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

Nathan Van Den Bossche

Overview

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

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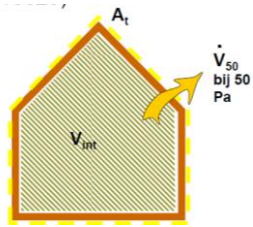
Introduction

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

$$n_{50} = \dot{V}_{50} / V_n \left[h^{-1}\right]$$

$$v_{50} = \dot{V}_{50} / A_t \left[m^3/h/m^2\right]$$



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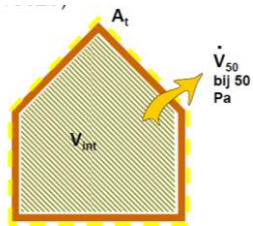

	V_{50} [m³/h]	n_{50} [h^{-1}]	v_{50} [m³/h/m²]
Standard (EPBD)	5112.0	11.28	**12.00**
low energy	906.0	**2.00**	2.13
passive house	271.8	**0.60**	0.64

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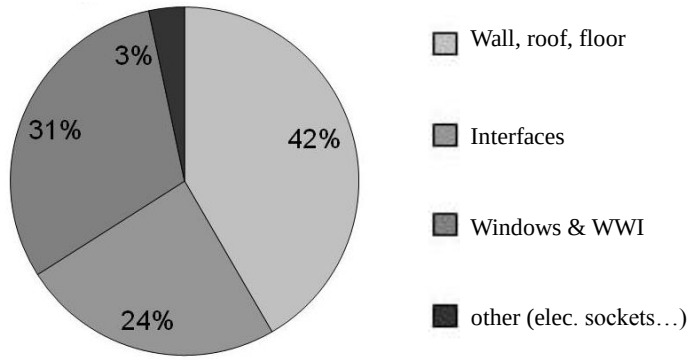
Introduction

Typical distribution of air leakage paths



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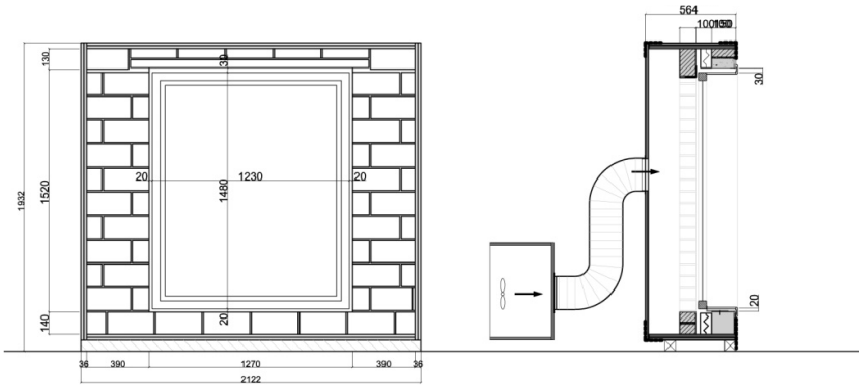
Experimental setup



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Experimental setup

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Experimental setup

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Experimental setup

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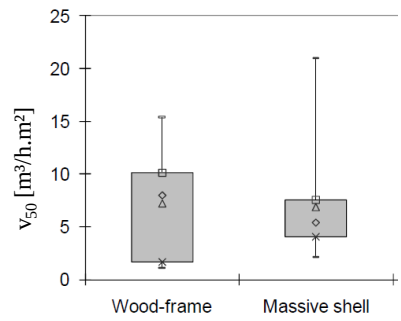

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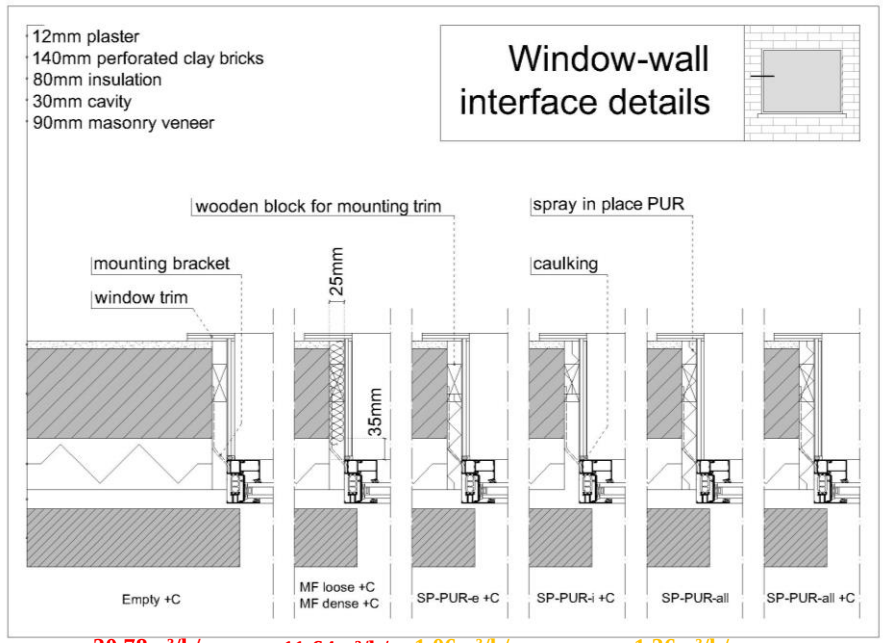
Masonry construction

- 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 33.07m³/h/m

3 Classes:

- **Poor**: v_{50} > 3.3 m³/h/m
- **Average**: 0.33 m³/h/m < v_{50} < 3.3 m³/h/m
- **Good**: v_{50} < 0.33 m³/h/m



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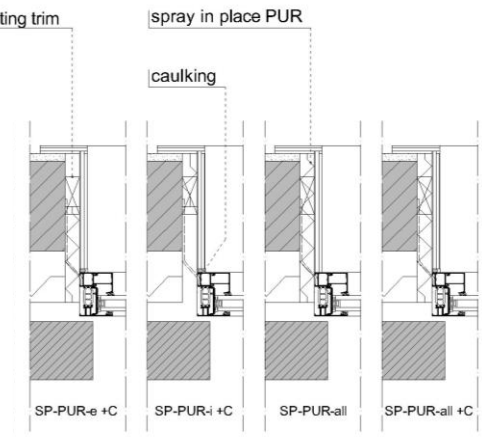
12mm plaster
140mm perforated clay bricks
80mm insulation
30mm cavity
90mm masonry veneer

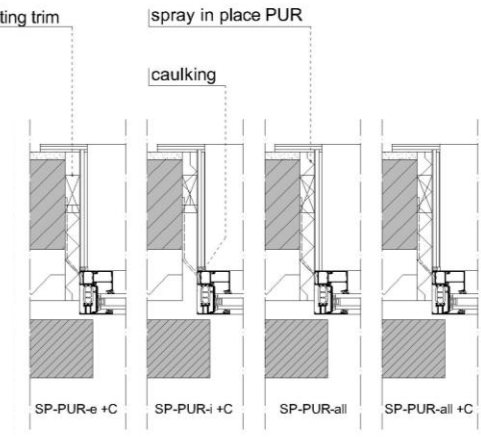
Window-wall interface details



1.06m³/h/m 1.36m³/h/m
1.77m³/h/m 0.00m³/h/m

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

Window-wall interface details



1.06m³/h/m 1.36m³/h/m
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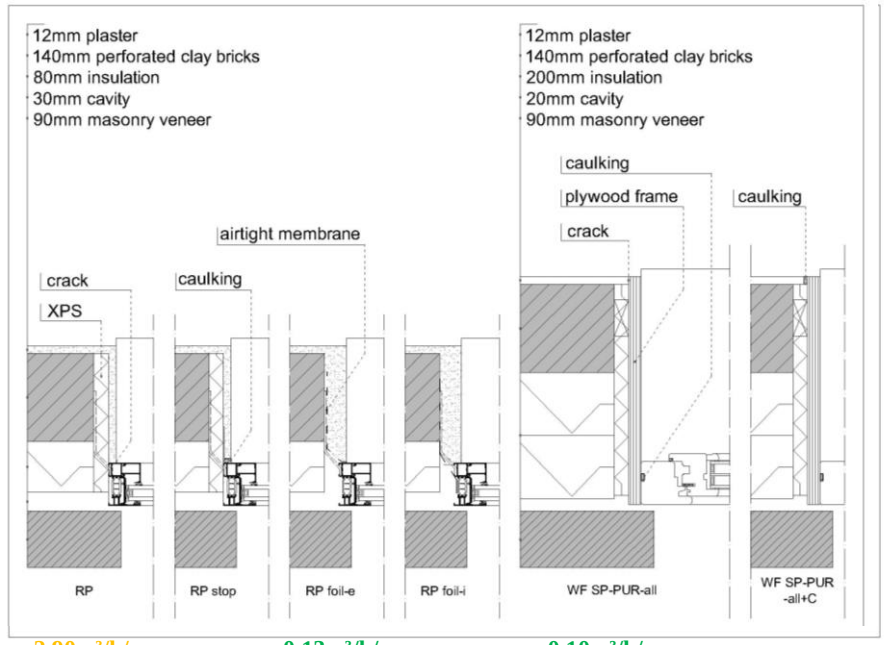
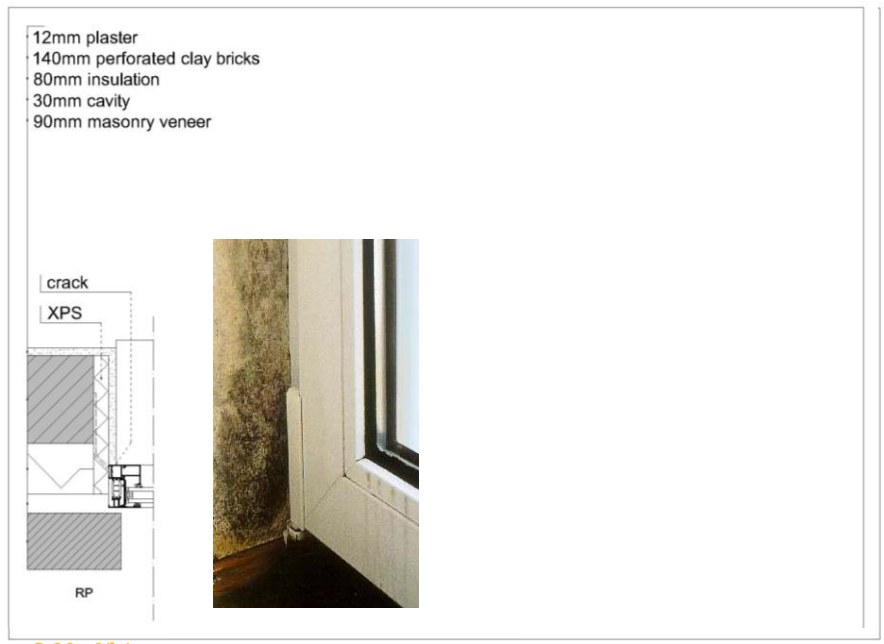


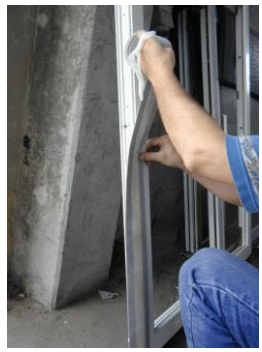
2.90m³/h/m **0.08m³/h/m** **0.13m³/h/m** **0.19m³/h/m** **0.10m³/h/m** **0.03m³/h/m**

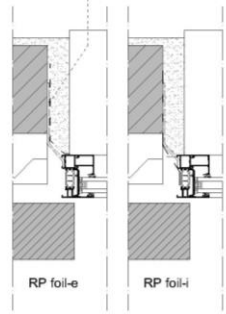


2.90m³/h/m

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

airtight membrane

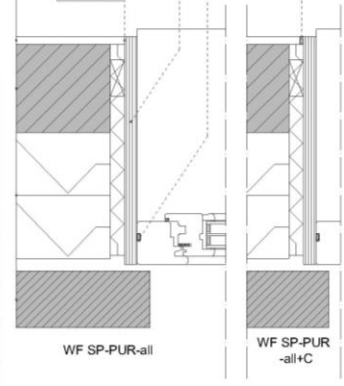




0.13m³/h/m **0.19m³/h/m**

12mm plaster
140mm perforated clay bricks
200mm insulation
20mm cavity
90mm masonry veneer

caulking
plywood frame
caulking
crack



0.10m³/h/m **0.03m³/h/m**

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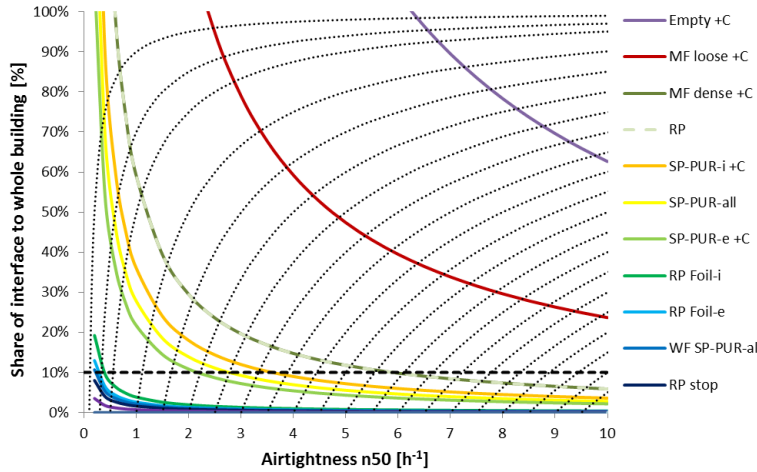
Results



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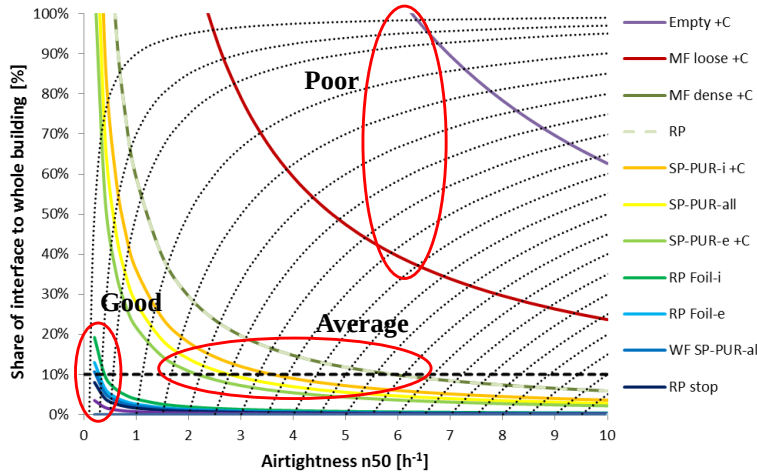
Results



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Foil continuous – exterior corner

Basic setup:
0.3 m³/h/m

Silicone at corners:
0.09 m³/h/m

BRACKETS

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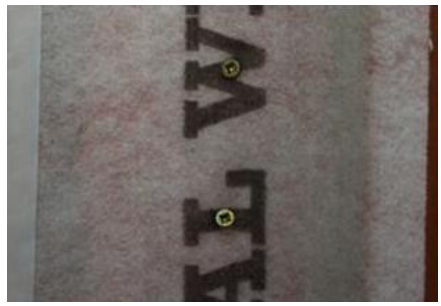
Foil continuous – exterior corner



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

Screws removed:
0.16 m³/h/m extra

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Foil discontinuous – exterior corner

Basic setup:
0.23 m³/h/m

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Foil continuous – interior corner

Basic setup:

1.68 m³/h/m

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Foil continuous – interior corner

Basic setup:

1.68 m³/h/m

Silicone at corners:

1.19 m³/h/m

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Foil discontinuous – interior corner

Basic setup:

1.13 m³/h/m

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Spray-in-place polyurethane foam (SPF)

SPF without moistening:

0.09 m³/h/m

SPF with moistening:

0.03 m³/h/m

BRACKETS

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Foil – window in plywood frame

Basic setup:

0.25 m³/h/m

PLYWOOD

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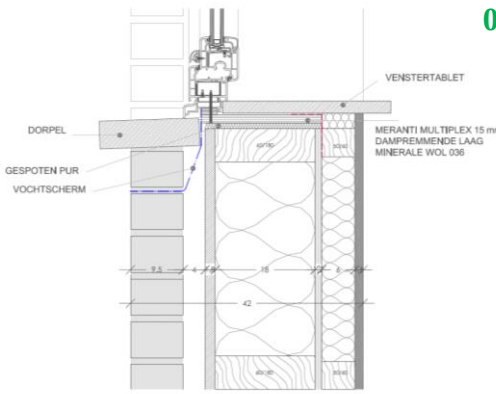
Foil – window in plywood frame

Basic setup:

0.25 m³/h/m



PLYWOOD

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SPF – window in plywood frame

SPF with moistening:
0.00 m³/h/m

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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

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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

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Questions?

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