green
sustainable architecture and landscape design

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Design Tips

Keeping the house cool

1
The rationale for a naturally cool house

The reasons for keeping your house naturally cool are twofold: much as an un-insulated but heated house will never be as comfortable as a well-insulated moderately heated house, a house with poor design but a large air conditioning unit will not be as pleasant or healthy as one with low cooling loads and a small cooling system. So whilst comfort is one main factor, the other has to do with the capacity of our coal-fired power plants to deal with the summer spikes driven by the use of refrigerated air conditioning units. One source cites that for every $1000 of A/C unit purchased, the investment in infrastructure has to be $3000 to cope with the extra peak demand. Properly designed or retrofitted buildings could divide in half the summer demand of power for cooling.

Exposure to direct solar radiation and high ambient air temperature are the two relatively independent factors that can cause the mercury in a house to hike up.

Shading, ventilation and insulation are the passive tools used to address the issue, with the climatic zone dictating which of these tools is most relevant. Generally, drier climates with a high difference between summer day and night temperatures are the easiest ones to address while humid climates may be made more comfortable with passive measures without necessarily eliminating the need for active air conditioning altogether.

2
Design to reflect

Up to 90 per cent of the sun's radiant heat can be reflected out by using sarking placed directly under the roofing material, leaving an air gap of 25 mm minimum between the reflective sarking and the roofing. These reflective membranes are easy to install in both new work and retrofit situations – ensure the installers are qualified of course. Metal roofs are preferable over tiled roofs as they absorb less heat and come in light colours, some of them with a special coating designed for maximum reflectivity. Walls also play their part: masonry walls are particularly sensitive to radiant heat as they have a great capacity to absorb it, releasing it later to both the outside and the inside of the house. You will be amazed how much less heat a brick wall will absorb when painted white. I have indeed seen situations where a south-facing window was brightly lit from the reflection of a white wall sitting in the sun opposite!

Other ideas include installing perforated reflective sarking in the brick cavity where possible, growing a vine on the wall or planting a tree nearby – provided it is not placed on the north side of your windows or glazed doors. Last but not least, specify low emissivity glazing which features a transparent but heat-reflecting metallic coating. Ensure glass coated thus is installed only in east, west and possibly south windows: installing such glazing on the north side will prevent sufficient passive solar gains in winter which is too high a price to pay in the southern states. Double glazing is also effective in warm weather as it assists in keeping cool air from escaping.

3
Shade and insulate

The more light that enters a room the warmer it will be. Canvas blinds mounted on the outside or internal blinds made of a perforated reflective material both provide an effective radiant heat barrier to windows. It is my experience that even if the sun's rays do not penetrate a room in the midday hours in summer – thanks to well-designed eaves – the high amount of reflected light and heat from a sun-drenched environment can be enough to bring uncomfortable heat to a room. Shading of openings is therefore a useful strategy, and quite a critical one in a house with a concrete floor (thermal mass). Where a slab is shaded, it will stay cool and make a major contribution to keeping indoor temperatures down.

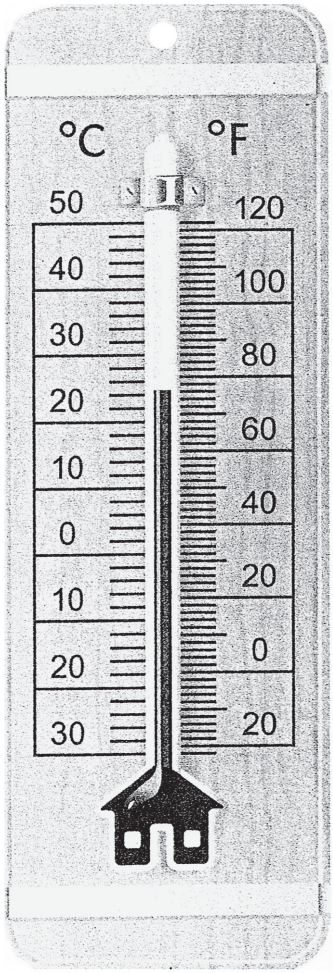
Vertical blinds are not so desirable for glazed doors of course, but the north-facing ones can be effectively shaded using a horizontal canvas blind on extendable arms. Doors facing any direction can otherwise benefit from reflective blinds if their mode of operation allows. Whenever a source of cool energy is present indoors in the form of thermal mass or air conditioning, it is best to ensure that the energy thus produced or stored will not be lost to the outside too quickly. Much as it does in a winter situation, weather stripping and bulk insulation in floors, walls and roofs come into their own in this case too, slowing down the rate of heat exchange between the inside and the outside.

4
Ventilate

While a modest energy-efficient ceiling fan is always appreciated, other forms of ventilation are equally important. In roof cavities, ventilation helps keep structural timbers dry in winter and will flush excess heat where present in summer. I find whirly birds are not efficient as they extract valuable warm air from the roof cavity when cold winds blow in winter, and can remain stale on a hot summer day when nothing is moving. A better idea is a passive roof valve teamed with some eave vents as it only acts on hot air rising, or a kinetic roof ventilator, which helps not only the roof cavity but also individual rooms with night-time heat purging. On this topic, most climates have a significant difference between day and night temperatures and it is essential for home owners to open windows at night to allow for flushing of excess heat before daybreak. Cross ventilation helps when a cooling breeze is present while stack ventilation is useful at all times: to this end ensure that your skylights and high windows are openable so they can flush the hot air layers sitting near the ceiling. This will call cooler air from below and cause air movement inside the room, demonstrating the cooling power of the so-called Venturi effect.

5
Active air conditioning

While evaporative air conditioning is useful only in drier climates, it is a lot healthier and more economical to run that refrigerated air conditioning if you don't mind the occasional humid day where it will not be serving you. In tropical climes, a refrigerated air conditioning system might be hard to avoid but there are ways to be thrifty with it even then. Keep cooling loads low by thinking through the house insulation, reflective properties and shading devices. And as not all units are created equal either in the energy-efficiency department, make sure you choose one with a SEER of 20+. SEER indicates the relative amount of energy needed to provide a specified cooling output. Of course, the energy used can be from renewable sources from your energy provider or from your own roof. A solid array of photovoltaic panels (5 kW +) will certainly help to further reduce the energy footprint of your A/C use.



6
Look further afield

Phase-change materials are an exciting development in housing, providing a blanket filled with vegetable oils that can absorb large amounts of heat. The product can easily be retrofitted to ceilings – placing them under bulk insulation – to add instant thermal mass and cooling effect. Solar cooling is still in the development stage at the CSIRO, but it is full of promise as the sun's energy is the greatest when the needs for cooling are too. A match made in heaven and solar hot water systems helping to make it possible. Last but not least, earth cooling is a system whereby outside air gets cooled in underground pipes and is pumped indoors. Although the idea is brilliant in southern states where the earth remains cool in summer, it is still in its experimental phase until we build the know-how to overcome the issues of air quality and condensation inherent in the processing of warm air.

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