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Ventilative Cooling and Summer Comfort: The FREEVENT project

ALLIE'AIR Etudes et Diagnostics Aérauliques & Acoustiques
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FREEVENT SURVENTILATION ET CONFORT D'ÉTÉ GUIDE DE CONCEPTION I MARS 2018
venticool the international platform for ventilative cooling

Contents

Programme (Brussels time)

10:30	**INTRODUCTION:** Peter Wouters, INIVE, Belgium	11:20	**Questions and answers**
10:40	**ASSESSMENT OF THERMAL AND COMFORT PERFORMANCE** Andres Litvak, Apebat, France	11:30	**GUIDELINES TO ACHIEVE AN EFFECTIVE VENTILATIVE COOLING** Nicolas Piot, EGE, France
10:55	**Questions and answers**	11:45	**Questions and answers**
11:05	**ON SITE MEASUREMENTS AND FEEDBACK** Anne Marie Bernard, Allie'Air, France	12:00	**End of the webinar**

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Ventilative Cooling major issues

- Heat wave periods are more and more frequent. The associated increase of mortality is a real issue in terms of public health
- Non air-conditionned new or refurbished buildings show summer overheating issues (loads containment)
- Energy Transition, bioclimatic architecture and passive house buildings : how to guaranty summer comfort without air-conditionning

FREEVENT Guide : published and online

Downloadable on Construction21.fr :

https://www.construction21.org/france/community/pg/groups/19939/

since April 2018

Ventilative Cooling Performance

- Thermal Energy Evacuation

Evening 18:00

28°C

Thermal energy evacuation :

Morning 8:00

26°C

22°C

18°C

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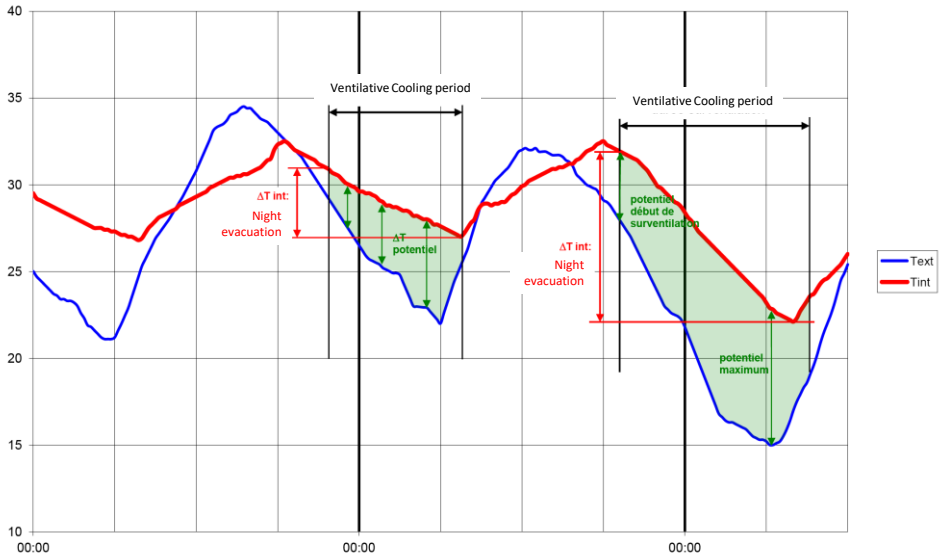
Thermal Potential and Evacuation



Energy Performance

- EER : Energy Efficiency Ratio

EER = kWh cooling / kWh electric

- Natural Ventilation

kWh élec ~ 0

EER = ∞

- Mechanical Ventilation

EER usually between 4 and 10

The EER optimization depends on evacuation potential. A performant EER doesn't mean necessarily an efficient ventilative cooling.

OPTIMIZATION OF THERMAL PERFORMANCE AND COMFORT

- To characterize the ventilative cooling performance : evacuation and EER
- Accounting for all the comfort issues related to ventilatve cooling :
  - Temperature (over-heating, too cold in the morning)
  - Acoustics (inside, outside)
  - Air velocity
- Bioclimatic Architecture and Ventilative cooling

Thermal Comfort

- Definition of discomfort threshold
  - According to activity, clothing, adaptative comfort. Generally between 27 and 28°C.
  - Acceptable number of hours beyond the discomfort threshold
  - Caution for discomfort in the morning
  - Caution for residual air velocities, if ventilation occurs during building occupancy hours

Acoustics Comfort

- Premises occupied during ventilative cooling period:
  - Natural ventilation: noise exposure zone, as regarding to doorway openings
  - Mechanical ventilation: equipment noise, air velocity
- Unoccupied premises during ventilative cooling period:
  - Mechanical ventilation: equipment noise towards neighbours
- In all cases: install interphone systems if transfer grille are necessary to mantain adecuate airflow pathways through the whole premises

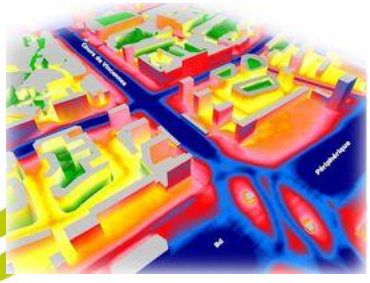
Indoor Air Quality

- Ventilative Cooling impacts IAQ, through increased air change rates
  - Positive impact in the majority of cases in non polluted environments (increased dilution of indoor pollutants)
  - Caution for preventing outdoor pollutants penetration from outside (industrial zone, road traffic routier, airport, etc…). The necessity of filtration enforces mechanical ventilation equipments and has an impact on EER.

Available Public Ressources

- Noise exposure

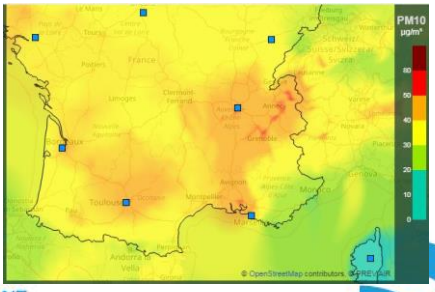
Maps provided by local authoritues



- Air Quality

In France, maps provided by Prevair.org
- **PM_{10}**
- **$PM_{2.5}$**
- **NO_2**
- **O_3**

Example of 24/02/2018



Bioclimatic Architecture

- The challenge of ventilative cooling :
  - Unload in a brief summer sparsely cold night all the accumulated heat during a hot long day, then preserve coolness as long as possible.
- Action-levers:
  - Solar shadings
  - Thermal inertia and insulation,
  - Height of premises (stack effect) and warm air stratification
  - Limitation of internal loads

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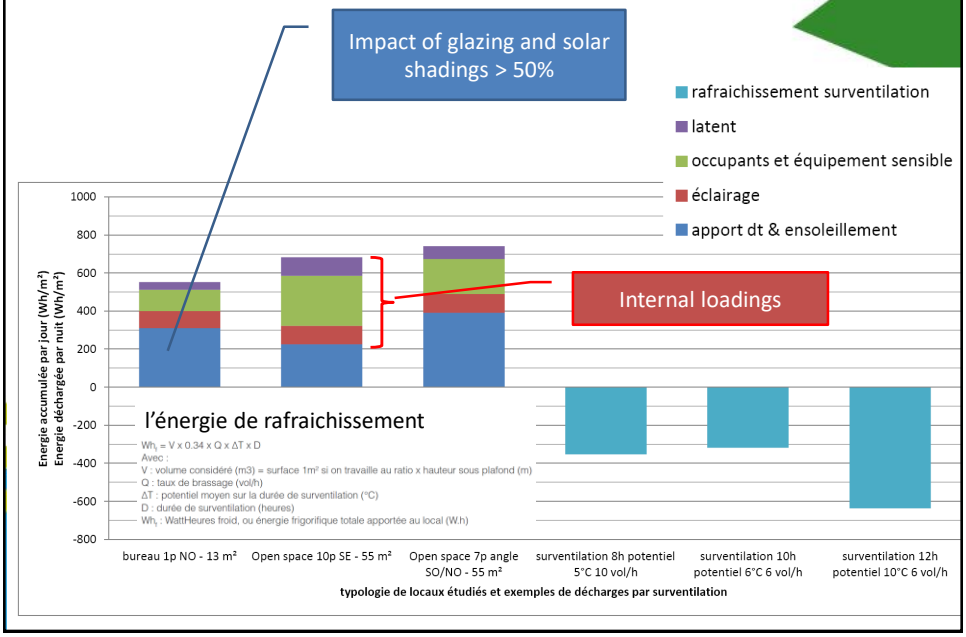
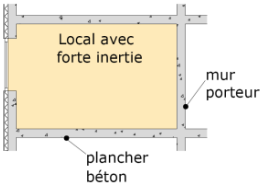
Energy Approach



Thermal Inertia / Insulation

- Thermal shift and damping

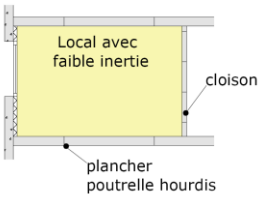
Heavy walls
(internal insulation)



Inside Peak Temperature
at 22:00 = 29 °C
Damping = 4 °C
Shift = 6h
T° at 2:00 am = 25°C

Outside Peak
Temperature =
33 °C at 16:00

Light walls
(internal insulation)



Inside Peak Temperature
at 18:00 = 32 °C
Damping = 1°C
Shift = 2h
T° at 2:00 am = 23°C

<u>In all cases</u> : external envelop with high inertia

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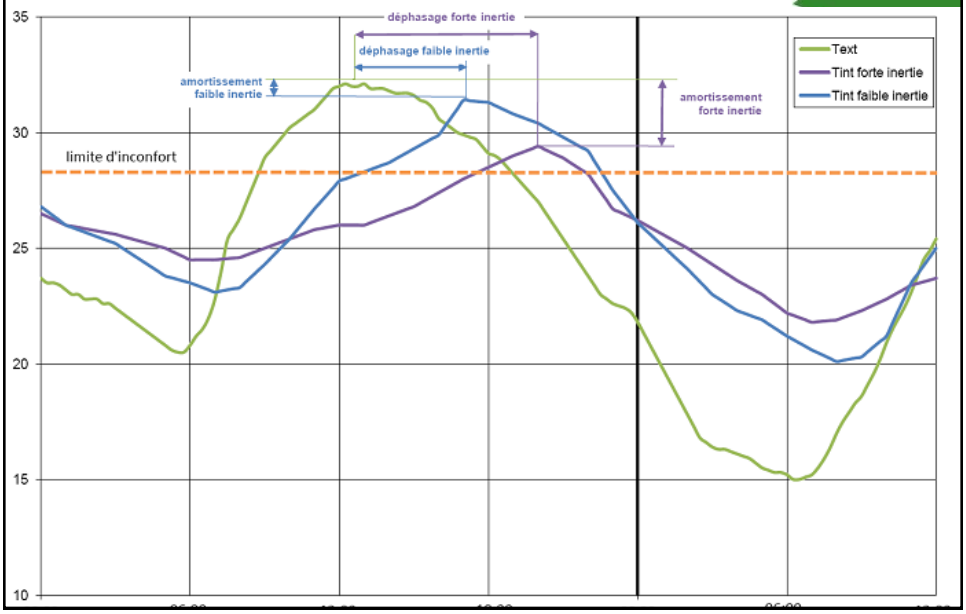
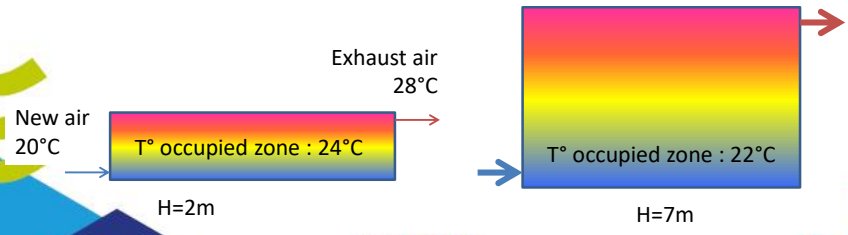
3. Building Analysis

Thermal Inertia



Stack Effect Height

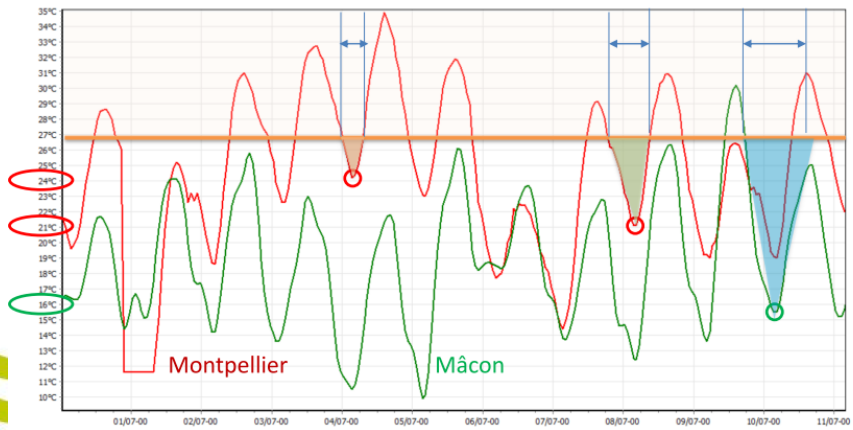
- Tall height promotes:
  - Stack effect for natural ventilation
  - Warm air stratification, then comfort in occupied zones in all cases



Ventilative Cooling Air Flowrates

- The air flowrate depends mainly on the cooling potential of the site.
- Modelling on identical buildings in Mâcon and Montpellier show better results of 1 ACH in Mâcon, and 4 ACH in Montpellier.
- Usually, one should **aim at 2 to 6 ACH**

Comparison of outside T°



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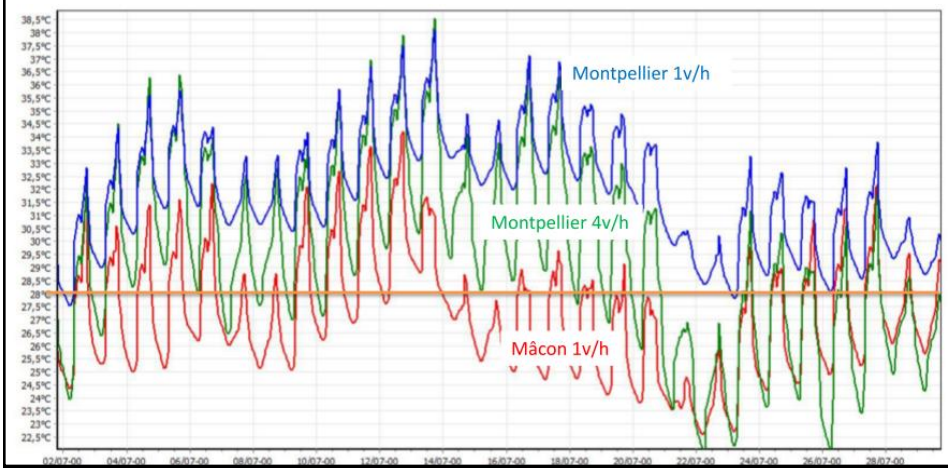
ORDERS OF MAGNITUDE

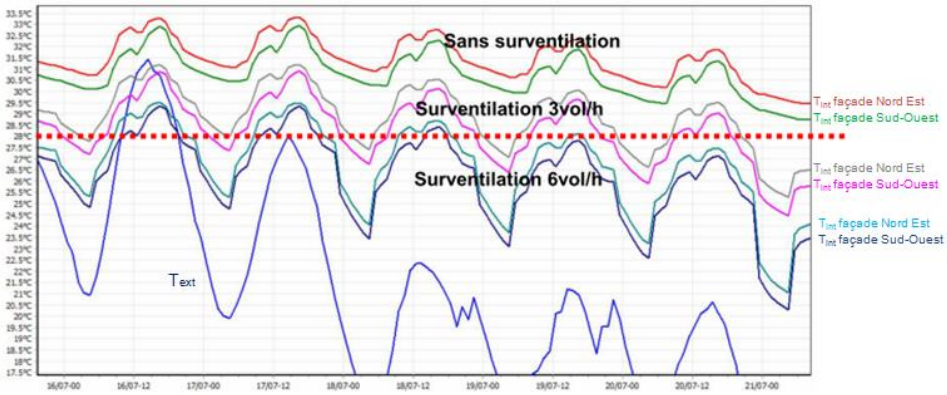
Ventilation air flowrates

Comparison of 2 sites :
better results in Mâcon (1 vol/h) than in Montpellier (4 vol/h) !



Ventilation air flowrates

Assessing ACH in an office building in Toulouse Détermination du taux de brassage sur un bâtiment tertiaire à Toulouse



Regular Hygienic Ventilation (**0,3 à 0,5 vol/h**) : **722 h** average discomfort hour/year
Ventilative Cooling **3 vol/h** : **266 h** average discomfort hour/year
Ventilative Cooling **6 vol/h** : **83 h** average discomfort hour/year

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KEY POINTS FOR SUCCESS

- Upstream bioclimatic design :
  - Ventilative cooling will not compensate a poor design of internal and external loadings.
- Adapted dimensionning that accounts for all comfort criterias
- Involvement of owners / maintener and occupants in the first years for fine-tuning operation.

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Questions ?

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