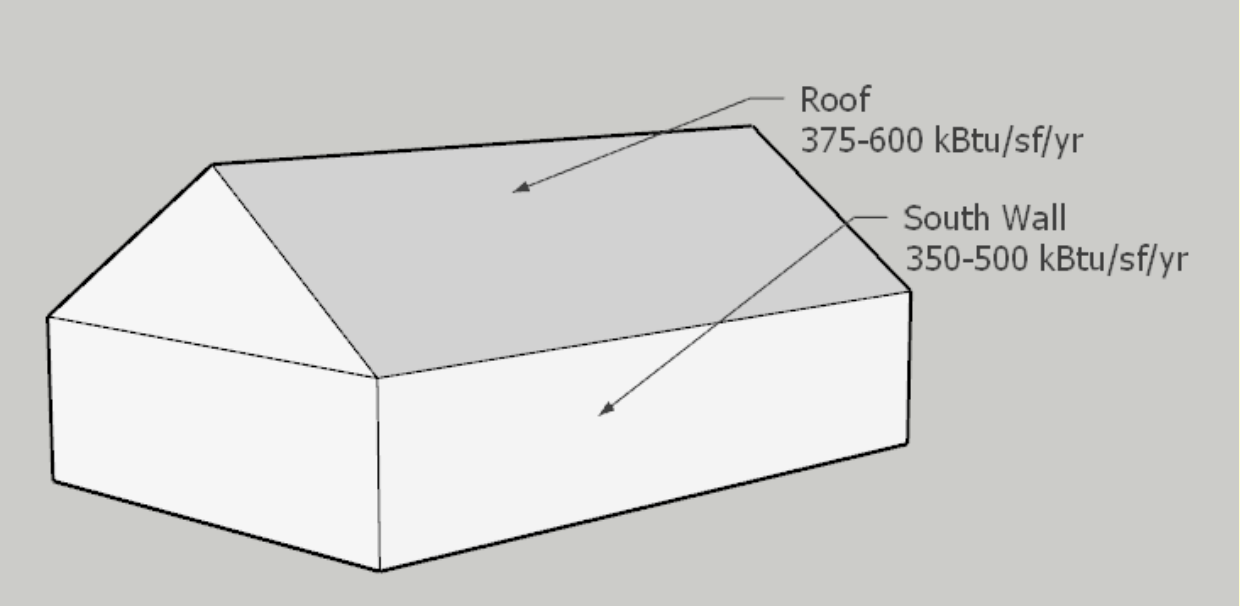
Sun strikes the roof and walls of all homes.

We can either use the sun's solar energy, or let it go to waste.

By Debbie Rucker Coleman, Architect, Sun Plans

South Roof vs. South Wall

they receive almost equal solar energy annually



Roof: 375-600 kBtu/sf/yr (1200-1900 kw/m2/yr)

South Wall: 350-500 kBtu/sf/yr (1100-1600 kw/m2/yr)

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South Wall for Passive Solar, South Roof for PV

- Active solar photovoltaics (PV) is a complex system, easy to see, and can be added later.
- Passive solar features of orientation, windows, and overhangs are subtle and must be designed for initially.
- Passive solar design rearranges elements already used in a home.
- Passive solar with passive cooling can minimize the number of PV panels required to provide electricity for a home

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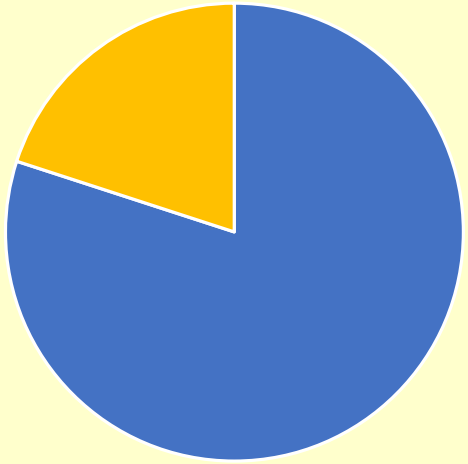
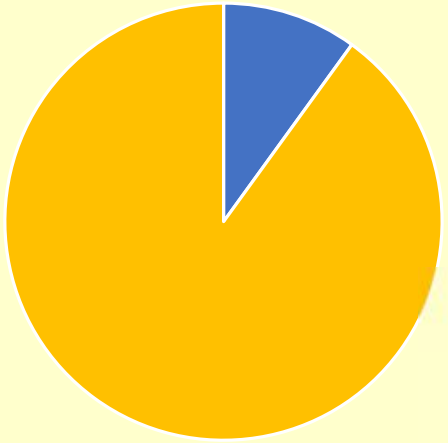
“Passive Solar” = Natural heating by the sun

The sun can provide 20 to 90% of a home’s heating and up to 100% with Ambient House strategies.

20% Passive Solar



90% Passive Solar



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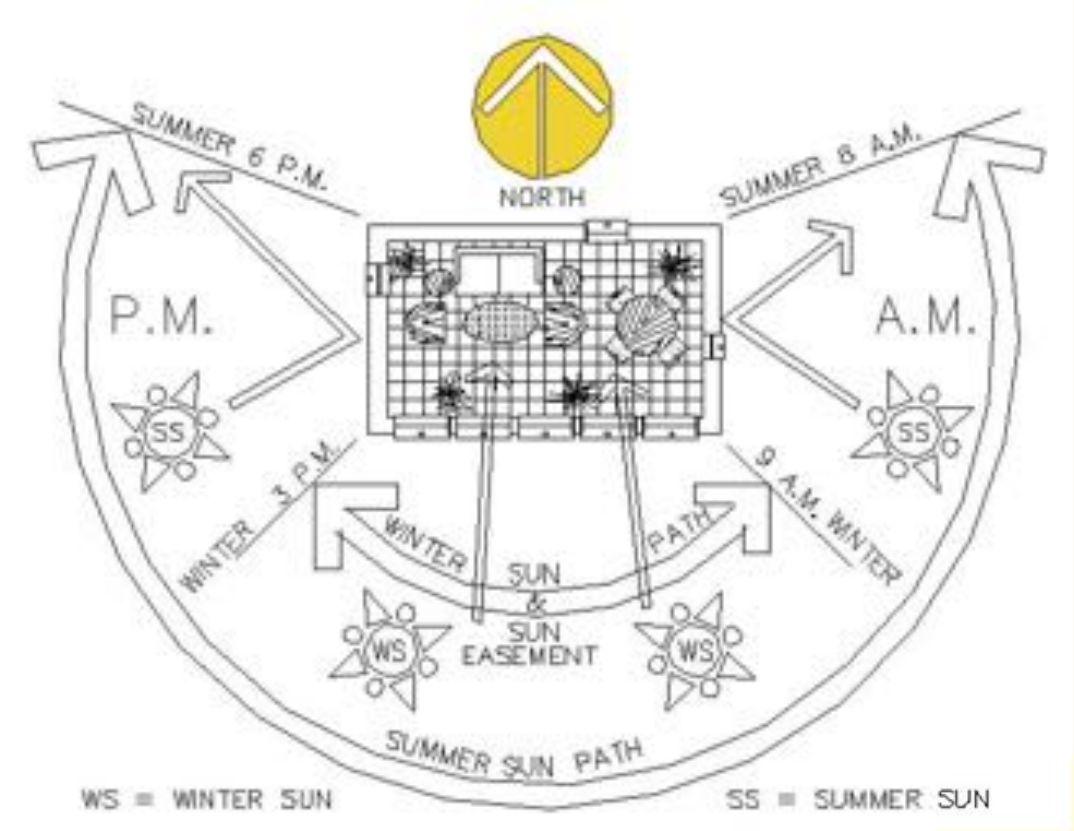
Key Concept:
The sun's seasonal movement varies from summer to winter



Proper orientation to the sun is the key concept in passive design.

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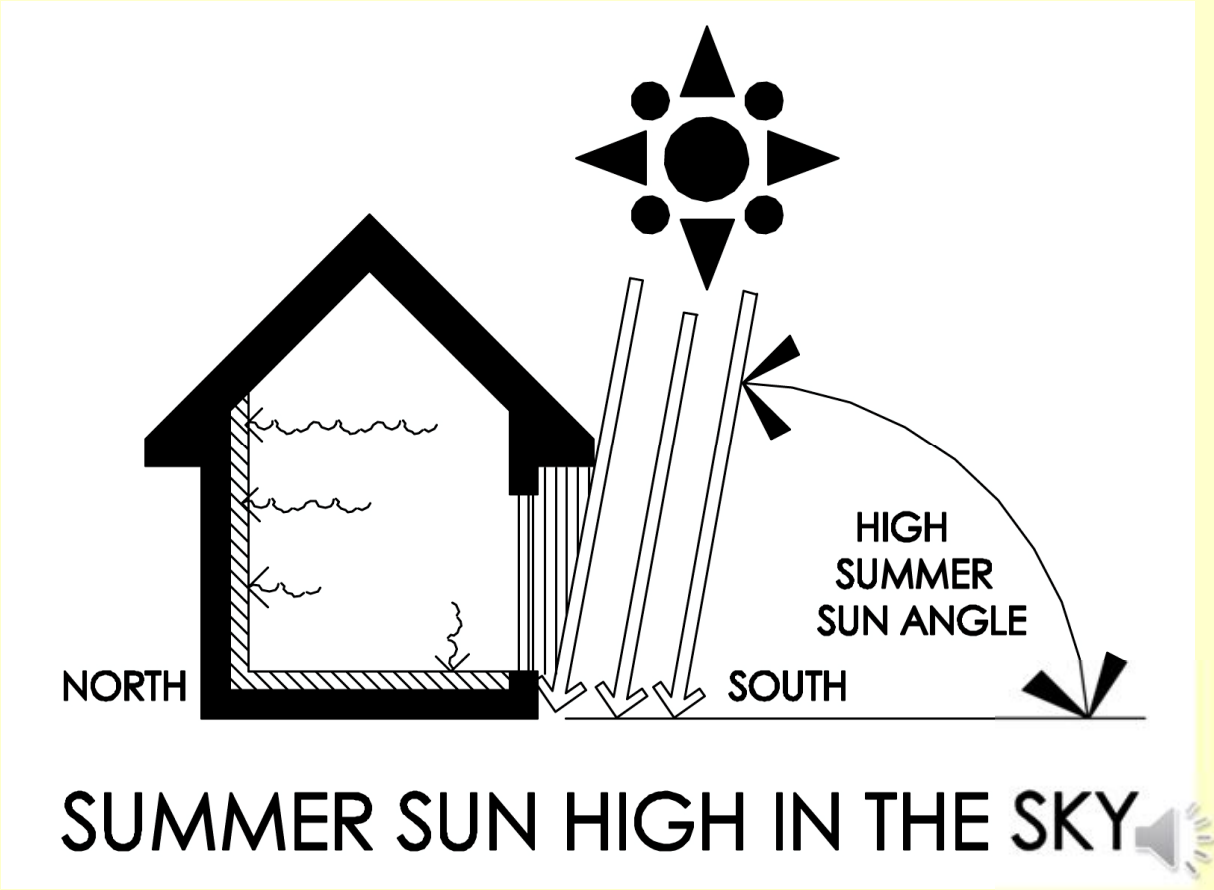
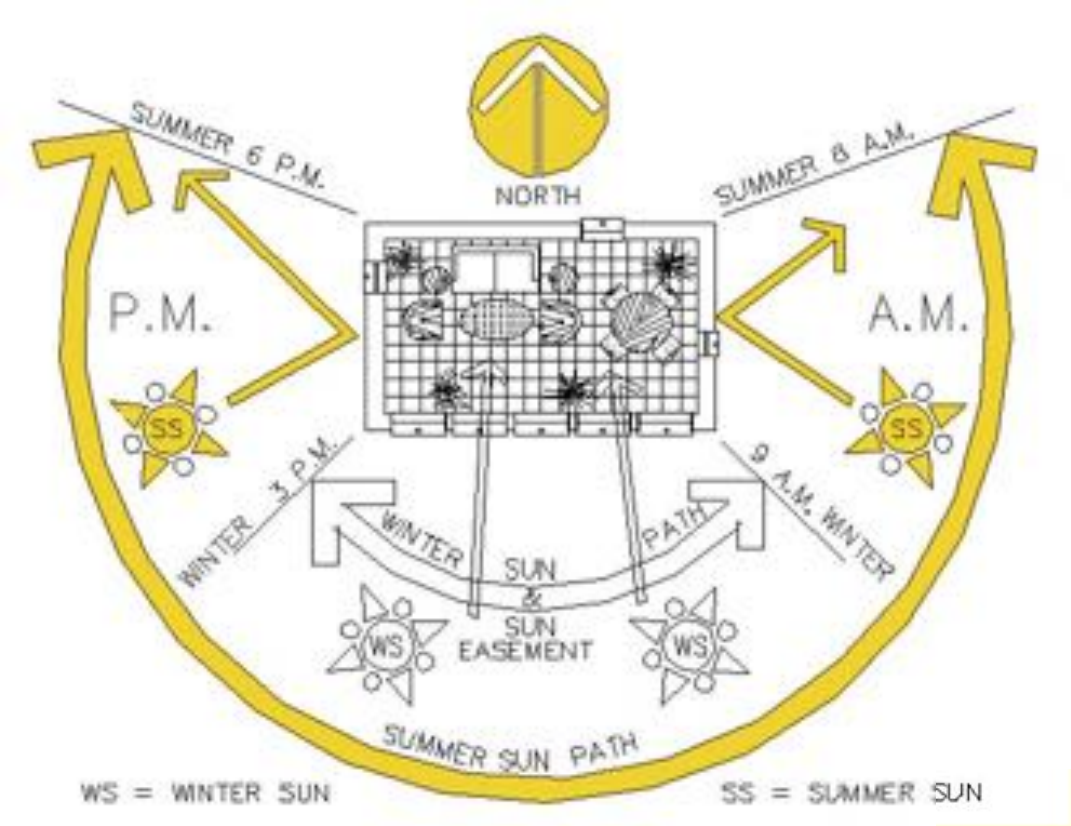
In summer, the sun is almost overhead at noon.



In summer,
the sun
rises in the
northeast
&
sets in the
northwest



More sun strikes the roof, and the east and west walls than the south wall in summer.

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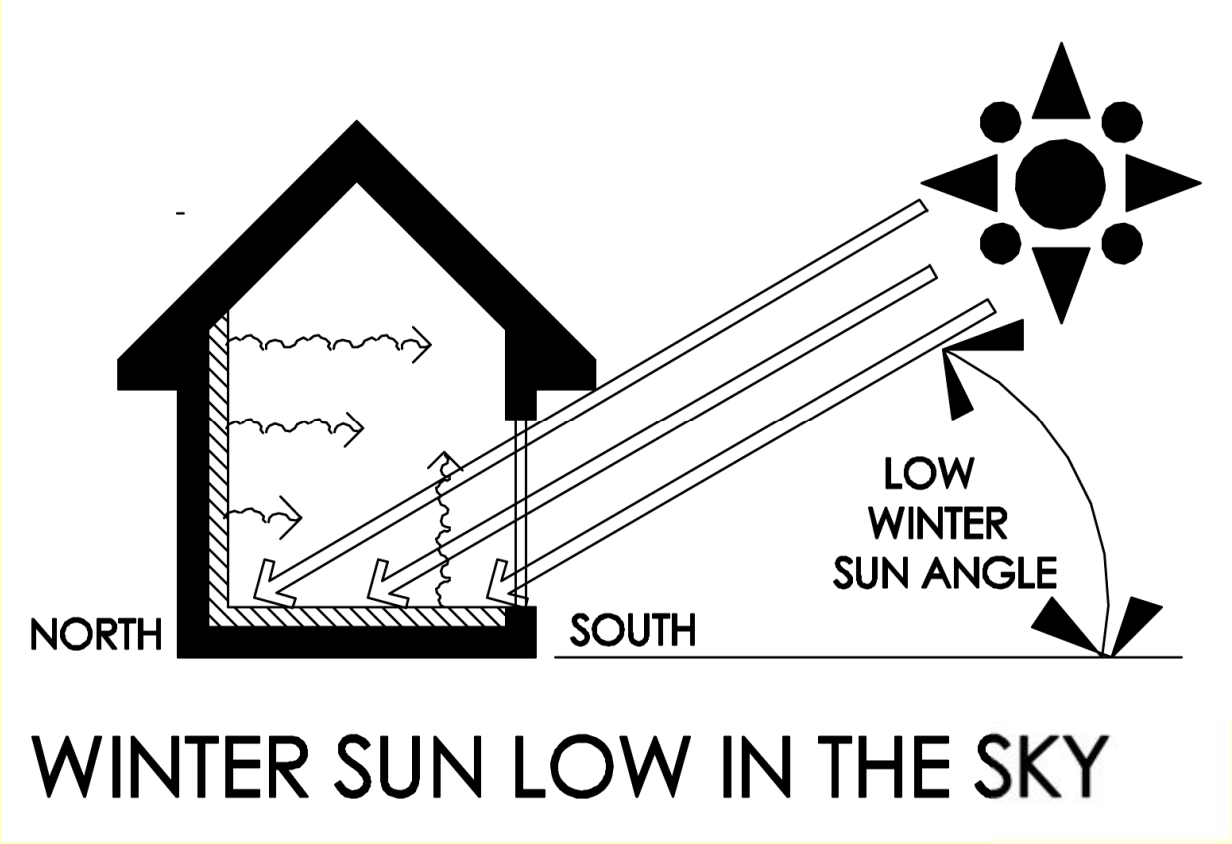
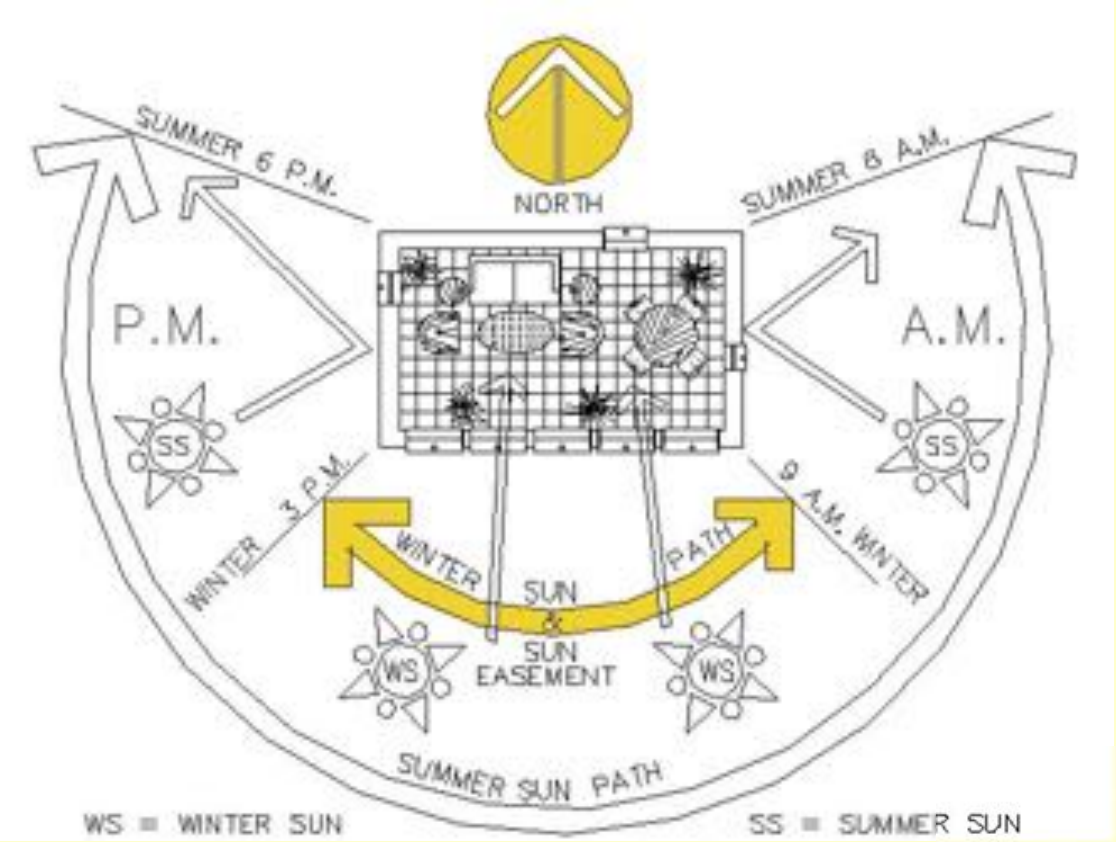
In winter, the sun is lower above the horizon (about 46 degrees less)



In winter,
the sun
rises in the
southeast
&
sets in the
southwest



More sun strikes the south wall than the roof, and east and west walls in winter.

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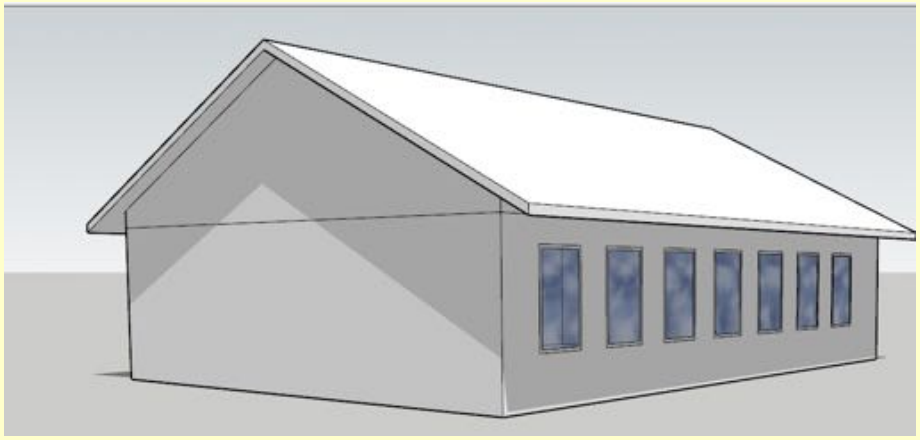
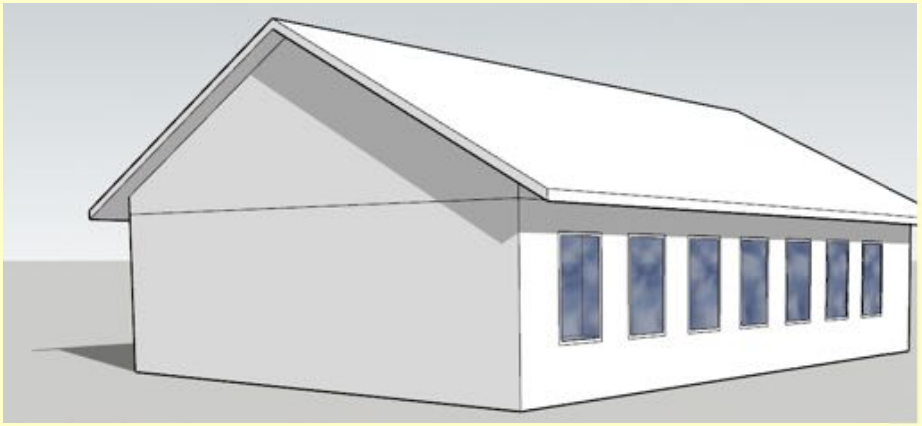
Overhang Design

Summer
Full Shade



Winter
Full Sun



By Debbie Rucker Coleman, Architect, Sun Plans

Front
Faces
South

Front
Faces
North

Back faces south.

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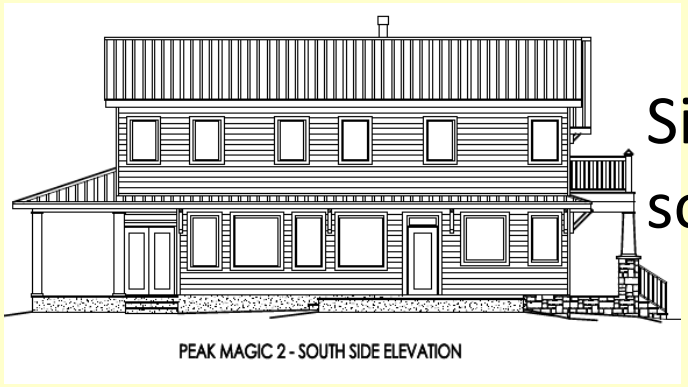
Front
Faces
East



Side faces
south

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Front
Faces
West

Side faces
south

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Front Faces West

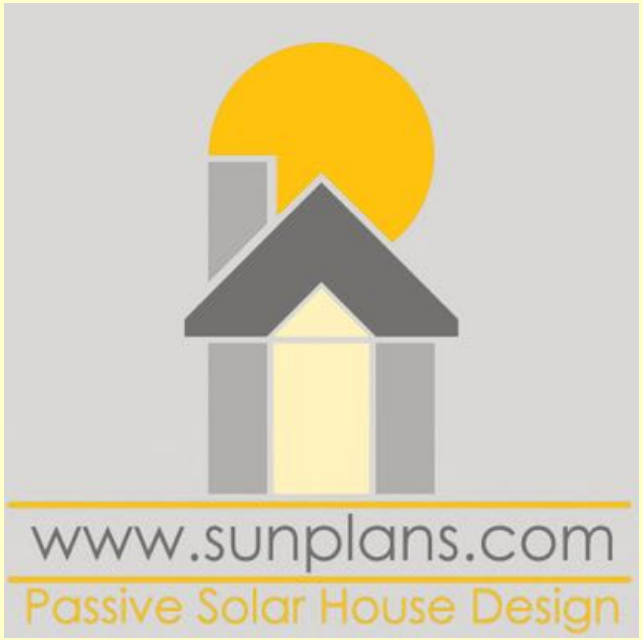
Side faces south

By Debbie Rucker Coleman, Architect, Sun Plans

Best of Both Worlds Leads to Zero Net Energy

By Debbie Rucker Coleman, Architect, Sun Plans

Thanks for visiting Sun Plans!



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Free Project Showcase Opportunities

By Debbie Rucker Coleman, Architect, Sun Plans