Ventilative cooling experiences by Renson: lessons learned and solutions

Ivan Pollet - Renson Ventilation*
Healthy Concepts: for residential and non-residential applications

3 systems:
- Demand controlled hygienic ventilation (DCV)
- External solar protection
- Intensive nightcooling

Several sectors:
- Dwellings and apartments
- Health Care
- Schools
- Offices ...

- Indoor air quality
- Acoustic comfort
- Thermal summer comfort
- Visual comfort
1. Process of applying ventilative cooling
2. Ventilative cooling in practice
Process of applying ventilative cooling

- Specifications
- Design
- System/installation
- Commissioning
- Maintenance

Legislation and standards on European, national, regional and community level
Process of applying ventilative cooling

**European EPB-directive**

- Not explicitly mentioned to consider into the calculation methodology (annex I)
  - not or slowly taken up by countries
  - no benefits on paper / EP-certificate
  - not or little applied

= great barrier

Legislation and standards on European, national, regional and community level
Impact of EPBD on the market: DCV

EPBD: impact of demand controlled residential ventilation in different countries

- The Netherlands - CO2-control
- France - Aldes hygro B (F3)
- Germany - Fixed small effect
- UK - not considered
- Belgium - Renson C+evo II
- Belgium - Duco - Ducotronic

Percentage of constant air flow rate (%)

Significant effect = Great market

No or small effect = No or small market
Impact of EPBD on the market: DCV

EPBD: impact of demand controlled residential ventilation in different countries

= unfair competition?

Important issue for European commission, but not in relation to the EPBD ... ?

Belgium - Renson C+evo II
Belgium - Duco - Ducotronic

Percentage of constant air flow rate (%)
Process of applying ventilative cooling

Fire/smoke regulation

• Fire compartment of a building
  = fire resistant air transfer devices
  = barrier

• Smoke evacuation used as ventilative cooling
  = opportunity

Legislation and standards on European, national, regional and community level
Process of applying ventilative cooling

Specifications

- Operable windows often required
  = opportunity
- Protection/securing of openings
- Maximum indoor temperature < 25°C
  ⇒ no guarantee if only ventilative cooling
  = barrier (→ EN15251)

Legislation and standards on European, national, regional and community level
Process of applying ventilative cooling

**Design**

Lack of simple design rules within standards

- cooling capacity \( \approx 5 \text{ W/m}^2/\text{air exchange rate} \)
- ventilation principles \( \approx \) single sided, cross, ...
- pressure difference across façade opening \( \approx 1 \rightarrow 2 \rightarrow 5 \text{ Pa} \)

= barrier

Legislation and standards on European, national, regional and community level
Process of applying ventilative cooling

**Design**

Lack of simple design rules within standards

- protection/securing of openings: $K$ of $\xi$-factor
- mechanical ventilation:
  - maximum air speed in ducts?
  - maximum SFP (W/m³/s)?

**COP** = \[
\frac{\text{cooling power}}{\text{fan power}} = \frac{1200 \Delta T \text{ (in–out)}}{\text{SFP}}
\]
Mechanical ventilative cooling

COP of mechanical ventilative cooling

- 500 W/m³/s
- 750 W/m³/s
- 1000 W/m³/s
- 1500 W/m³/s
- 2000 W/m³/s

Mean temperature difference indoor - outdoor (°C)

Working area of standard airco
Process of applying ventilative cooling

**System/installation**

- Simplicity ↔ automation
- Integration: - nightcooling / solar shading
  - hygienic and intensive ventilation
  - within the façade elements
- Acoustic insulated openings
- Mechanical support on exhaust

Legislation and standards on European, national, regional and community level
Process of applying ventilative cooling

**Commissioning and maintenance**

- “Guarantee on correct performance”
- The more automated (sensors, actuators, fan), the more necessary
- A real “as-built” dossier and not “should built”
- An internal responsible

Legislation and standards on European, national, regional and community level
Process of applying ventilative cooling

Commissioning and maintenance

- **Soft Landings** means designers and constructors staying involved with buildings beyond practical completion. This will assist the client during the first months of operation and beyond, to help fine-tune and de-bug the systems, and ensure the occupiers understand how to control and best use their buildings.

Legislation and standards on European, national, regional and community level
Ventilative cooling in practice

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Renson offices (Waregem – Belgium, 2002)

- Passive stack nightcooling
- Average air exchange rate: 6 h⁻¹
- Free area of air supply: 2% of floor area
- Occupancy: 12 m²/person
- Controlled by BMS
- Combined with external adjustable solar shading and exposed ceiling as thermal mass
- Summer of 2006: 76 nights in operation (20%)
Renson offices (Waregem – Belgium, 2002)

- Number of occupants more than doubled
- Number/power of computer/screens strongly increased
Renson showroom (Waregem – Belgium, 2013)

- Located **under the offices**
- **Vertical screens** as solar protection
- **Hybrid nightcooling system**: natural cross ventilation, supported by mechanical exhaust (5 h⁻¹)
- **Floor cooling** on reversible heat pump ~ 30 W/m²
Renson showroom (Waregem – Belgium, 2013)

Natural cross ventilation

Half open ceiling

Optional: Mechanical extract

Solar protection

Solid Floor
Renson showroom (Waregem – Belgium, 2013)

- **Natural air supply – exhaust:**
  - acoustic insulating automated window vents at the top of the windows (also used for hygienic ventilation)
  - automated windows integrated in the plenum above the entrance doors
Renson showroom (Waregem – Belgium, 2013)

- Half open ceiling covered by acoustic absorption profiles
  - thermal mass available
  - acoustic absorption
  - integration of lightings, loudspeakers, ducts, ...
• Mechanical exhaust if needed
• SFP = 800 W/m³/s
BBL office (Brussels – Belgium, 2012)

- Renovation and extension of an office – 4 floors
- Nightcooling with mechanical extract – 6 h⁻¹
- Half open ceiling
BBL office (Brussels – Belgium, 2012)

- Facade openings – manually operated
- Protected/secured by sliding solar protection louvres

⇒ multifunctionality: window protection
Green office (Paris – France, 2011)

• Positive energy building – 23,300 m² over 6 floors:
  o Total energy consumption: 62 kWh/m²/year
  o Total produced energy: 64 kWh/m²/year
    o Photovoltaic: 4200 m²
    o Cogeneration (CHP) on bio-diesel
Green office (Paris – France, 2011)

- **Solar protection:** sliding louvres - screens
  - Solar heat control
  - Daylight control
  - Protection/security of openings for nightcooling
- **Concrete slabs** as thermal mass
- **Ceiling fans** to increase summer comfort
Tour Elithis (Dijon – France, 2009)

- **Positive-energy building – 5.000 m² over 10 floors:**
  - Total energy consumption: ~100 kWh/m²/year
  - Total energy production:
    - Photovoltaic: 40 kWh/m²/year (560 m²)
    - Boiler on wood granulates
  - External solar shading shield
Tour Elithis (Dijon – France, 2009)

Motorized air supply by means of vents

- **Ventilative cooling** with natural supply (acoustic vents) and low pressure mechanical exhaust ventilation from atrium during **daytime** (T > 10 °C) or **nighttime** (3 h⁻¹)

- **Occupancy**: 15 m²/person

- Adiabatic + compressor **cooling** ~ 7 kWh/m²/year

- **Lighting**: 2 W/m² + occupancy and daylight control
Renson Healthbox II (residential sector)

Demand controlled mechanical extract ventilation (MEV)

Control valves
Air flow rate of each room (living and/or functional rooms) controlled on internal and external air temperature

- Cooling rate is automatically increased during hot periods with lower outdoor air temperature

Burglary resistant louvre WK2 before operable window
Thanks for your attention