Airtightness of window-wall interfaces in masonry brick walls and wood-frame construction

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Overview

• Introduction
• Experimental setup
• Masonry construction
• Wood-frame construction
• Conclusions
Introduction

An ‘average’ dwelling:
Exterior volume $V_e$: 617 m³
Interior volume $V_i$: 453 m³
Area building shell $A_b$: 426 m²
Area windows $A_w$: 43.4 m²

\[ n_{50} = \frac{V_{50}}{V_a} \text{ [h}^{-1}] \]

\[ V_{50} = \frac{V_{50}}{A_i} \text{ [m³/h/m²]} \]

<table>
<thead>
<tr>
<th></th>
<th>$V_{50}$ [m³/h]</th>
<th>$n_{50}$ [h⁻¹]</th>
<th>$V_{50}$ [m³/h/m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (EPBD)</td>
<td>5112.0</td>
<td>11.28</td>
<td>12.00</td>
</tr>
<tr>
<td>low energy</td>
<td>906.0</td>
<td>2.00</td>
<td>2.13</td>
</tr>
<tr>
<td>passive house</td>
<td>271.8</td>
<td>0.60</td>
<td>0.64</td>
</tr>
</tbody>
</table>
Introduction

Typical distribution of air leakage paths

- Wall, roof, floor: 42%
- Interfaces: 31%
- Windows & WWI: 24%
- Other (elec. sockets...): 3%

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Masonry construction

- Air leakage per meter @ 50Pa (including corners)
- 14 details tested for standard configuration
- 1 detail tested in a passive house wall
- collaboration with manufacturers and contractors
- results: 0.00 to 33.07 m³/h/m

3 Classes:
- **Poor**: \( v_{50} > 3.3 \text{ m}^3/\text{h/m} \)
- **Average**: \( 0.33 \text{ m}^3/\text{h/m} < v_{50} < 3.3 \text{ m}^3/\text{h/m} \)
- **Good**: \( v_{50} < 0.33 \text{ m}^3/\text{h/m} \)
Window-wall interface details

12mm plaster
140mm perforated clay bricks
80mm insulation
30mm cavity
90mm masonry veneer

wooden block for mounting trim
spray in place PUR
caulking

1.06 m³/h/m
1.77 m³/h/m
1.36 m³/h/m
0.00 m³/h/m
2.90m³/h/m
0.13m³/h/m
0.08m³/h/m
0.19m³/h/m
0.10m³/h/m
0.03m³/h/m

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Results

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Foil continuous – exterior corner

Basic setup:
0.3 m³/h/m

Silicone at corners:
0.09 m³/h/m
Foil continuous – exterior corner

Impact 10 screws Ø 4mm:
0.09 m³/h/m extra

Screws removed:
0.16 m³/h/m extra

Foil discontinuous – exterior corner

Basic setup:
0.23 m³/h/m
Foil continuous – interior corner

Basic setup:
1.68 m³/h/m

Silicone at corners:
1.19 m³/h/m
Foil discontinuous – interior corner

Basic setup:
1.13 m³/h/m

Spray-in-place polyurethane foam (SPF)

SPF without moistening:
0.09 m³/h/m

SPF with moistening:
0.03 m³/h/m
Foil – window in plywood frame

Basic setup:
0.25 m³/h/m
SPF – window in plywood frame

SPF with moistening:
0.00 m³/h/m

Other type of plywood:
air currents at plywood edge
additional 0.11 m³/h/m
Conclusions:

- Windows class 4: not sufficient for very airtight buildings
- Average performance joint: air loss < 3.3 m³/h.m @ 50Pa
- Good performance joint: air loss < 0.33 m³/h.m @ 50Pa
- Foil: apply continuous, mind the corners
- SPF: mind the mounting brackets, moistening

_Airtightness in practice: materials, training, coordination_

Questions?