Application of louvres to support ventilative cooling

June 1st, 2021, Webinar – Resilient Ventilative Cooling in practice

About Renson

Belgian family business

- 112 years
- Headquarters in Waregem
- Team of 1200 enthusiastic men & women
- Core business: ventilation, sunprotection & outdoor
Ventilation – Sun protection - Outdoor

Products: background ventilation versus ventilative cooling

Continuous louvre systems as façade cladding or ventilative cooling

Integrated architectural design with shapes and colours
Connection of products towards smart buildings > servitization

+ ventilative cooling mode

Louvres: characteristics, testing and regulation?
Louvres: multi-functionality combined within simplicity

**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, ...

*How to characterize?*

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**Testing and optimization of louvres performance**

**Aerodynamic and rain tightness characteristics (EN13030)**

**Water tightness and air flow rate**

*Table 1 — Penetration classes*

<table>
<thead>
<tr>
<th>Class</th>
<th>Effectiveness $\varepsilon$</th>
<th>Maximum allowed penetration of simulated rain $q_w$ in $l/m^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 to 0.99</td>
<td>0.75</td>
</tr>
<tr>
<td>B</td>
<td>0.99 to 0.95</td>
<td>3.75</td>
</tr>
<tr>
<td>C</td>
<td>0.94 to 0.90</td>
<td>15.00</td>
</tr>
<tr>
<td>D</td>
<td>Below 0.8</td>
<td>Greater than 15.00</td>
</tr>
</tbody>
</table>

*Table 4 — Discharge loss coefficient classification*

<table>
<thead>
<tr>
<th>Class</th>
<th>Discharge loss coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.4 to 1.0</td>
</tr>
<tr>
<td>2</td>
<td>0.3 to 0.399</td>
</tr>
<tr>
<td>3</td>
<td>0.2 to 0.296</td>
</tr>
<tr>
<td>4</td>
<td>0.199 and below</td>
</tr>
</tbody>
</table>

NOTE: The above classes also apply to entry loss coefficient.

$$q_w = C_d A \sqrt{\frac{2 \Delta p}{\rho}}$$
Testing and optimization of louvres performance

Aerodynamic and rain tightness characteristics (EN13030)

Optimization based on CFD: air flow resistance ↓ and/or water tightness ↑
**Ventilative cooling: quick design, rules of thumb**

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

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

**Resistance**
- Reduction of air flow rate
  - \( \sim 50\% \)

**Guarantee on higher operation time**
- Fully openable windows (90°) instead of tilted (10%)
- More in use during night and absence
  - \( \sim \) higher utilization factor

On average, net effect of louvres on air exchange rate is mostly limited
Testing and optimization of louvres performance

**Sound insulation:** sound reduction index $R_w$ (EN ISO 10140 & 717)

![Image of sound reduction test setup]

**Burglary resistance of window openings (~ building assurances): RC class**

<table>
<thead>
<tr>
<th>Mechanical strength</th>
<th>Static loading</th>
<th>Dynamic loading in resistance classes 1, 2 and 3...</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>7.1</td>
<td>7.2</td>
</tr>
</tbody>
</table>

**Manual burglary attempts:**

When tested in accordance with prEN 1630, using the tool sets and times specified in Table 6, the test specimen shall not fail at the resistance class claimed. For construction products of resistance class 1, no manual test will be carried out. The tool set A1 is intended for preparation of the test specimen.

<table>
<thead>
<tr>
<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>A1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>A2</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>A3</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>A4</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>A5</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<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:

Belgium (residential)

- Physical free area of VC openings
  (≥6.4% of room net floor area)
- Accessibility/burglary resistance
  (location, max opening, resistance class ≥ 2)
- Control possibilities

The Netherlands (all buildings)

- Physical free area of VC openings
- Accessibility/burglary resistance
  (location, max opening, resistance class ≥ 2)
- Control possibilities
- Insect-proof requirement
- Rain tightness requirement (louvre, sensor)

Red zones = burglary risk
Louvres applications in-situ

Schools (Gent, Belgium)

Passive cooling measures, no active cooling, small or no occupation in summer
**Schools** (Gent, Belgium)

Burglary resistance, fall prevention safety, daylight

Different shapes and colors > attractive façade

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

Ventilation – Sunprotection - Outdoor

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**Student homes** (Campus Diemen Zuid, The Netherlands)

Acoustic insulation for intensive ventilation and ventilative cooling

Continuous louvre systems as façade cladding and VC louvre

Private home > Belgium

"Resilient Ventilative Cooling in practice"
Continuous louvre systems as façade cladding and VC louvre

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*  
*Privacy ↔ daylight*

Louvre: movable/adjustable versus fixed

*Movable/sliding louvre panels*  
*Adjustable/orientable blades*
**Apartments (Weinfelden, Switzerland)**

**Combination of ventilative cooling and solar shading**

- **Adjustable in zones**
- **Personalization**
- **screens and awning**
- **screens on roof windows**
- **Integrated screens**

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Renson offices/showroom (Waregem, Belgium, 2002)

Designed 20 years ago as a living lab of bioclimatic architecture, and still contemporary

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Renson offices (Waregem – Belgium, 2002)

- Passive stack ventilation
- $n_{design} \approx 6 \text{ h}^{-1}$
- $Area_{VC} \approx 2\%$ of floor area
- Controlled by BMS
- Combined with external SS + exposed thermal mass
- $>26^\circ C$: 5 to 8\% of office hours (high occupation and climate change)
- $>28^\circ C$: <1\% of office hours
Louvers…
where simplicity meets multi-functionality

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