Natural cooling for offices

By Sara da Costa Lopes, CEO Proma Estate

At the moment many countries are suffering under an extraordinary heatwave with which even air conditioning cannot always cope, and the issue of natural cooling is becoming increasingly pressing. We asked Sara da Costa Lopes, CEO at OOO Proma Estate, to share some natural cooling solutions that can be used in the offices buildings to make the heat more bearable for the residents.

The reduction of the greenhouse gas emission by the construction sector has resulted in the increase of interest for bioclimatic architecture. The latter focuses on meeting occupants' needs for thermal comfort at reduced levels of energy and resources consumption. In particular, it takes advantage of the climate conditions: natural heat in winter and natural cool in summer.

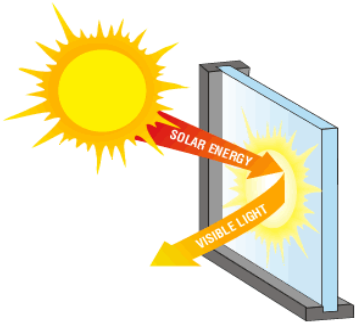
Speaking of the latter, consumers all over Western and developing countries demand more and more of it. Air conditioning became a minimum requirement for most office buildings, due to high internal loads.

Before air conditioning technologies appeared, several methods were used over thousands of years to cool the houses: breezes flowing through windows, water evaporating from springs and fountains, thick walls made of stone and earth absorbing daytime heat are just some of the numerous examples. Modern natural or passive cooling systems used to minimize loads on air conditioning systems use the same principles.

1. Heat gains control

Heat transfer through solar radiation deserves particular attention since it can result in very high temperatures and thus considerably decrease thermal comfort inside the buildings and productivity of the tenants. Solar radiation finds its way into the building predominantly through the windows and roof, but also through walls.

Efficient design of windows would mean that the windows are properly located and sized to allow sun and wind wherever and whenever needed. Solar radiation can be easily avoided by installing window films or special coating that reflects a significant amount of solar energy, while absorbing the rest of the energy. External solar shade systems are also efficient.



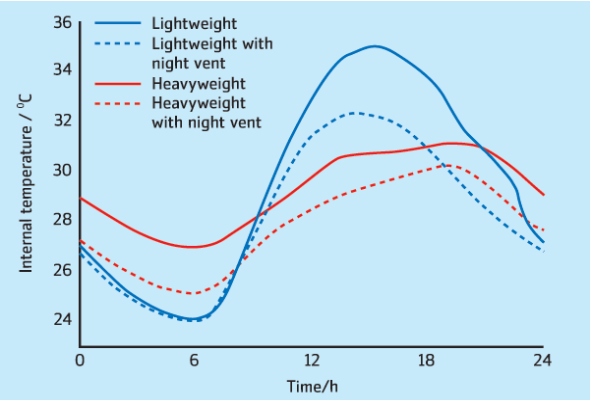
For roofs, which receive the majority of solar radiation, a proper roof treatment is essential. One of the most efficient solutions is vegetation ('green roofs'): evaporation from the plants will keep the roof cool. Incorporated vents and skylights in the roof also provide for effective ventilation.

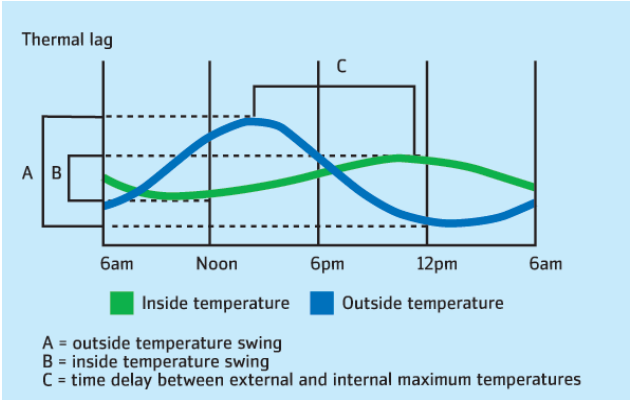
Finally, materials with high solar reflectance are ideal for external walls.

2. Strong thermal inertia of the building structure plus night ventilation

Heavyweight structures with strong inertia can store either heating or cooling energy. They also allow for smoothing internal temperatures in summer and winter, i.e. times of the year with the biggest temperature variations.

In case of light buildings, it is possible to increase thermal inertia by using **Phase Change Materials** (PCM). They contribute a lot to the prevention of overheating from solar radiation or from internal loads. Due to their strong storage capacities, they can be integrated as membranes either in the ceilings or floors. There are different types of PCMs: organic, inorganic, eutectics and hygroscopic materials.





In summer, with the support of strong night ventilation, thermal inertia is used as a "cooling reservoir": fresh air caught during the night will decrease the overall temperature of the building (through the

diffusion of this air inside the concrete structure). The time that it takes for the cool air to flow through the structure (approximately 100 mm in 4 hours) determines the thickness of walls and slabs.

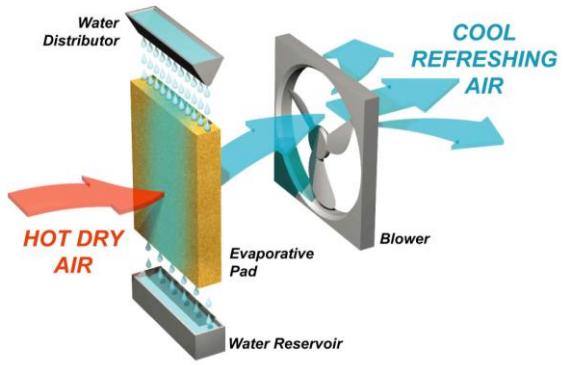
The performance of heavyweight thermal storage can be increased by allowing heating or cooling energy to be directly taken to the core of the slab using air (or water) systems. Enhanced concrete slabs provide a more extensive storage of energy that can be used to cool the building in a more controlled manner.

The slab that was cooled during the night by the air flowing through it acts as a radiant and convective panel to condition the room temperature. The thermal mass of the slab provides a time delay between the air passing through and the resulting room temperature.

Night ventilation is a low-energy strategy for cooling a building, providing a more comfortable environment for the occupants during hot daytime periods. It works by using natural or mechanical ventilation to cool the surfaces of the building fabric at night so that they can absorb heat during the day.

3. Evaporative cooling

In case of extreme temperatures and when internal loads are very high (in server rooms, for example), the design considerations described above may not be sufficient. One of the possible alternatives to air conditioning can be evaporative cooling.



When water evaporates, it absorbs a large amount of heat from its surroundings. The most familiar example of this is the cooling effect of evaporating perspiration on the human skin. Evaporative cooling (also called adiabatic cooling) consists in humidifying the air with water in order to decrease the indoor air temperature. Evaporative cooling is supplemented with mechanical means such as fans, which use substantially less energy than refrigeration systems.

Evaporation can result in very high humidity rates, which can be source of discomfort. That is why, instead of humidifying the supplied air, it is better to humidify the exhaust air, recover the cooling from it, and, through an exchanger transfer the recovered cooling to the supplied air.

To minimize environmental impact and CO2 emissions associated with operation of air-conditioning systems, renewable energy technologies are already being implemented and they will be further developed in the future.

Solar air conditioning and geothermal systems are the two efficient ways of utilising renewable energy instead of fossil fuels in order to meet the cooling demands of buildings.

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