Controlled windows for ventilative cooling
Best practice examples of residential ventilative cooling
AIVC & Venticool webinar on June 1, 2021
Peter Foldbjerg, VELUX A/S

THE VELUX VISION

To lead the development of better living environments with daylight and fresh air through the roof, and to be rated as the best in the eyes of our customers.
Our products are developed to improve indoor environments by taking full advantage of natural light and fresh air.

THE MODEL HOME 2020 PROGRAMME

Six buildings to explore if it is possible to build healthy and sustainable buildings for the future – today. 2009-2016
POST-OCCUPANCY EVALUATIONS AND MONITORING

Continuous hourly measurements in each room:
- Temperatures
- lux
- Humidity
- CO₂-level
- Energy production and consumption
- Position of windows and solar shading

Post Occupancy Evaluations by anthropologists

KEY RESULTS FROM MODEL HOME 2020

- Having many large windows doesn’t necessarily lead to overheating
- Plenty of daylight eliminates your need for artificial lighting during the day
- Moderate bedroom temperatures ensure a good night’s sleep
- Good ventilation lowers the temperature during the night
- Solar screening protects your home from overheating
- To get the full effect, you need intelligent automation
- Natural ventilation provides good indoor air quality during large parts of the year
- Mechanical ventilation in combination with natural ventilation enables automated switch between modes
- Good air quality in the bedroom can require targeted measures
- Kindergartens and schools benefit from scheduled, natural ventilation
MODEL HOME 2020: MAISON AIR ET LUMIÈRE

It was possible to keep the indoor temperature below the outdoor temperature during daytime.

Indoor temperature was typically 5-8°C lower than without ventilative cooling.

Control of windows by a WindowMaster control system, for overheating control parameters are indoor temperature and solar radiation.

During the summer heat wave the outside temperature reached 32 °C, but inside we had a bearable temperature of 26 °C thanks to the awnings.

At night the house quickly cooled down when windows at ground floor level and roof windows were opened to create a flow of cool night air through the house.
HIGH AIR FLOWS WITH VENTILATIVE COOLING CAN BE MEASURED AND CALCULATED

- Good correspondence between measured and simulated air change rate in main room in summer
- Air change rates between 10 and 23 ACH

<table>
<thead>
<tr>
<th></th>
<th>Wind speed m/s</th>
<th>Tracer Gas ACH</th>
<th>Simulated CONTAM ACH</th>
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<tbody>
<tr>
<td>Morning</td>
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<tr>
<td>Closed door</td>
<td>3.6</td>
<td>13.4</td>
<td>13.9*</td>
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<tr>
<td>Open door</td>
<td>2.8</td>
<td>22.5</td>
<td>20.6</td>
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<tr>
<td>Afternoon</td>
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<tr>
<td>Closed door</td>
<td>2.3</td>
<td>13.2</td>
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</tr>
<tr>
<td>Open door</td>
<td>2.3</td>
<td>19.8</td>
<td>19.5</td>
</tr>
</tbody>
</table>

Max 30% difference per case, 10% difference in average

MEASUREMENTS PERFORMED ON A SUMMER DAY IN MAISON AIR ET LUMIERE BY ARMINES IN FRANCE IN COOPERATION WITH VELUX

HIGH DAYLIGHT LEVELS WITHOUT OVERHEATING

Daylight factor in all main rooms: 5% average
Almost all main rooms achieve EN 16798-1 category 1 for summer comfort

Maison Aire et Lumiere, Paris, France
Each hour is categorised according to the measured temperature, following the Active House Specification (corresponds to EN 16798-1)
FREQUENT USE OF VENTILATIVE COOLING

Category refers to Active House / EN 16798-1 category
“Open window” if one or more windows are open in the room

SOLAR SHADING USED FREQUENTLY

Category refers to Active House / EN 16798-1 category
“Open window” if one or more windows are open in the room
AUTOMATION IS IMPORTANT

Automated solar shading and window openings were used frequently during work-hours on weekdays, and during the night

.. e.g. at times when the families cannot be expected to be able to operate the products themselves

The indoor climate could not have been achieved with only manual products.
RenovActive
Replicable and affordable renovation of run-down social housing in Bruxelles

Photo: Adam Mørk
01/06/2021
A HEALTHY AND AFFORDABLE RENOVATION CONCEPT

RenovActive - the 7 elements

- Growing from within
- Daylight treatment
- Respiratory channel
- 3rd skin
- Hybrid breathing
- Envelope upgrade
- New life space

Challenge: Overheating RenovActive elements

- 3rd skin
  - Use sun screening to prevent the building from getting too hot.
  - Equip windows with automated sun screening.
- Envelope upgrade
  - For better thermal comfort, keep your home cool in summer.
  - Some glasses can protect you from sun gains.
  - Ensure you have well insulated windows, walls and roof so you keep the heat outside.
- Hybrid breathing
  - In summer, prioritise natural ventilation. In winter, combine natural and mechanical ventilation.
  - Use automated cross-ventilation and stack effect to increase ventilation rates.
- Respiratory channel
  - Use automated ventilative cooling to cool the building when too hot.
  - To do so efficiently, you may want to place the staircase in the center of your home, with 1 or 2 roof windows over it.
Ventilation system in RenovActive (Renson HealthBox):
- Ventilation system C (extract ventilation)
- Natural supply vents above the windows
- Extraction by fan
- Automatically controlled window openings.

The switch between hygienic and peak ventilation is controlled based on indoor air quality and in order to prevent overheating.

Where possible, the façade windows were sectioned with a 20 cm motorized window at top for natural ventilation without impact on privacy or risk of burglary.
Renson Hybrid ventilation system + control of window opening

Renson Healthbox

- Cold outside - warm inside (overheating): Windows open to cool down the house
- Warm outside - warm inside (overheating): Windows open to cool down the house
- Warm outside - warm inside (no overheating): Windows open to cool down the house
- Warm outside - cold inside: Windows open to let in the warm outside air

**Temperature in the living room**

- Winter 1 ventilation by:
  - pivoting windows
  - fan extraction
- Winter 2 ventilation by:
  - natural supply vents
  - fan extraction

**BUILDING MONITORING - QUANTITATIVE DATA**

Min ΔT for vent cooling
Min ΔT for vent heating
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Thank you!

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Photo: Adam Mørk

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