Application of louvres to support ventilative cooling

9 December 2020, Webinar – Resilient Ventilative Cooling in practice

About Renson

Belgian family business

- 111 years
- Headquarters in Waregem
- Team of 1200 enthusiastic men & women
- 224 Mio € turnover
- Core business: ventilation, sunprotection & outdoor
**Products**

- **VENTILATION**
- **SUNPROTECTION**
- **OUTDOOR**

**Louvres**

- **Louvres: characteristics, testing and regulation**

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**Louvres: simplicity + multi-functionality**

**Simplicity**
- Number of horizontal or vertical fixed or adjustable blades (alu/wood)

**Multi-functionality**
- Ventilative cooling (renewable)
- Solar shading
- Insect-proof
- Rain-tightness
- Persons from outdoors (burglary) or indoors (fall-through)
- Fire/smoke control
- Noise insulation
- Outdoor pollution control (?)
- Opportunities for creativity, integration, accents, ...

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**Louvres: flow resistance ↑ + usage of VC potential ↑**

**Resistance**
- Reduction of air flow rate
  - ~ 50%

**Guarantee on higher usage time**
- Fully openable windows (90°) instead of tilted (10%)
- More operated during night and absence
  - ~ higher utilization factor

On average, net effect of louvres on air exchange rate is mostly limited

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Ventilative cooling: quick design, rules of thumb

- Available natural pressure difference: \( \Delta p \sim 1 \text{ to } 2 \text{ Pa} \)
- Required air exchange rate: \( q_v = 4 \text{ to } 8 \text{ volumes/h} \)
- Air flow rate through opening:
  \[ q_v = \frac{\Delta p}{\sqrt{0.4 \kappa}} \]
  \( ~5 \text{ W/m}^2/\text{air exchange rate} \)
- Cooling capacity:
- Temperature reduction during night in case of at least 10°C \( \Delta T \) between max indoor T and min. outdoor T:
  \( \sim 0.75 \text{ to } 1 \text{ °C/(vol/h)} \)

Testing and optimization of louvres performance

Aerodynamic and rain tightness characteristics (EN13030)

Water tightness and air flow rate

<table>
<thead>
<tr>
<th>Class</th>
<th>Effectiveness</th>
<th>Maximum allowed penetration of simulated rain</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 to 0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>B</td>
<td>0.25 to 0.6</td>
<td>1.5</td>
</tr>
<tr>
<td>C</td>
<td>0.6 to 3.0</td>
<td>10.0</td>
</tr>
<tr>
<td>D</td>
<td>3 to 15.0</td>
<td>Greater than 15.0</td>
</tr>
</tbody>
</table>

Water flow rate:

\( q_r = C_r A \sqrt{\frac{\Delta p}{\rho}} \)
Testing and optimization of louvres performance

Aerodynamic and rain tightness characteristics (EN13030)

\[ q_c = C_d A \sqrt{\frac{2 \Delta p}{\rho}} \]

Optimization based on CFD: air flow resistance ↓ and/or water tightness ↑
Testing and optimization of louvres performance

Burglary resistance of window openings (~ building assurances)

- 7 Mechanical strength
- 7.1 Static loading
- 7.2 Dynamic loading in resistance classes 1, 2 and 3
- 8 Manual burglary attempts

When tested in accordance with EN 13049, using the test sets and times specified in Table 6, the test specimens shall not fall at the result of the test. For construction products of resistance class 1 no manual test will be carried out. The test set A1 is intended for preparation of the test specimen.

<table>
<thead>
<tr>
<th>Resistance class</th>
<th>Tool set (see prEN 1630:2009, Clause 7)</th>
<th>Resistance time min</th>
<th>Maximum total test time min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>A2</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>A3</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>A4</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>A5</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>A6</td>
<td>20</td>
<td>50</td>
</tr>
</tbody>
</table>

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Testing and optimization of louvres performance

Barrier load testing / Fall prevention safety (EN13049)
### Integration of VC louvres within EPBD regulation

**Impact of VC on overheating risk and PE consumption depending on:**

<table>
<thead>
<tr>
<th>Belgium (residential)</th>
<th>The Netherlands (all buildings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Physical free area of VC openings (≥ 6.4% of room net floor area)</td>
<td>• Physical free area of VC openings</td>
</tr>
<tr>
<td>• Accessibility/burglary resistance (location, max opening, resistance class ≥ 2)</td>
<td>• Accessibility/burglarity resistance (location, max opening, resistance class ≥ 2)</td>
</tr>
<tr>
<td>• Control possibilities</td>
<td>• Control possibilities</td>
</tr>
<tr>
<td></td>
<td>• Insect-proof requirement</td>
</tr>
<tr>
<td></td>
<td>• Rain tightness requirement (louver, sensor)</td>
</tr>
</tbody>
</table>

Red zones = burglary risk

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### Louvres applications in-situ
Schools (Gent, Belgium)

Passive cooling measures, no active cooling, small or no occupation in summer

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Schools (Gent, Belgium)

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**Student homes** (Bournemouth University, Southern England)

**Burglary resistance, fall prevention safety, daylight**

Different shapes and colors > attractive façade

**Continuous louvre systems as façade cladding**

Integrated architectural design with shapes and colours
Continuous louvre systems as façade cladding

International Lyceum > Luxembourg

Private houses (Belgium)

Vertical blades, integration in façade/LED-lighting

Privacy ↔ daylight
Concept home of Renson (Waregem, Belgium)

**Vertical blades, integration in façade**

Bay window

**Privacy ↔ daylight**

![Concept home of Renson](image)

Louvre: movable/adjustable versus fixed

**Movable/sliding louvre panels**

Green office (Paris – France, 2011)

**Adjustable/orientable blades**

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Apartments (Weinfelden, Switzerland)

Personalization

Connected smart systems > servitization

Services
Data analysis
Connectivity
Actuators/sensors

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Combination of ventilative cooling and solar shading

Screens and awning

Integrated screens

Screens on roof windows

Renson offices/showroom (Waregem, Belgium, 2002)

Designed 20 years ago as an example of bioclimatic architecture, and still contemporary
Renson offices (Waregem – Belgium, 2002)

- **PSV**
  - $n_{\text{design}}$: 6 h$^{-1}$
  - $A_{\text{VC}} \sim 2\%$ of floor area
- Controlled by BMS
- Combined with external SS + exposed thermal mass
- $>26^\circ\text{C}$: 5 to 8% of office hours (high occupation and climate change)
  - $>28^\circ\text{C}$: $<1\%$ of office hours

Renson offices > Belgium
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Louvres…
where simplicity meets multi-functionality

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