COOLING INDOOR SPACES USING VENTILATION

HAZARD

HEAT

IMPLEMENTATION STEP

CONSTRUCTION

RENOVATION

BUILDING IN OPERATION

AREA OF ACTION

COOLING

COST

€ € €

low **medium** high

LEVEL OF SKILL

medium

At a time when users' indoor thermal comfort is under increasing threat from climate change, and in particular from rising temperatures and heat waves, ventilative cooling systems can be used to cool the interior spaces of buildings. These natural or mechanical systems help to renew the air, either passively or by consuming low levels of energy. They are based on the principle of "free cooling", which involves taking advantage of the difference in temperature between the (cooler) outside air and the inside air to bring down temperatures, particularly at night.

IMPACTS

Ventilative cooling helps to **maintain the thermal comfort** of building occupants with **zero or low energy consumption**. The use of ventilation also helps to improve air quality and protect buildings from moisture damage, thanks to a high air renewal rate. In fact, by controlling humidity inside the building, ventilation can help prevent moisture-related problems such as mould growth, deterioration of building materials and equipment, and health problems associated with damp indoor air.

However, to be fully effective, ventilative cooling systems must be **combined with a strategy to limit heat penetration** into the building using solar protection devices, effective insulation of opaque and glass walls, and high-albedo wall and roof coverings.

INSTALLATION GUIDE

There are three main methods of ventilative cooling:

- **Natural ventilation**: this involves cooling the building's interior spaces without the use of mechanical equipment and therefore without consuming energy (passive cooling system). In ascending order of efficiency, this ventilation can be unilateral (the air enters and exits from the same side), transversal (the air flow crosses the building), or vertical (the air enters at the level of the lower spaces and then rises to escape from the building at the top). The latter method can be used to develop innovative architectural practices, in particular by reproducing the way termite mounds and wind towers work.
- **Hybrid ventilation**: works in a similar way to natural ventilation, but with mechanical assistance at certain points to ensure minimum flow rates.
- **Mechanical ventilation**: this involves creating air movements using fans. Mechanical ventilation can be single flow, double flow, insufflation or distributed.

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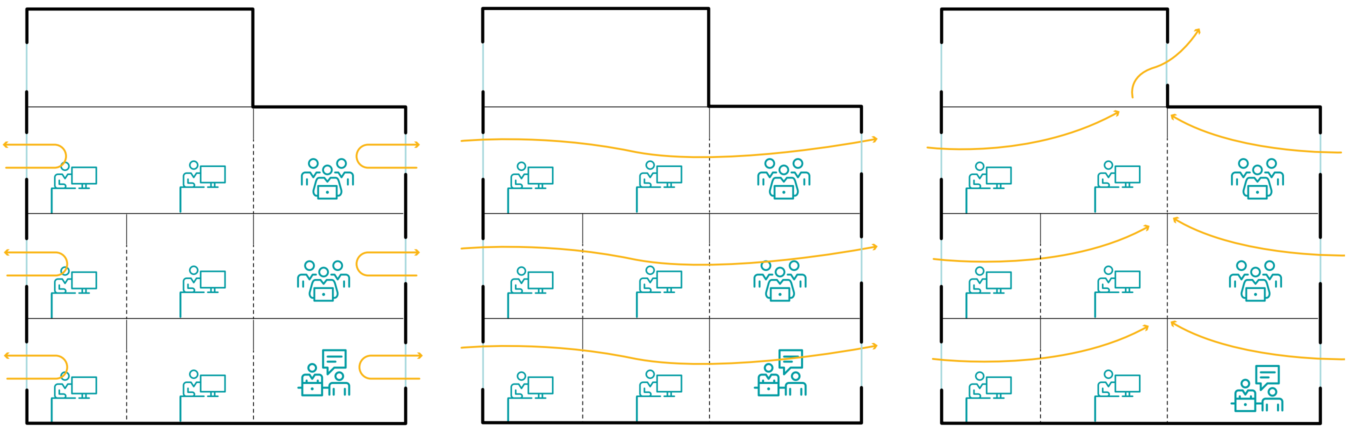
ILLUSTRATION OF THE THREE NATURAL VENTILATION SYSTEMS



Unilateral ventilation Transversal ventilation Vertical ventilation

WEAK POINTS AND STRONG POINTS

(+) Because it makes use of the outside and inside temperature differences, cooling by ventilation has **limited cooling potential between seasons and during the summer** (daytime). This strategy is therefore often **implemented at night**.

(−) Although it brings the biggest energy savings, natural ventilation is difficult to install in large existing buildings because it **requires a specific architectural layout**. In smaller buildings, you can take advantage of free cooling by simply opening a window or door at the beginning or end of the day.

(+) The installation of ventilation systems in commercial buildings must **comply with the requirements set out** in the applicable local health and work regulations related to workplaces.

MALADAPTATION

Maladaptation can result from the following:

Neglect of long-term investments to make buildings resilient

Installing ventilation systems as a quick and temporary cooling solution can encourage occupants and building managers to become complacent. However, it's important not to overlook the importance of more substantial investments aimed at structurally improving the building. These investments have the potential to deliver significant, lasting benefits in terms of thermal comfort and energy savings.

Loss of efficiency, and even inefficiency, in the face of rising temperatures

As outdoor temperatures rise due to climate change, ventilation cooling systems may become less effective at maintaining optimum thermal comfort. If this reduction in efficiency is not taken into account in planning, occupants could find themselves facing increasingly uncomfortable indoor conditions. Similarly, if ventilation systems are designed for the current climatic conditions, this could lead to inefficiency during periods of extreme heat, leaving occupants vulnerable to heat waves due to the system's inability to manage extreme temperatures.

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MONITORING INDICATORS

MONITOR MY ACTIONS FOR CLIMATE CHANGE ADAPTATION

+/- : Quantitative indicator ★ : Qualitative indicator

	INDICATORS OF RESULTS	INTERPRETATION
+/-	Comparison between night-time indoor temperature using a ventilative cooling system and that of a control situation* (°C)	Indoor temperature using a ventilative cooling system < control situation*
+/-	Comparison between daytime indoor temperature using a ventilative cooling system and that of a control situation* (°C)	Improved thermal comfort
+/-	Comparison between energy consumption using a ventilative cooling system and that of a control situation* (kWh)	Energy consumption using ventilative cooling system < control situation*
+/-	Percentage of cooling requirements covered by ventilative cooling system (%)	To be maximised
+/-	Air change rate	To be maximised

**The control situation is defined by the parameters set to isolate the influence of the adaptive action (similar conditions: weather, time of measurement, space, etc.).*

TOOL

- The Caisse d'Assurance Retraite et de la Santé au Travail Sud-Est and Languedoc-Roussillon (a regional Social Security and Occupational Health Fund) have developed a simulator of changes in carbon dioxide (CO_2) concentration in enclosed spaces. To implement the simulator, you need to use a CO_2 sensor to measure the quantity of CO_2 inside and outside the building, which serve as reference values. The simulator makes it easier to assess the concentration of carbon dioxide (CO_2) so that you can work out **the correct ventilation of an enclosed workspace** according to the characteristics of the room, the volume of fresh air induced by mechanical ventilation, and the real-life occupancy. The simulator can be used to **identify the air renewal rate** and thus modify the characteristics or balancing of the ventilation systems.

FIND OUT MORE

Génie Climatique Magazine (2018), La ventilation naturelle double-flux fait ses preuves dans une école maternelle

Agence Régionale de l'Environnement et des Nouvelles Energies (ARENE) Île-de-France, Institut pour la Conception Écorespon-sable du Bâti (ICEB) (2014), Les guides bio-tech - ventilation naturelle et mécanique

Guide bâtiment durable Brussels (2016), Free-cooling

OID (2022), L'architecture bioclimatique et les contructions traditionnelles

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