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Hygrothermal Aspects of Building Airtightness Solutions

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Webinar – TightVent Europe
Building Airtightness Solutions:
System approach and characterisation of
air barrier and moisture management systems
October 8th, 2013

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Before 2020 :

EU countries will have to generalise
nearly zero-energy buildings
in new constructions and major renovations

Building and ductwork airtightness will implicitly become a mandatory concern

2

Energy efficient ventilation systems will have to be used

Figure from TightVent Europe

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Increased building airtightness by interior air barrier system


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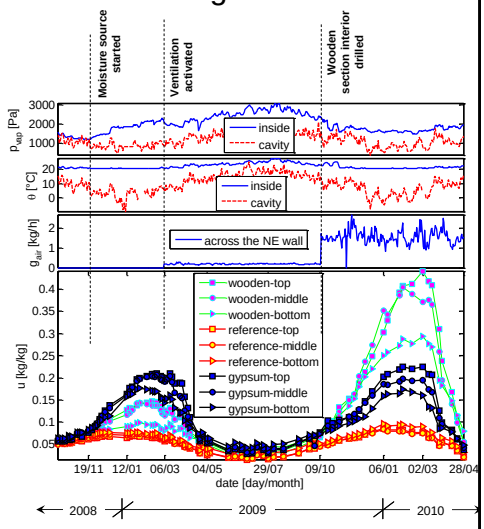
Interior air barrier not only for energy efficiency but also to avoid moisture damage



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Interior air barrier not only for energy efficiency
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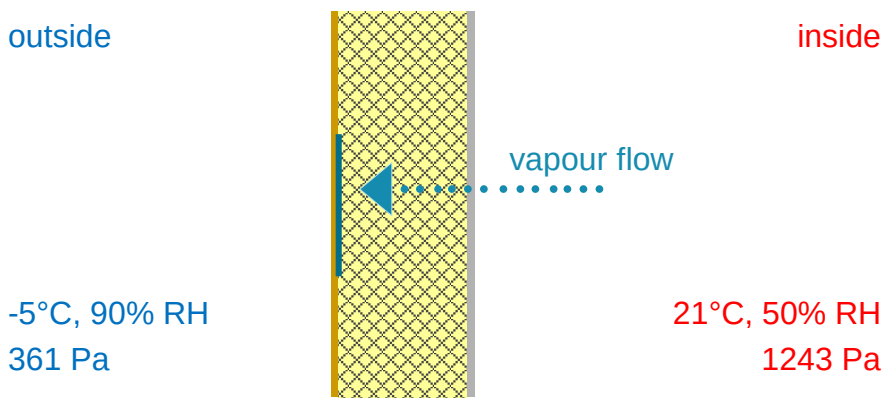

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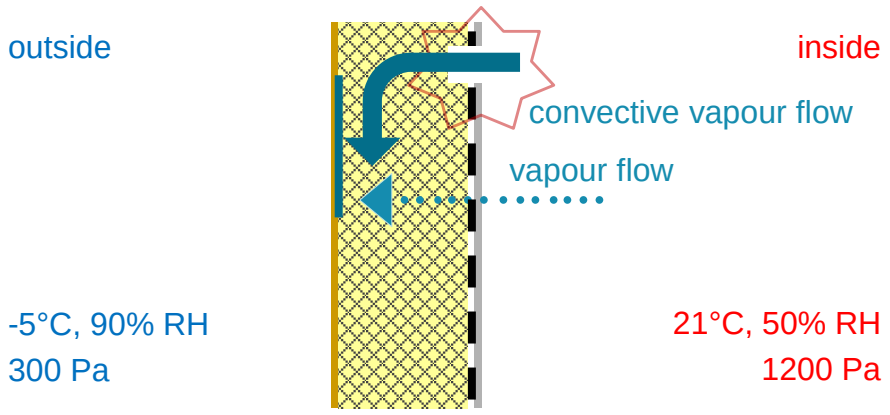

continuous combined vapour and air barrier

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Increased building airtightness by interior air barrier system

Passive house standard: n_{50} = 0.6 1/h

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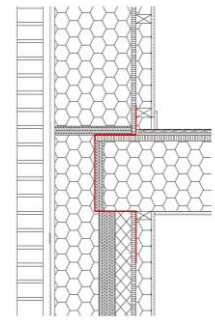
But, often complex details of interior air barriers



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As a result: tendency towards exterior air barriers

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Experience from Norway

Since 2009: stricter regulation: n_{50}<2.5 ACH

Legal requirement results in stepwise testing:

- First measurement $n_{50,w}$ in windtight stage
- Second measurement $n_{50,f}$ on finished building (with interior air barrier installed)




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Test case in Belgium

	n_{50} (1/h)
Exterior air barrier	0.60
Cellulose inflated	0.25
Interior air barrier	0.24

Workmanship

Interior barrier: +/-152h

Exterior barrier: +/-72h

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Complex details of interior air barriers

Exterior air barriers: potential to reduce labour costs

Problem: no longer control of the airtightness of interior barrier

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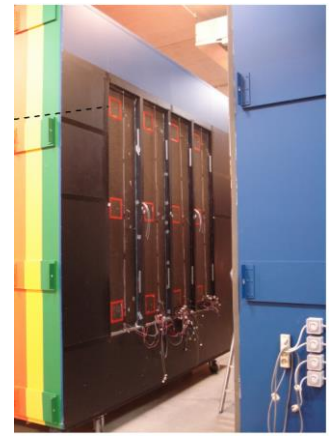
Experimental validation of hygrothermal risks



Hot Box / Cold Box experiment on 4 wall types

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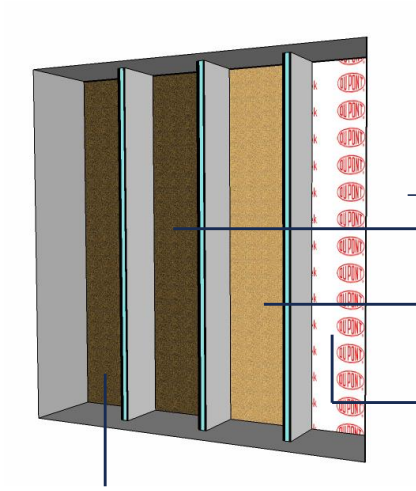

Ia: reference section

Test series I

Air barrier	Ka ($m^3/m^2/h/Pa$)	R (m^2K/W)	buffering
Ib	0.005	0.36	Yes
Ic	0.13	0.36	Yes
Id	<0.001	-	-

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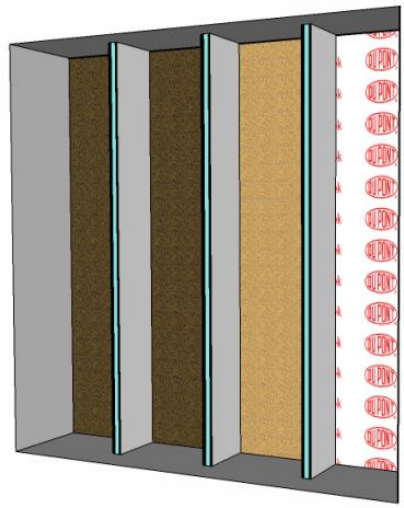

Ia Ib Ic Id

Different exterior sheeting
(Ka / R / buffer potential)

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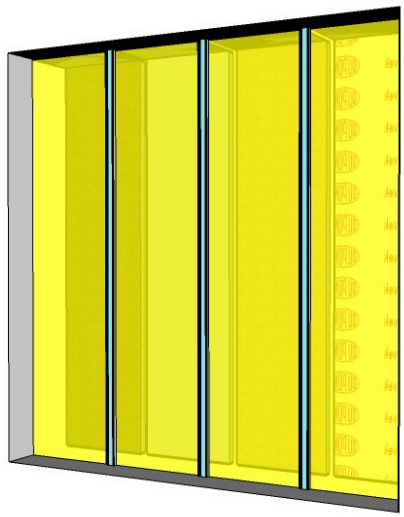

Ia Ib Ic Id

Different exterior sheeting
(Ka / R / buffer potential)

30 cm mineral wool (20 kg/m³) (15cm-15cm)

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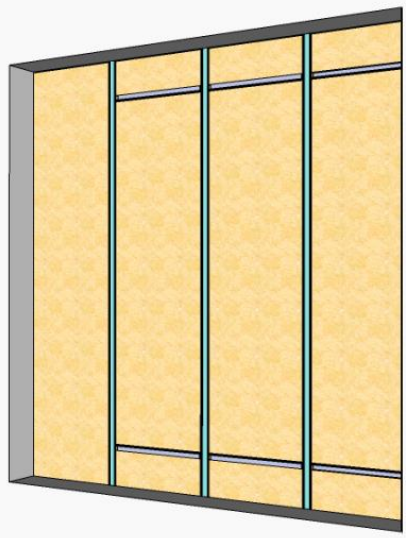

Ia Ib Ic Id

Different exterior sheeting
(Ka / R / buffer potential)

30 cm mineral wool (20 kg/m³) (15cm-15cm)

OSB interior panels
with top and bottom air gaps

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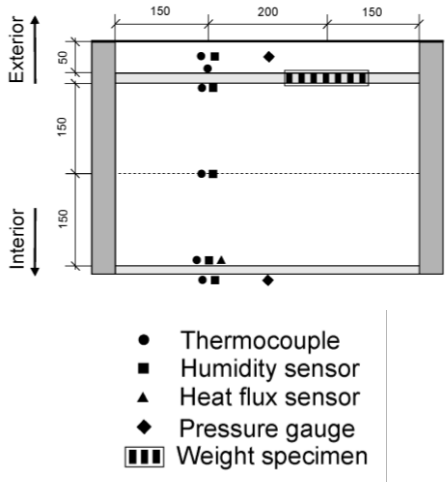
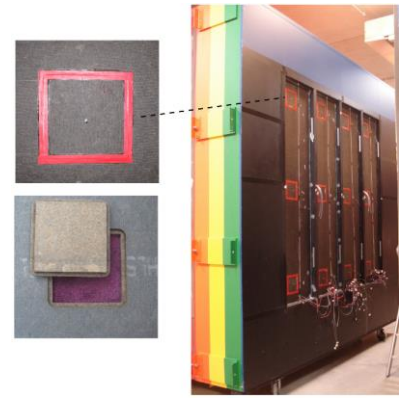
Installed sensors





gravimetric weight specimen
at three heights

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- Boundary conditions in HB/CB
  - T_{in} = 20°C and T_{ex} = 3°C
  - RH_{in} = 54% and RH_{ex} = 86%

3 steps in experimental setup:

1. Intact interior and exterior sheathing
2. Openings in interior sheathing (top/bottom)
3. Total air pressure difference

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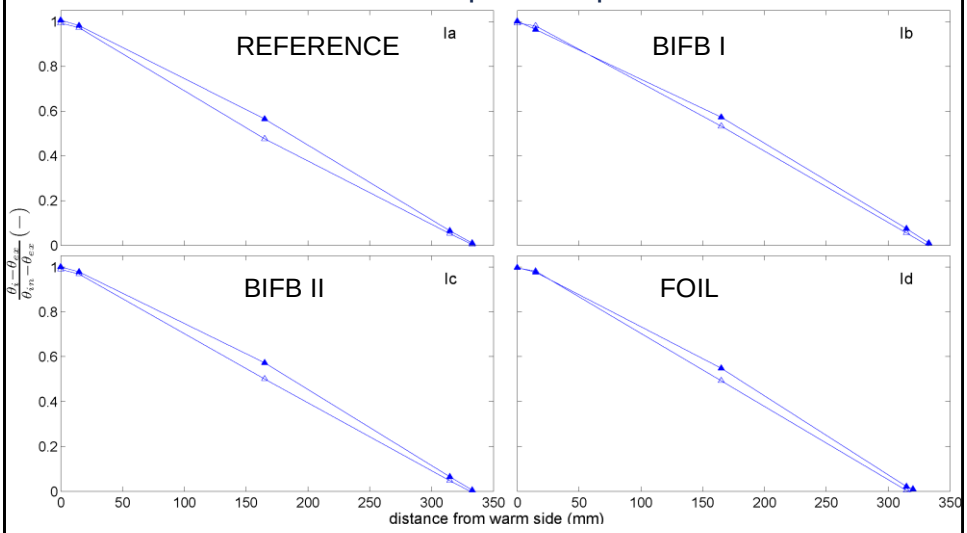
Observed temperature profiles



STEP 1

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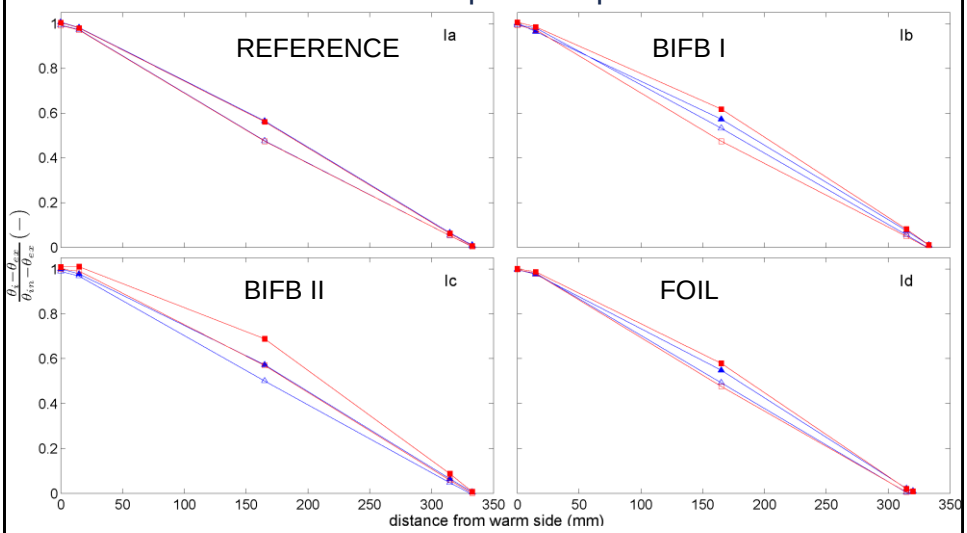
Observed temperature profiles



STEP 1 STEP 2

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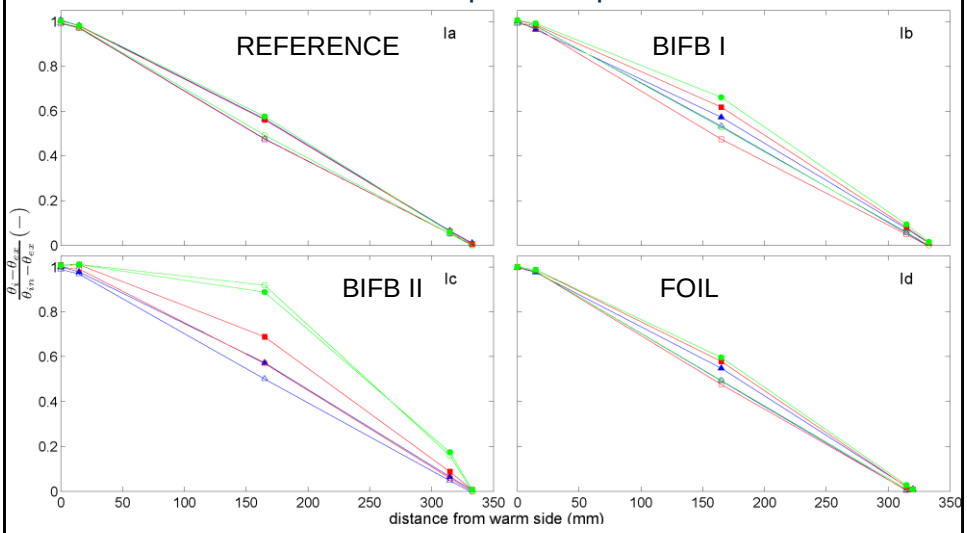
Observed temperature profiles



STEP 1 STEP 2 STEP 3

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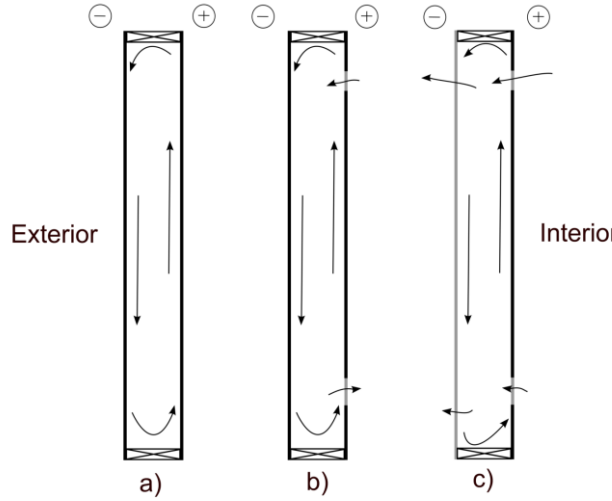
Observed air flow patterns



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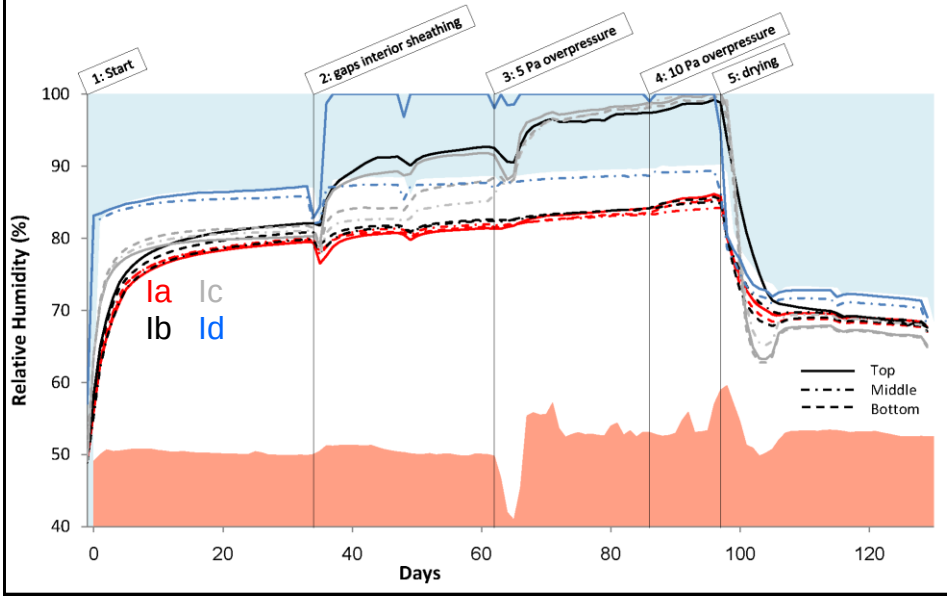
RH at inside of windbarrier



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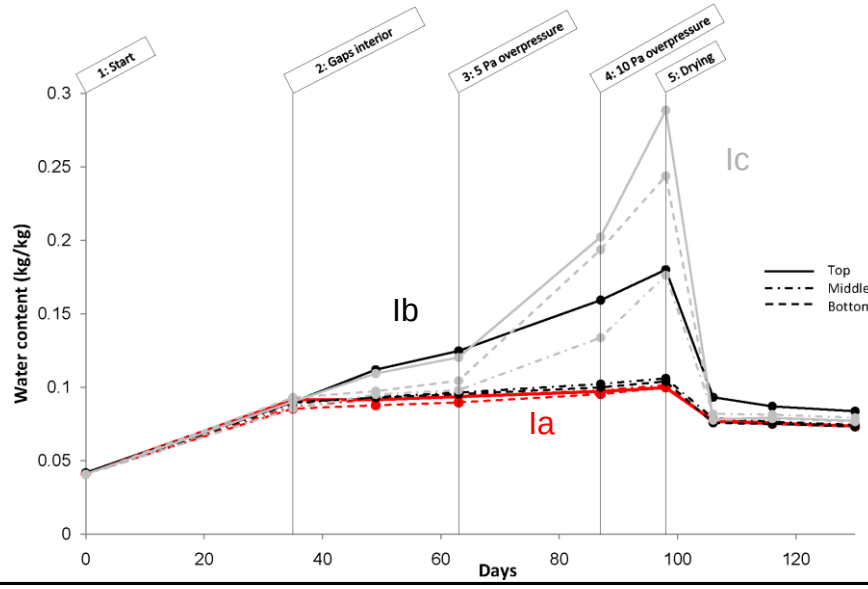
corresponding weight increase of wind barrier specimen



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severe conditions result in mould growth and interstitial condensation

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conclusions

- Air tightness is not only important from an energetic point of view, but is a prerequisite for a good hygrothermal performance of building components
- Stringent air tightness requirements resulted in a shift towards airtight windbarriers. This might hamper a control of the quality of the interior barrier.
- Laboratory experiments revealed the importance of air transport on heat and moisture response of light weight building components. This might result in hygrothermal risks of air flow in – even air tight – light weight constructions:
    - Natural convection in/around mineral wool blankets (workmanship!)
    - Increased risk for high moisture contents at upper cold parts
    - Mould growth and interstitial condensation was observed as a result of natural and forced convection

Thanks for your attention

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