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# Passive Cooling Ideas for the Southeast

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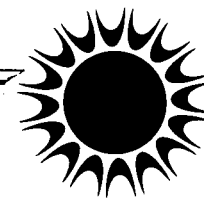
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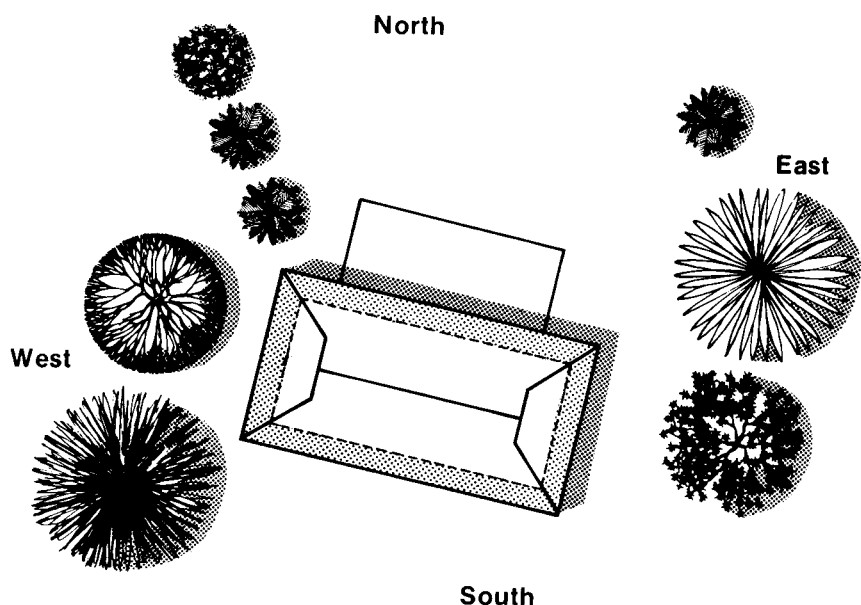
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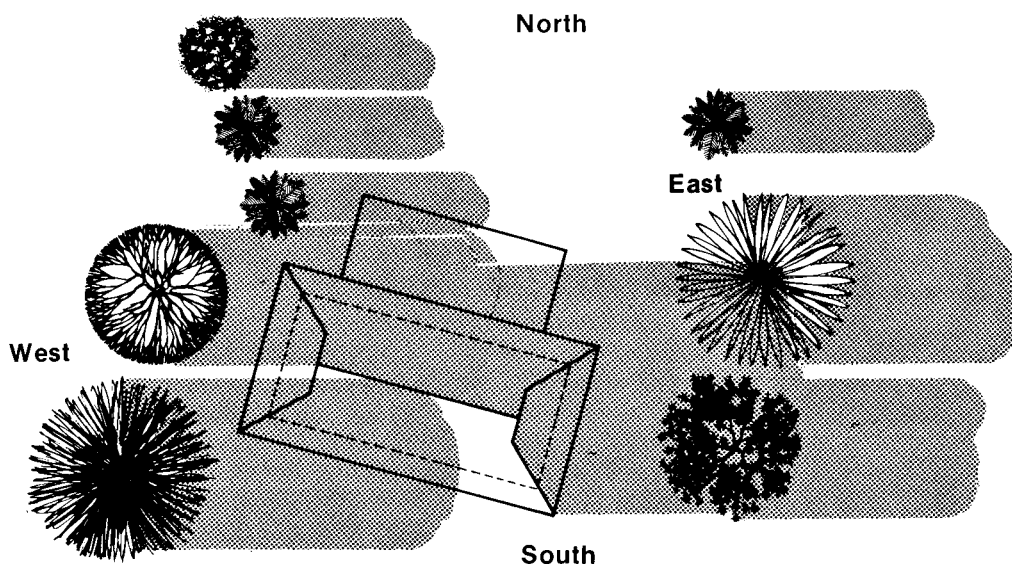
# Passive cooling ideas for the Southeast

Chris Beck  
Florida Solar Energy Center

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Properly sized roof overhangs will prevent the noon sun from reaching and heating the walls of a house.



Early in the morning and late in the afternoon, shade from trees can also reduce the solar gain on the walls and windows of a house.

A passively cooled home is one which is kept relatively comfortable through natural means. Homeowners in the Southeast have been using passive building techniques in order to live more comfortably during hot, humid seasons since the early 1900's. The concept of designing for minimum use of artificial cooling and heating systems is not new, but with the advent of sophisticated mechanical air-conditioning and heating systems and the availability of inexpensive fossil fuels in the '40s and '50s, builders began bypassing passive techniques. Too many of today's homes are designed with more concern about accommodating a mechanical conditioning system than with natural or passive cooling techniques, and as energy costs rise we are again faced with the need to "go passive."

A passive building approach to the cooling problem in the Southeast poses a difficult and complex dilemma. Seemingly all the climate factors—humidity levels, breezes, ambient air temperatures, etc.—defy the feasibility of passive cooling. How-

ever, there are ways to work with the climate through building design to reduce dependence on mechanical cooling devices.

The most important factors to be considered in a passive cooling system are heat gain, humidity, and air movement or ventilation. A passive home is one that deals with these factors satisfactorily without continuous input or nonrenewable fuels.

## Site cooling

The tract developments so common in the Southeast do not usually lend themselves well to passive cooling techniques. Houses are often placed too close together to allow breezes to flow freely, and many lots are stripped of shade trees. In choosing a home location, careful consideration should be given

to such factors as vegetation and adjacent structures, and the house should be positioned properly with reference to the sun and prevailing winds. Some existing structures can be successfully retrofitted with passive techniques if careful planning is done.

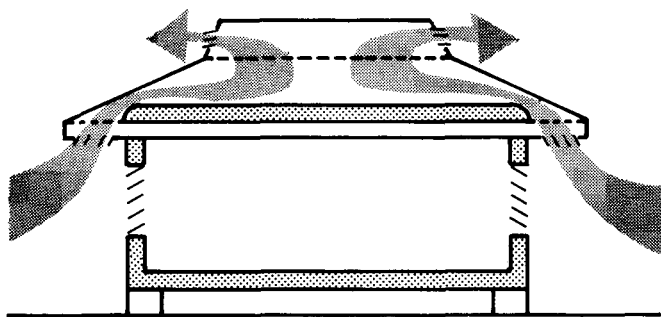
Whenever possible, the house should be elongated in an east-west direction, exposing its smallest wall area to the intense morning and afternoon sun. The south exposure should have properly sized overhangs, providing summer protection for windows, but admitting the lower winter sun. Although little can be done to shield the roof, unless there are trees tall enough to provide a canopy, insulation of at least R-19 value above the ceiling and radiant barriers can minimize the sun's effect.

Orientation to take advantage of prevailing breezes is also important, although not as critical as east-west orientation for sun control. Ventilation is actually slightly better when the house is "off" wind by about 45°.

## Landscaping

Landscaping and shading are keys to effective passive design. Trees can provide shade for portions of both roof and walls, and air drawn into the house from shaded areas will be relatively cooler.

Shrubbery planted a few feet away from the house will provide extra shade without obstructing air currents—in fact, landscaping can be used to capture and funnel air currents into the house.



Adequate soffit and gable vents allow air to circulate freely and prevent heat buildup in attic space.

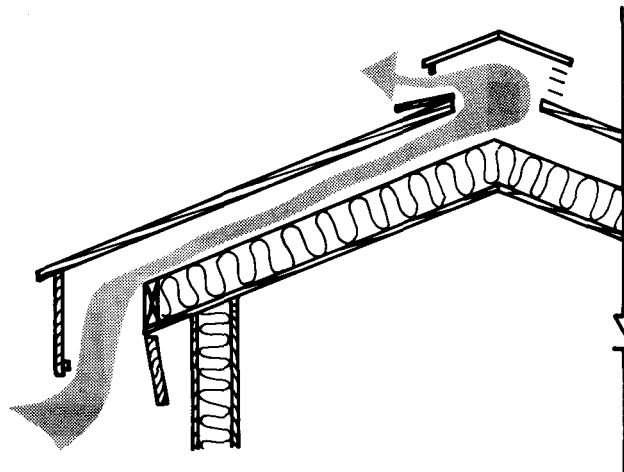
## Ventilative and convective cooling

Adequate ventilation is perhaps the most important aspect of passive cooling. Long, shallow homes only one room in depth with windows on opposite walls allow breezes to enter and exit with ease.

Air movement will evaporate perspiration, creating a cooling effect. For example, a well-shaded house with an indoor temperature of 85°F and little or no air movement will be uncomfortable. If ventilation is introduced and that 85° air moves across your body at 200 feet per minute, or 2.3 mph, the effect will be a 5° drop in tempera-

ture as sensed by your body.

Attic spaces are a major source of heat buildup, reaching temperatures in excess of 100°F, and unless there is some way to vent this trapped hot air, it will heat the interior of the home. To prevent excess buildup, gable or ridge vents should be designed into the structure to allow the air to escape as it becomes hot and rises. As hot air exits, relatively cooler outside air is drawn in through soffit vents to complete the convective cooling cycle.

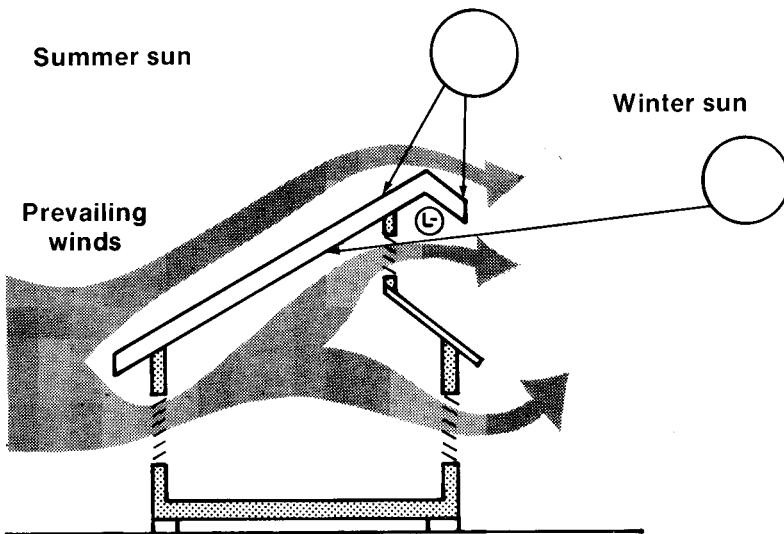


The air in the channel will rise and be vented at the peak of the roof as it is heated by the sun.

A good rule of thumb to follow regarding roof vents is to provide a minimum of 1 square foot of unobstructed opening for every 300 square feet of roof area. Remember, though, that roof openings are usually screened or louvered, which reduces the flow rate. In this case, 2 to 3 feet of vents should be installed for every 300 square feet of roof area.

A double-skinned (or ventilated-skin) roof can aid natural convection. As the air in the vent is heated, it rises and is vented at the roof peak to be replaced by cooler outside air entering through vents in the bottom edge of the roof. This air-movement cycle will help prevent heat buildup under the secondary (or inner) roof space and keep the house cooler. Insulation should be placed under the secondary skin. This double-skin configuration can also be used in wall construction.

Operable clerestories in combination with other ventilation techniques can be used to reduce cooling loads. Because warm air rises, a clerestory at the high point of a structure will accumulate warm interior air, which can be expelled through its windows (or vents). Clerestory windows should be located on the leeward side of the house to function best. If they face into the prevailing wind, the breeze will push the warm air (trying to escape through the windows) back down into the building. If the openings face the leeward side, breezes from the windward side can flow up and over the clerestory, creating a low-pressure area at the window opening. The resulting suction can aid the venting of warm air. If the clerestories are also south-facing, they should have overhangs of suf-



Prevailing winds flow up and over the clerestory, creating a low-pressure (L-) area at the leeward side of the window to help warm air escape. Note that the clerestory overhang protects against the high-riding summer sun but admits the lower winter sun.

efficient width to prevent the summer sun from penetrating the home, but short enough to allow the winter sun to reach in and warm the building interior.

Although electric fans are not considered passive, they are useful in creating air movement on still days. Exhaust fans pull warm air that would normally stratify near ceiling level. Some paddle fans can operate in reverse, pulling warm air up and out of the house. Fans are especially useful in existing structures which were not designed for natural or passive cooling. As an example of their effectiveness, the use of a ceiling fan in a normal size room allows the thermostat setting for the air conditioner to be raised as much as 6°F.

### Heat gain prevention

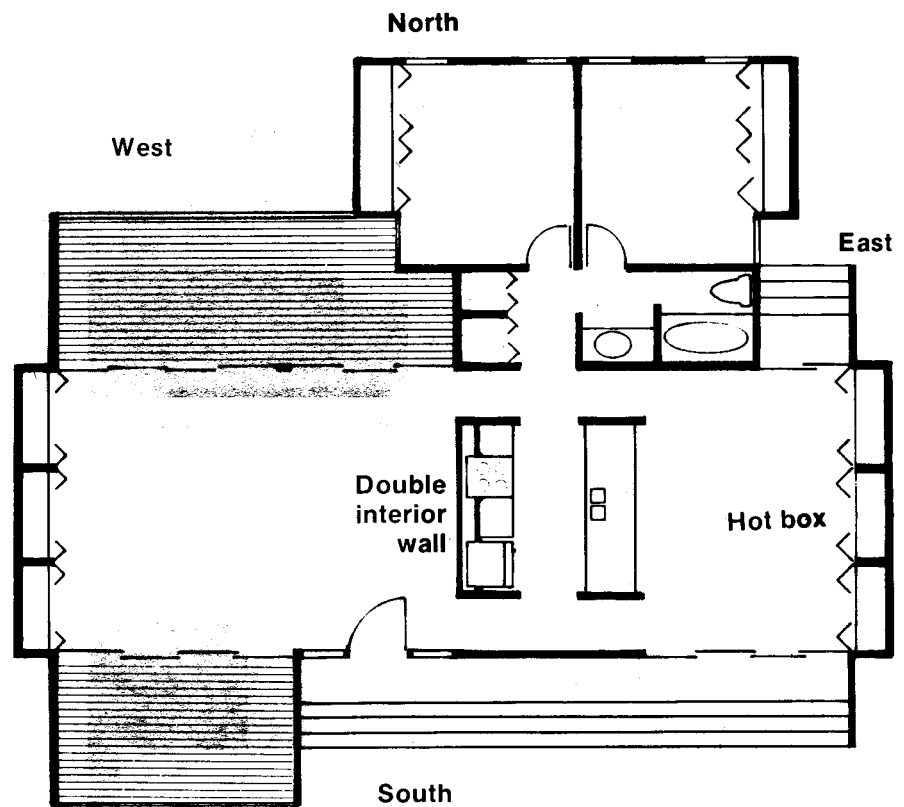
Although several heat gain prevention techniques were discussed earlier, there are others to be considered, for example, exterior surface color. Heat is absorbed by dark colors more readily than by light colors. Color of roofing material and exterior wall paint will affect heat gain dramatically. Obviously, light colors should be used in hot climates whenever possible.

Exterior awnings should be used on windows exposed to direct sunlight.

Vines and trellises also make good sunblocks and still allow air to flow through them. "Spectrally selective" window film will reflect more heat and transmit more light from the sun than any other type of window film. Window curtains with reflective linings are an alternative to permanent window film, and they can be left open during the winter season to allow for heat gain.

Layout of rooms and storage space which can be used as buffers in the home are important. Determine where family activity will be concentrated throughout the day, and plan living quarters accordingly. Bedrooms should be on the east end, away from the heat of the setting sun. Closets and little-used storage spaces can act as thermal buffers if placed on the east and west walls of the house.

Heat generated by large appliances such as stoves, refrigerators, washers, and dryers must also be dealt with. If possible they should be vented to the outside.

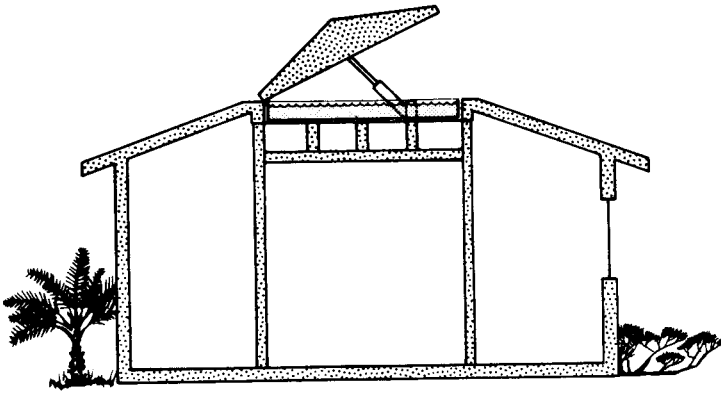


Closets or "hot boxes" serve as thermal buffers. Kitchen appliances in double wall space exhaust hot air to the outside, helping to maintain comfortable temperatures.

## Night sky cooling

Night sky (or radiant) cooling is a passive technique that can be effective. The roof structure is covered with heavy waterfilled plastic pools which are uncovered at night so that they can radiate to the night sky, drawing heat away from the ponds and subsequently the house. During the heat of the day, an insulated cover is drawn over the night-cooled ponds to protect them from the summer sun and enable them to absorb heat from the interior of the house.

Before considering this more expensive technique, one should make sure that the area's day-to-night temperature swing and humidity level will make it feasible.



**Roof pond will lose heat if exposed to a clear night sky. The night-cooled pond will then absorb heat from the house during the day.**

## Tradeoffs in passive design

A word of caution should be directed to the potential passive home builder or buyer. Internal comfort, created through the use of passive techniques such as high clerestory ceilings, and large window areas, can make a home particularly expensive to air condition mechanically. As a homeowner you may want to use combinations of passive techniques that will allow you to use mechanical air conditioning occasionally without heavy losses due to heat gain through windows or infiltration of outside air.

A middle ground, if you will occasionally be using air conditioners, can be achieved by dividing the home into two or more separately conditioned spaces. The living and dining areas of such a home can be totally passive, while bedrooms can be tightly constructed to accommodate efficient use of individual room air-conditioning units.

No matter what techniques or combination of techniques are used, the effect will be to greatly reduce the energy consumption and monthly electric bills in homes throughout the Southeast.

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