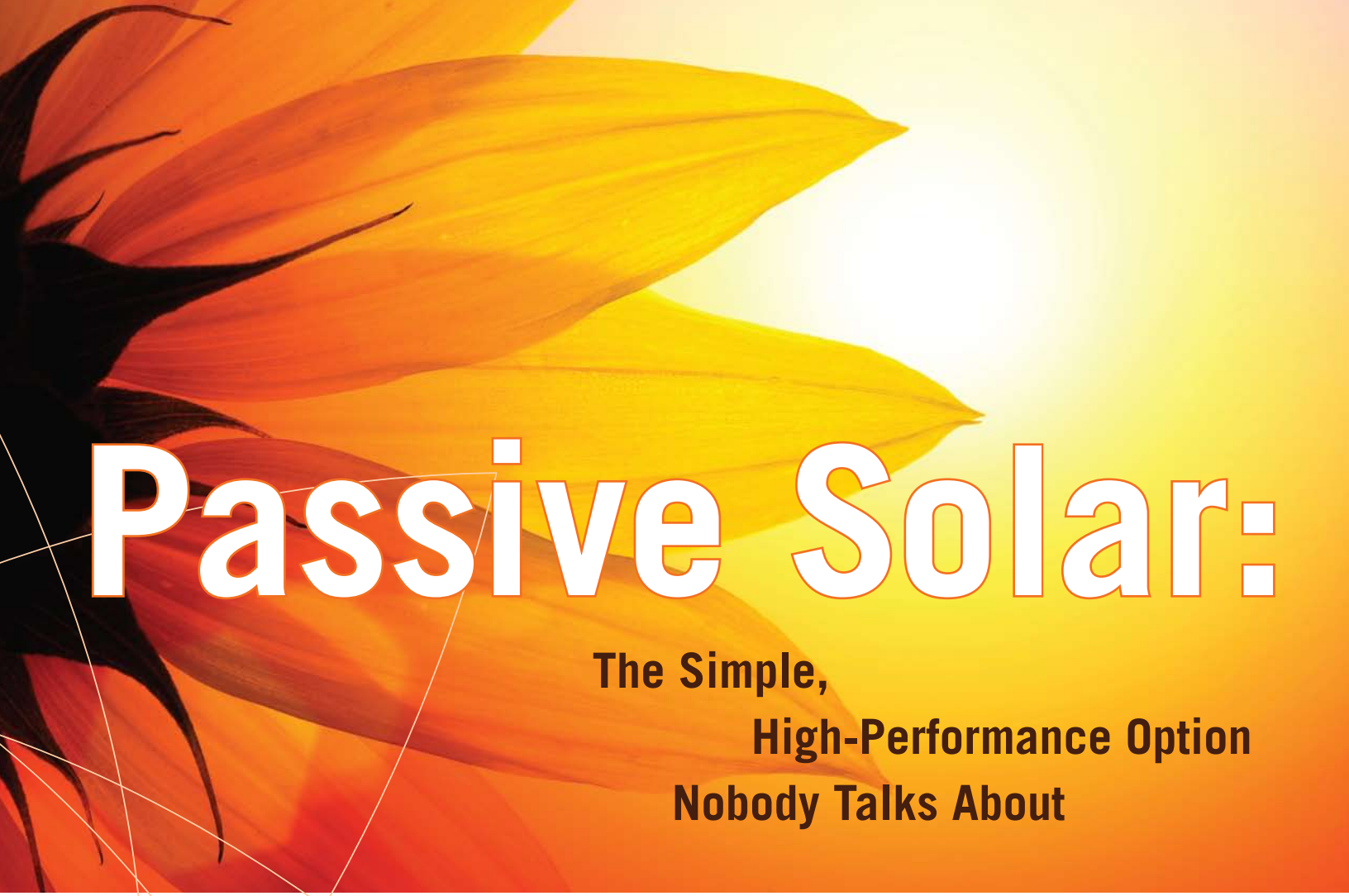


Passive Solar:

The Simple, High-Performance Option Nobody Talks About

by Mike Marsh, Marsh Associates Design

Imagine a building that heats itself in winter and cools itself in summer. It does this for free, requiring no dollars from your wallet and producing no carbon emissions. There is no expensive equipment, and no moving parts that can fail or break. It works quietly and simply, on its own, 365 days a year, creating a superbly pleasant interior environment.

Sounds like science fiction, too good to be true? The truth is that passive solar is an astoundingly good strategy for buildings. Passive solar simply means heating and cooling buildings using standard building materials without the use of motorized dampers, automatic valves, sophisticated control systems, or high-tech components. Unfortunately, it has recently taken a backseat to more complicated systems and gadgetry.

Perhaps passive solar's very simplicity undercuts its popularity in a technological age which favors complication. And, while current building codes and the new Home Energy Rating System (HERS) have developed valuated scoring for homes producing electricity through photovoltaic (PV) panels, they have yet to adequately valuate homes that produce their own space heating.

Before

Lisa Harris and Mike Marsh's home

After

Passive Performance

My wife and I live in a passive solar house I built. The passive solar element blends into the home's very traditional appearance. Nothing in the design shouts avant-garde or strange.

Yet there *is* something extraordinary about the passive solar's performance: It provides 85% of our space heating in winter. And, the house stays remarkably cool in summer without air conditioning or evaporative cooling.

All this for free: In new construction or a new addition, there's no additional cost to passive solar. Buildings require windows; passive solar simply maximizes them to the south and minimizes them to the north. In existing buildings, it's cheaper to enlarge or create a south window for passive solar energy, than to install active solar (PV or solar hot water) systems.

To create passive solar:

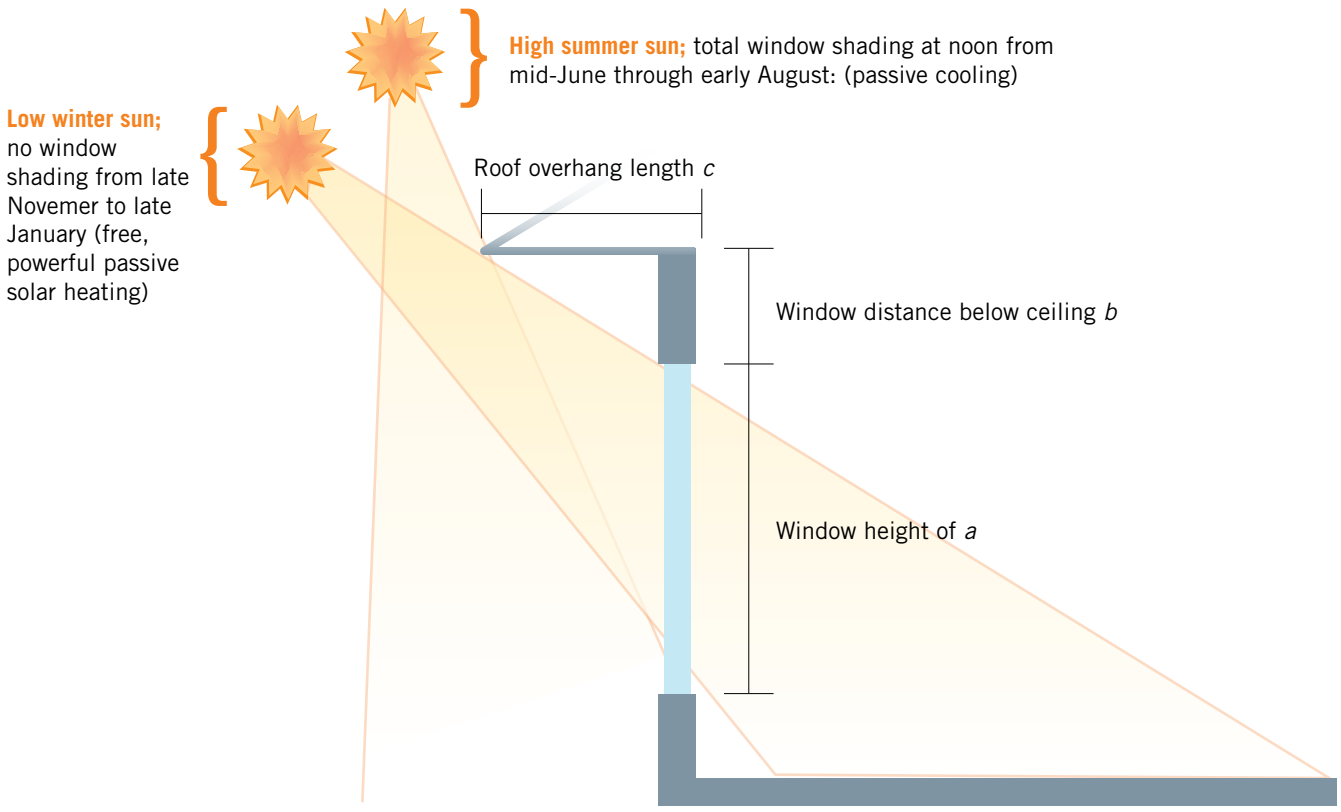
1. In new construction, incorporate south-facing windows. In existing construction, create or enlarge southern windows. To maximize these windows' solar gain in winter, use clear glass without reflecting coating.
2. Make certain your roof overhang above your south-facing windows extends far enough to shade the window in summer. Its length should be roughly half the height of your window. The distance your window sits below your ceiling also affects performance. (see illustration). A passive solar specialist can prescribe the exact length to achieve more shading in summer or more heating in winter.
3. Thermal mass, ideally in the floor's sunlit area, is critical to passive solar. Bricks, stone, or concrete covered with tile are good sources of thermal mass. These can be designed into initial construction or retrofitted into existing buildings. To understand the concept of thermal mass, imagine a sauna. Rocks are heated and then placed in the sauna. Rocks absorb tremendous heat due to their thermal mass, and they release this heat for hours, even after removal from their heat source. In passive solar, the sun is the heat source. The building's mass gradually heats during the day and it gradually releases its heat throughout the night. By sunrise, the mass has lost much of its heat, but then the cycle repeats.

   Thermal mass works for both heating and cooling. On summer nights, open windows. Your home's mass will cool dramatically during Colorado evenings. In the morning, close all windows to "seal your building envelope." The cooled mass cools your building for hours. By evening, when the mass starts to warm, it's cool enough outside to open windows, and the cycle repeats.

   Because mass heats and cools gradually, mass-filled buildings maintain more constant temperatures than other buildings.
4. Air ducts and high-efficiency fans can distribute warmer air from southern rooms to cooler, northern rooms when necessary.
5. Passive solar buildings should be super-insulated to conserve heat during winter nights and block it out during summer days.
6. Because your windows face south—where sunlight comes from—you have abundant natural daylight with passive solar. The house is bright and cheery. Natural daylight packs twice the lumens per watt of artificial light. Studies indicate that people in natural daylight are more productive and have a greater sense of well being. Design a floor plan that places rooms used during the day—living rooms, play rooms, kitchens – to the south, and bedrooms on the north side. Artificial lights produce heat, and your building stays cooler if you don't use them. Finally, natural lighting requires no fossil fuels.
7. To maximize passive solar, your home's longest length should face due south and north. You can harness passive solar from the front or back. It's more difficult, but not impossible, if your short axis faces south. Typically your street's orientation determines this. Billions of BTUs of fossil fuel-derived heat could be saved if new subdivisions were simply laid out so most streets, except for short north-south connectors, ran east and west. This would cause the majority of homes' long lengths to face south-north, saving enormous energy.

We knew our passive solar house would perform well, staying warm in winter and cool in summer. The surprise was the subjective enjoyment of living in such a house. Lisa and I still marvel at how the house seems to take care of itself, working with the changing seasonal patterns of the sun, doing just what we need it to do. There is an immense, deep feeling of satisfaction, knowing that we, and our house, are working with nature instead of fighting it.

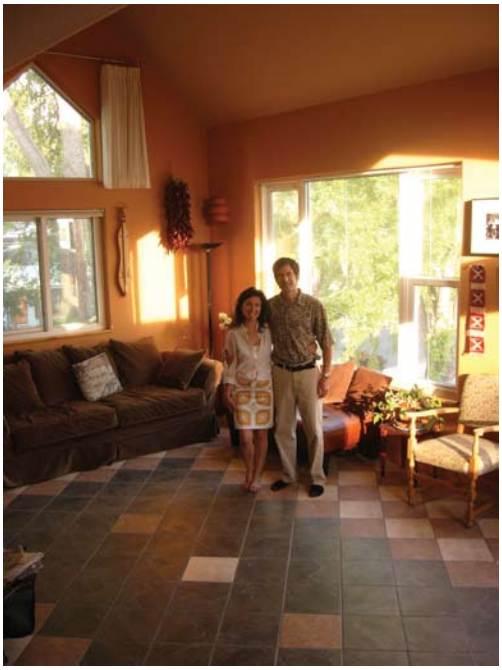
Optimized passive solar model at 40° north latitude (Boulder County)



Exact values for *a*, *b*, and *c*, can be adjusted for less shade in winter or more shade in summer.

Afterword

Marsh Associates believes that buildings should be designed properly in and of themselves, using the hierarchy of 1) energy efficiency first 2) passive solar second and 3) active solar—PV and solar hot water—last. This order yields the greatest return for each energy dollar spent. It is regrettable that loopholes in current building codes and the HERS numerical system allow poorly designed buildings to be covered with oversized PV systems and subsequently be assigned excellent scores. •



Dark tiles set into a concrete floor capture and store passive solar heat from large south-facing windows at the Marsh home.