



BEYOND THE BASICS:

Passive Thermal Design

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Heating and Cooling for Free!

Wouldn't it be great to have your indoor spaces be completely comfortable: toasty warm in the winter, cool in the summer, fresh clean air all year... and to have that comfort spending little or nothing on a utility bill? A well-designed building using the sun and wind to heat and cool, also known as "passive thermal design" can achieve all that and more!

Although there are sophisticated computer models to fine tune a system, the basics are not rocket science. Good energy-efficient design focuses on the following key elements:

- Glass: Location, quantity, and type of window
- Mass: Thermal mass such as concrete, block or water
- Insulation: In floors, walls and roof

Glass

The basic premise is to control how much and when the sun comes in, and the best way to do that is to orient your building toward the south. On the Central Coast, the winter sun at noon is only 30° above the horizon, so it's a straight shot for the sun to get in and heat your building as long as you have south-facing windows. In the summer at noon, the sun is 78° above the horizon, which means that with 1' – 2' of overhang, these same south-facing windows won't have any direct heat gain at all.

On the east and west sides, the sun will beat in all year, even in the summer or fall when you don't want it, so those windows should be limited and have extra shading. North-facing windows provide good daylight and cross ventilation, but no solar gain so should also be limited to avoid unnecessary heat loss.

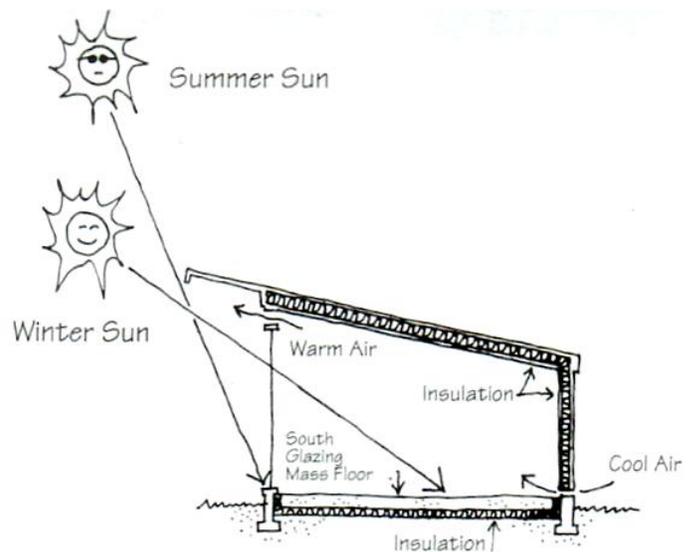
Of course, the location and quantity needs to be balanced with the reality of the site

regarding the specific climate of the area, views, prevailing winds, daylight and so on.

Mass

Thermal mass is simply using something really heavy such as stone or concrete as your heat "battery" to even out temperature swings. We've all experienced the dramatic change in temperature due to thermal mass by going into a cellar, adobe building, or even leaning against a concrete wall. When you're cold, a sun-drenched stone feels great, or when you're hot, entering an underground cellar feels refreshing.

Even if you have the right windows, if you design *without* mass you'll get plenty warm on a winter day but cold again by night. With mass, the sun will slowly warm the air as well as the concrete by day, and then re-radiate the heat at night when you need it most. In the summer, since you have good overhangs on your windows, there won't be any direct sun in the building, so the mass absorbs the day's heat, and the room will stay cool and comfortable. At night, open your windows and the cool central coast evenings will whisk away





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Beyond the Basics articles are written by the SLO Green Build Tech Resources Group: Stephen Ames, Greg Crabtree, Peggy Lance Little and Andy Pease

heat from the mass, re-setting it to absorb the heat from the next hot day.

Insulation

To make sure your glass and mass work effectively, your building needs to be well insulated. Insulation is measured in how well it resists heat loss (R value); the higher the R-value, the more insulating. R-13 is still allowed by code, but R-19 is more appropriate minimum and requires a wall 6" thick for batt insulation. Up to R-30 would still benefit performance, which is usually accomplished using alternate wall systems such as straw bale or insulating concrete forms (ICF).

For more details on passive thermal design, see the SLO Green Build Passive Heating and Cooling Rules of Thumb. After all, who could argue with cooling and heating for free?