ASBP The Alliance for Sustainable Building Products

Air Tightness and Breathability

Neil Turner, Ecological Building Systems

ASBP The Alliance for Sustainable Building Products | NATURAL FIBRE INSULATION GROUP

Airtightness, Breathability and Condensation Risk

26/04/2023

Airtightness, Breathability and Condensation Risk in Buildings

NATURAL FIBRE INSULATION GROUP

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INTRODUCTION

NEIL TURNER

Technical Manager (UK)

- Former TIMSA/BBA-competent U-value scheme member
- Involved in development of CEN European Standards
- Extensive experience within the natural insulation sector
- 14 years manufacture of Warmcel Cellulose fibre
- 7 Years experience of Air Tightness and other natural fibre insulation products

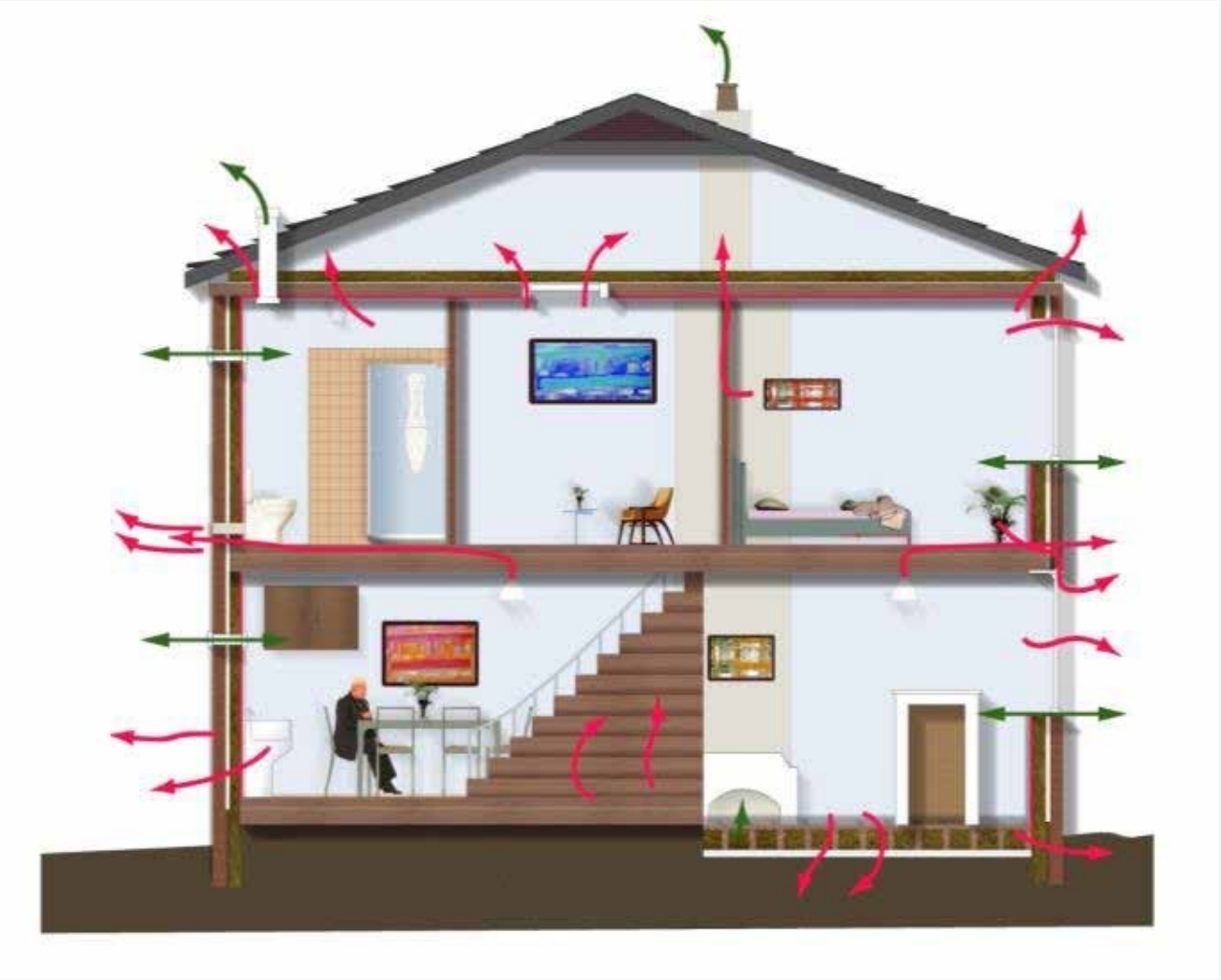
AIR TIGHTNESS AND BREATHABILITY

- Air Tightness
  - Definition, Importance and Benefits
- Breathability
  - Definition, Comparison between different materials
  - Moisture vapour diffusion variable materials
  - Combining air tightness and breathability – can an airtight material be breathable - ?
- Importance of Breathability in new buildings and retrofits and the key benefits of breathable natural insulation materials

DEFINE AIRTIGHTNESS?

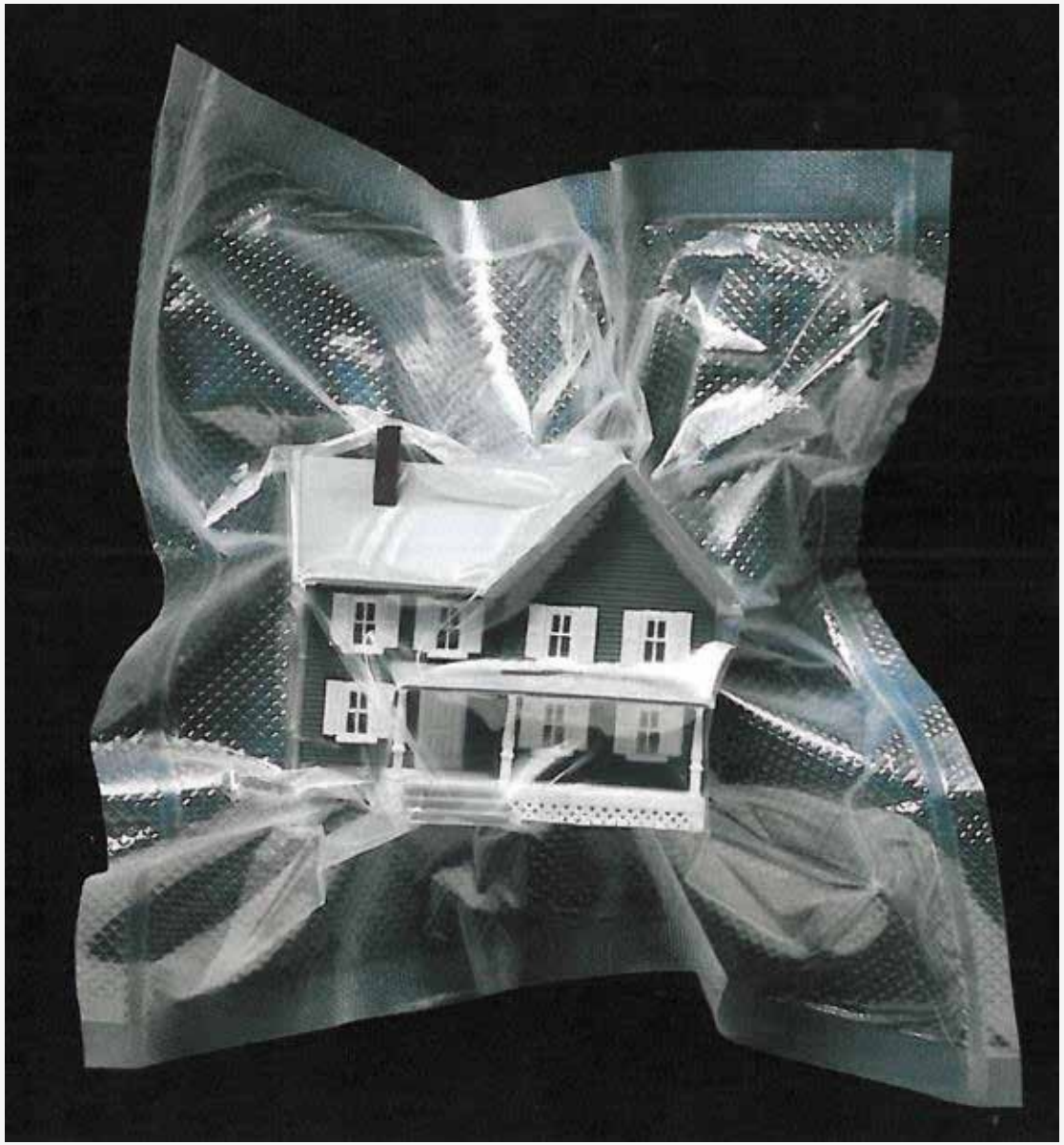
What it is:

The elimination of **uncontrolled** air infiltration & exfiltration



What it is **not:**

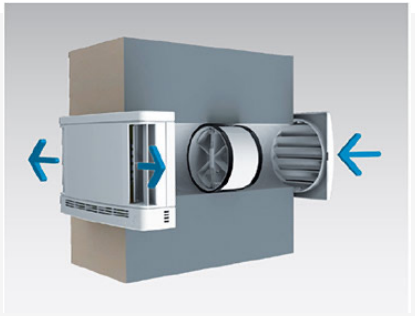
A hermetically sealed box



Build Tight,

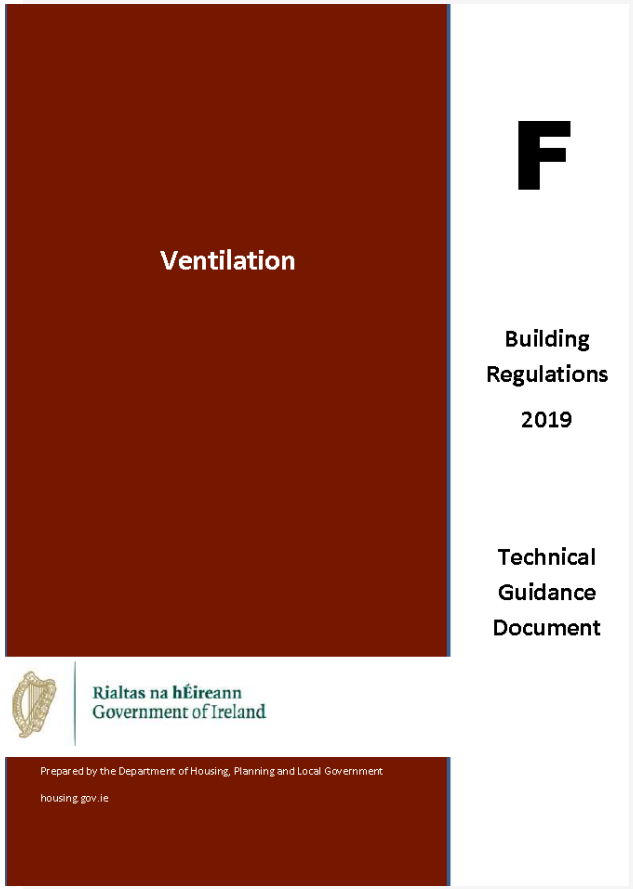
Ventilate Right

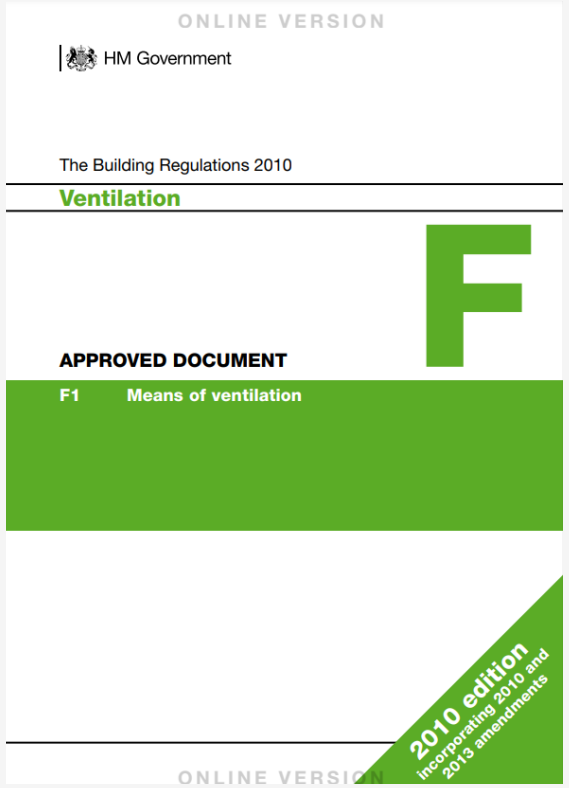
Controlling Moisture + IAQ



Demand Controlled

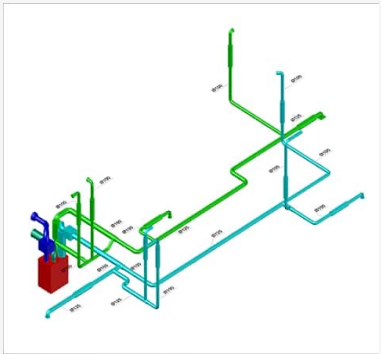
Decentralised



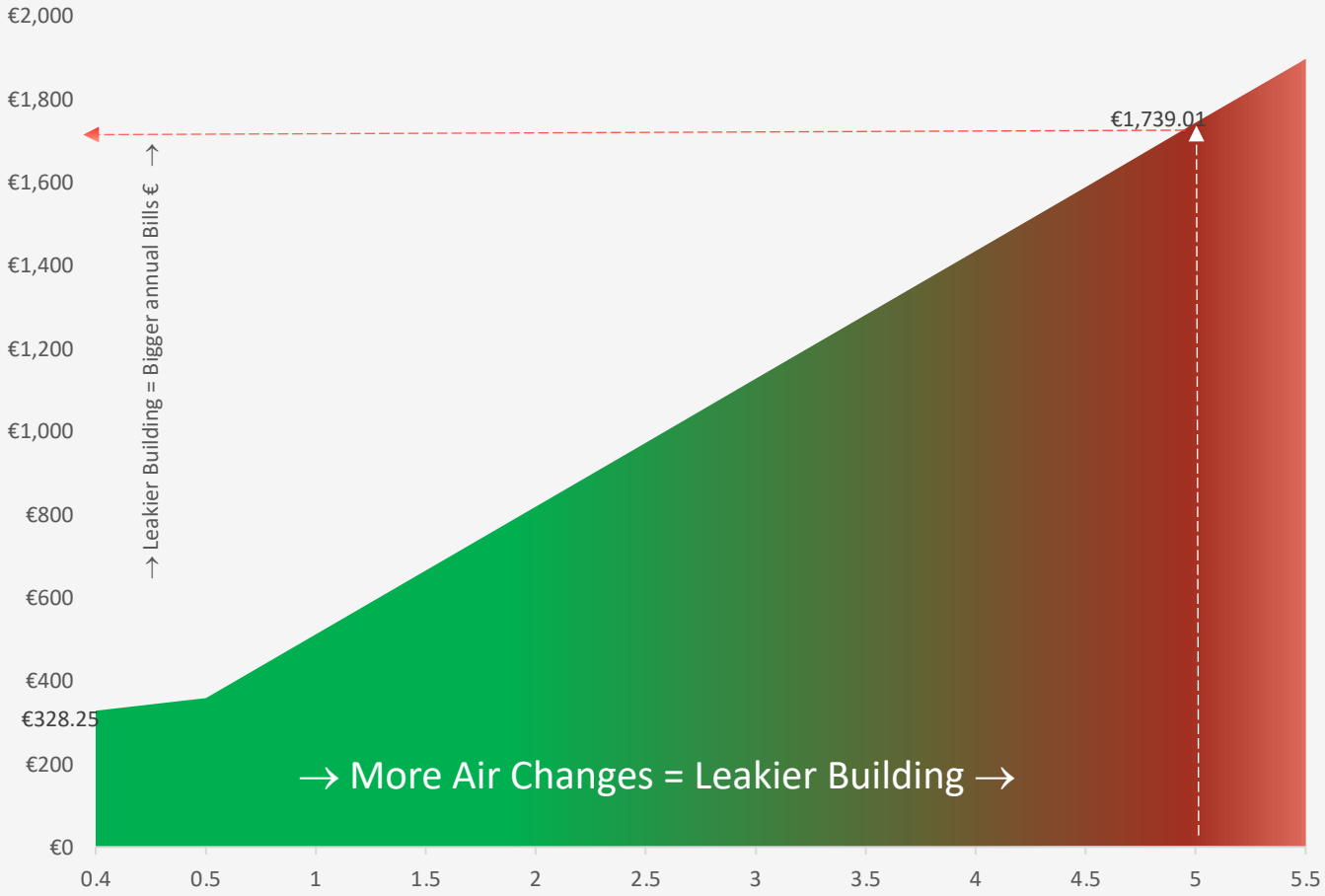


Passive Stack

MVHR



AIRTIGHTNESS COST BENEFITS



<0.4 ACH/hr

Very Low U Values

ANNUAL SAVINGS WITH BETTER AIRTIGHTNESS - Co. Cavan Passive 2019

- **Based on 2019 Irish weather data**
- **Elemental U value average 0.1W/m2K**
- **Based on Electrical cost consumption referenced from SEAI**

AIRTIGHTNESS TESTING & MEASUREMENT

Blower Door Test & Clarification on Air Permeability

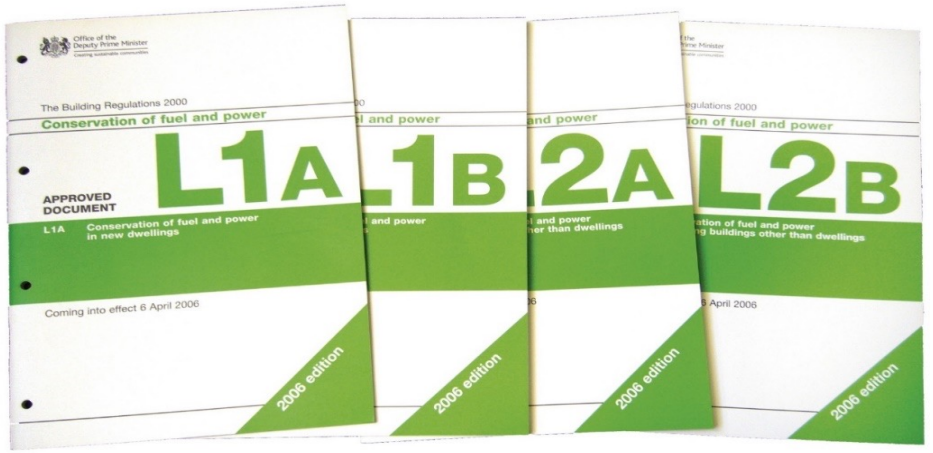
Air Permeability:
Q50 = cubic metres of leakage,
per square metre of building envelope per hour,
at a differential pressure of 50 Pascals, i.e.
m3/(m2.hr) @ 50Pa.

Volumetric Air Change Rate:
N50 – Air Changes per House at 50 Pascals
Required for Passivhaus certification

BUILDING REGULATIONS

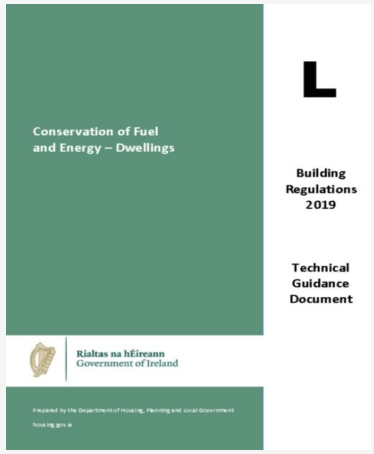
Legal Requirements for Air Tightness:

- **Northern Ireland** Part F 2012 is <**10m³**/hr/m²
- **England/Wales** Part L 2013 is < **8m³**/hr/m²
- **Scotland** < **7m³**/hr/m²
- **Ireland** nZEB– < **5m³**/hr/m²*



Better than the regulations

- **AECB Gold Standard** Q50< **0.75 m³**/hr/m²
- **Passivhaus** **<0.6 ACH** @50Pa



Below 3m³/hr/m² requires Controlled Ventilation normally MVHR or centralised continuous mech. Extract.

AIRTIGHT MATTERS

Equivalent Size
Hole in Fabric

- 200m2 footprint
- Two storey

0.44m2

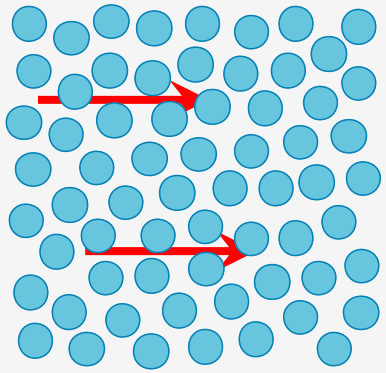
Building Regulation
Back Stop

.044m2

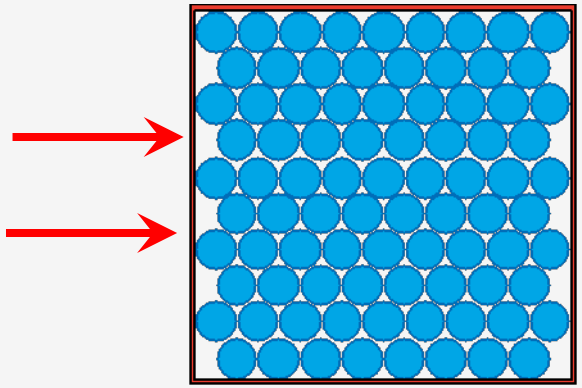
Passivhaus

PRINCIPLE BEHIND INSULATION

Convective
Heat Losses



Air Movement
= **Heat** Transport

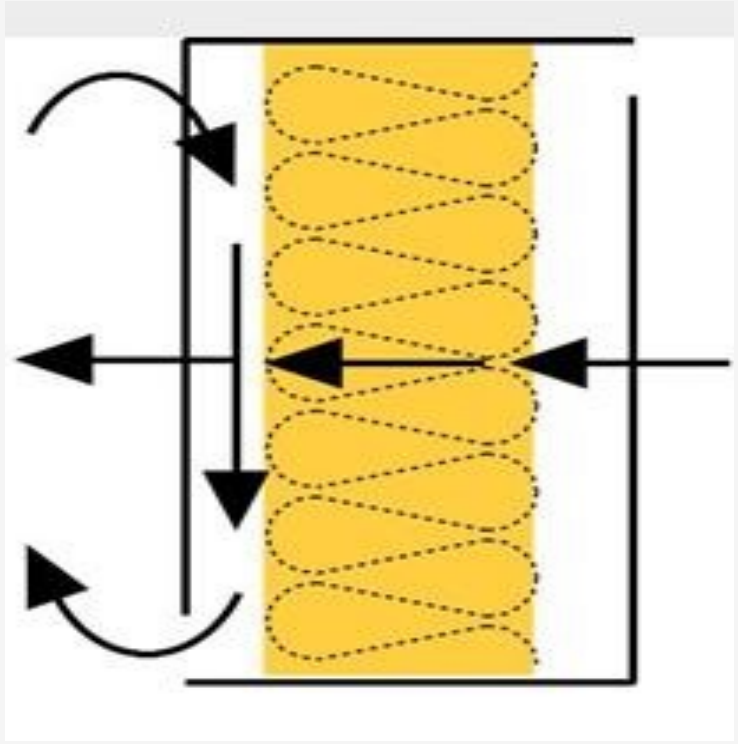


Restricted Air Movement
= **Integrity** of Insulation

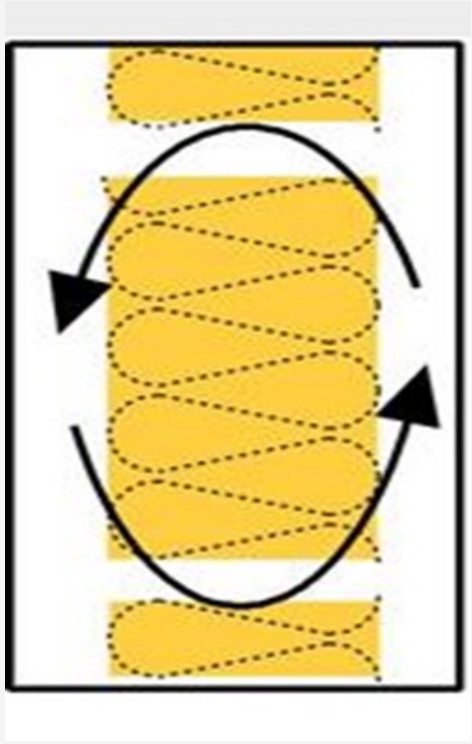
PRINCIPLE BEHIND INSULATION

Convective Heat Losses

Open Loop Bypass



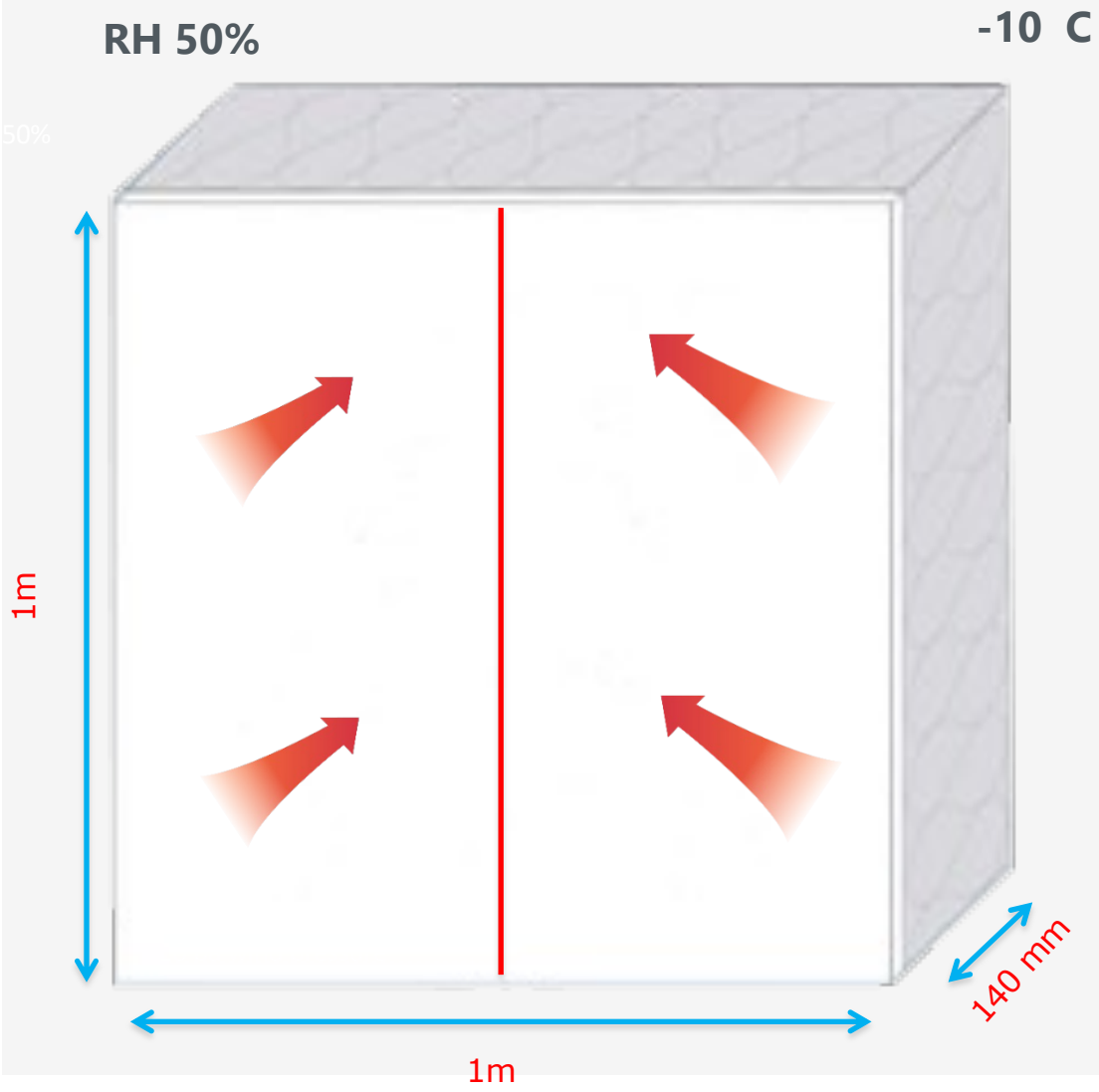
Closed Loop Bypass



Thermal bypass illustrations – Mark J Siddall

CONVECTION HEAT LOSS

The effect of air movement in insulation



Without Gap:
0.3W/m²K

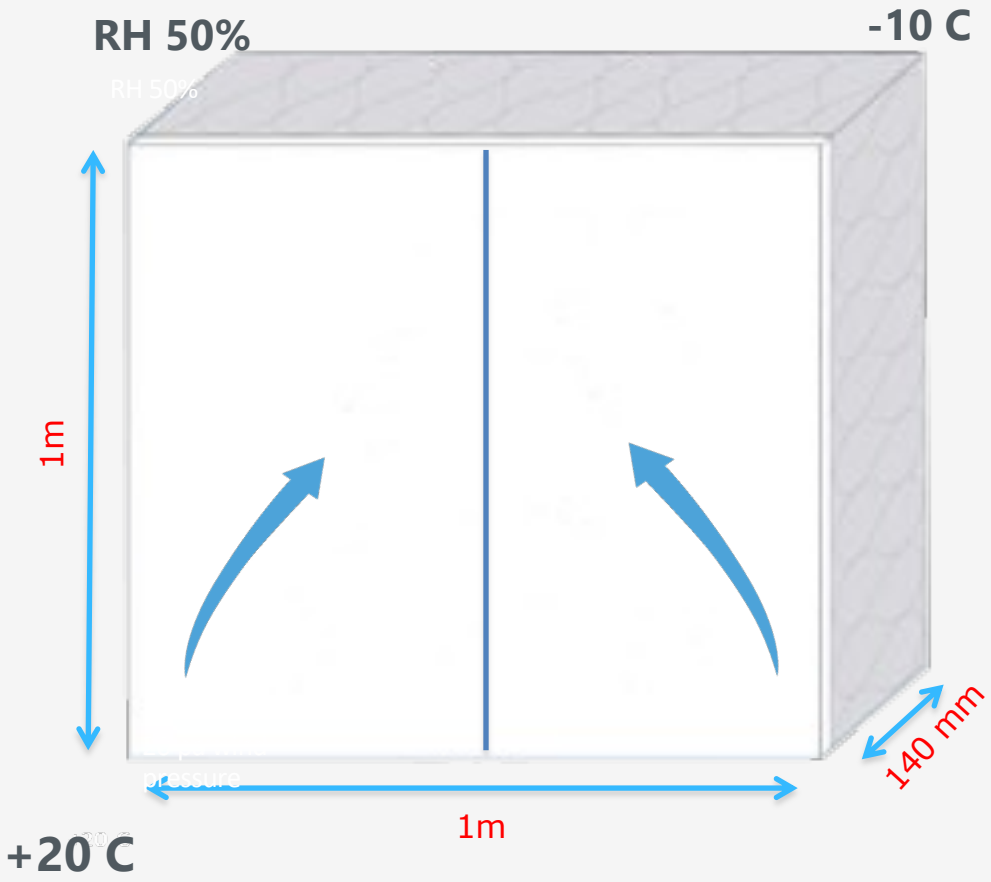
With Gap:
1.44 W/m²K

Reduction factor of:
4.8

*Institute of building physics, Stuttgart
DBZ:12/89, page 1639ff

MOISTURE VAPOUR IN CONSTRUCTION BUILD UPS

The effect of moisture by convection



Without Gap:
0.5g Water per 24hr

With Gap:
800g Water per 24hr

Reduction factor of:
1600

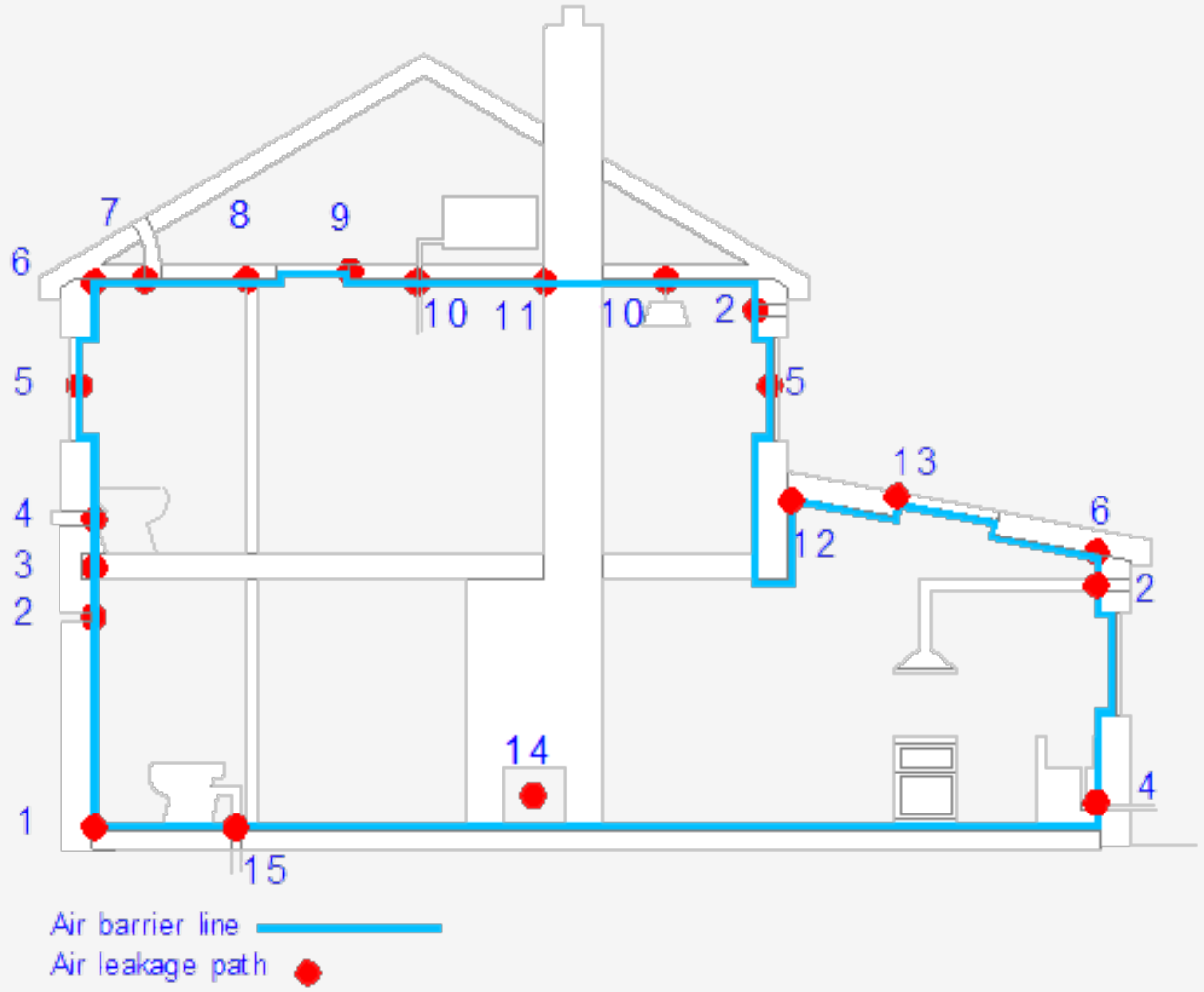
*Institute of building physics, Stuttgart
DBZ:12/89, page 1639ff

DEFINE THE AIR BARRIER

Identify leakage areas

3 main areas of Air Leakage

- Service Leaks
- Structural Leaks
- Combination of Both

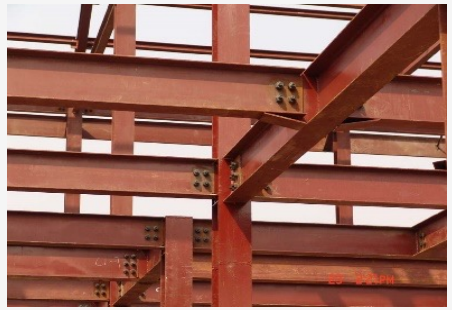


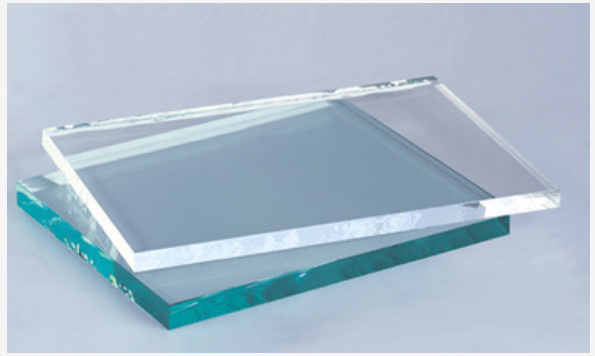
AIRTIGHT MATERIALS

A guide through the good & bad

- Steel
- Concrete
- Timber
- Plaster
- Glass
- Intelligent Vapour Checks
- Certified Vapour tight P5 boards

THE GOOD





AIRTIGHT MATERIALS

A guide through the good & bad

- Block & Brickwork
- Duct Tape
- Dot & Dab Plasterboard
- Silicone Caulking
- OSB*

THE BAD

AIRTIGHT MATERIALS

And the Ugly

- Poor details

👎 👎

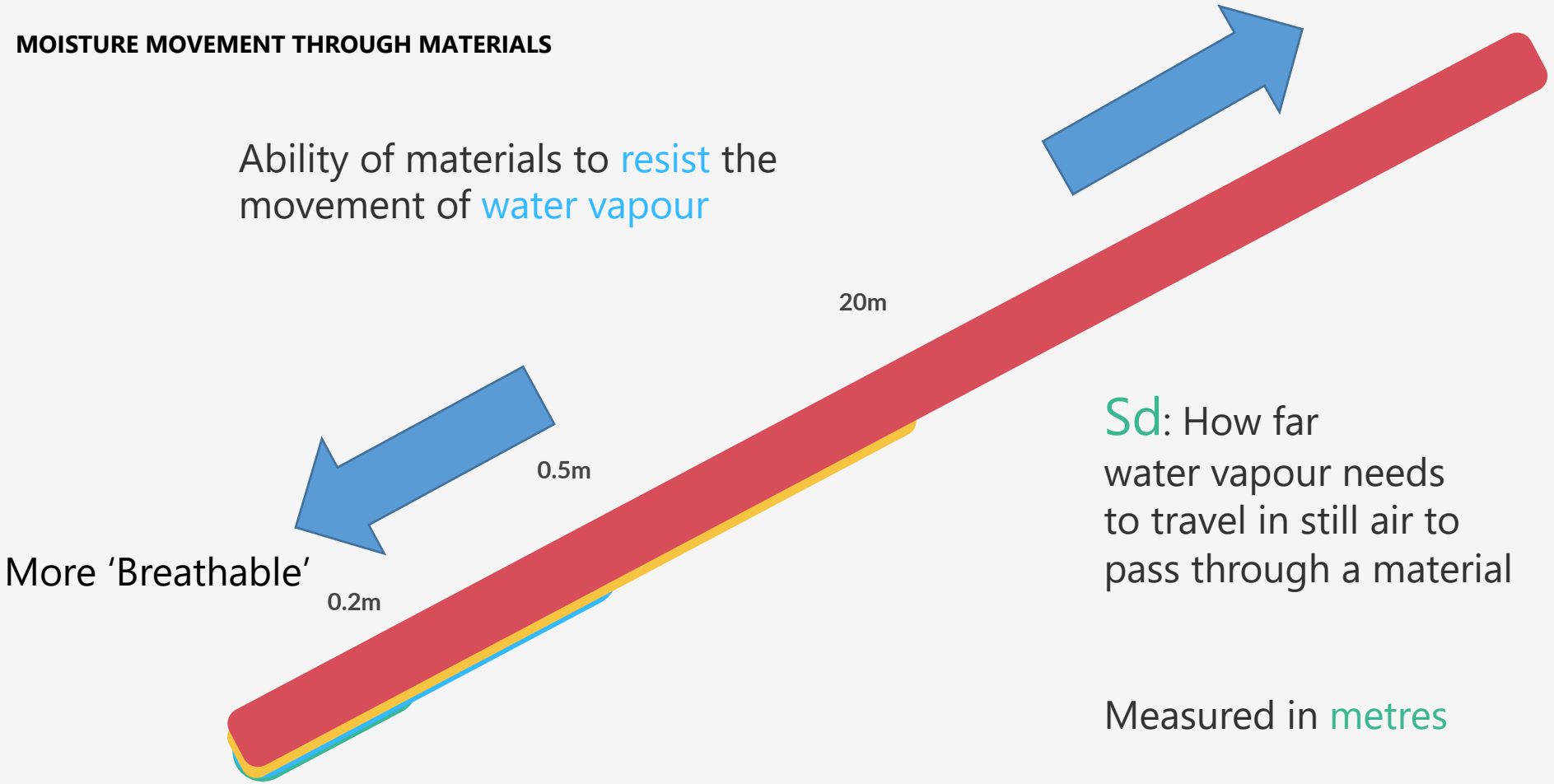
THE UGLY

Breathability

Moisture Vapour diffusion resistance

MOISTURE MOVEMENT THROUGH MATERIALS

Ability of materials to resist the movement of water vapour



Sd: How far water vapour needs to travel in still air to pass through a material

Measured in metres

VARIBLE VAPOUR DIFFUSION RESISTANCE

Other Units

Water Vapour Diffusion Resistance **(MNs/g)**

- Multiply the Sd value by 5 to convert to MNs/g)

Water Vapour Diffusion Resistance Factor (μ)

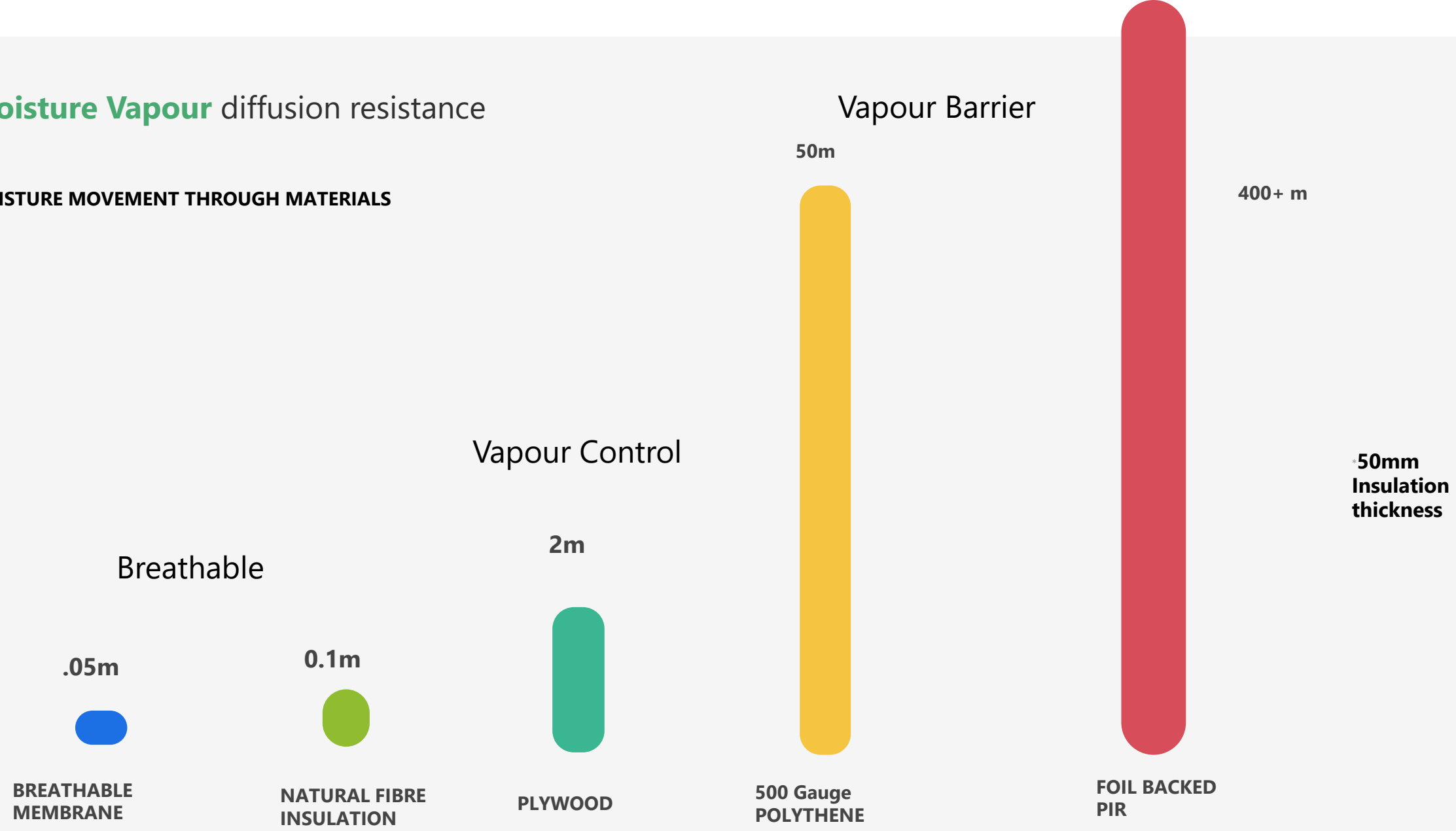
- Multiply the μ value by 5 (MNs/gm) – gives the Water Vapour Resistivity

- Divide the thickness of the product (in mm) by 1000: gives the MNs/g Value

- Lower the value = more moisture vapour diffusion open/breathable

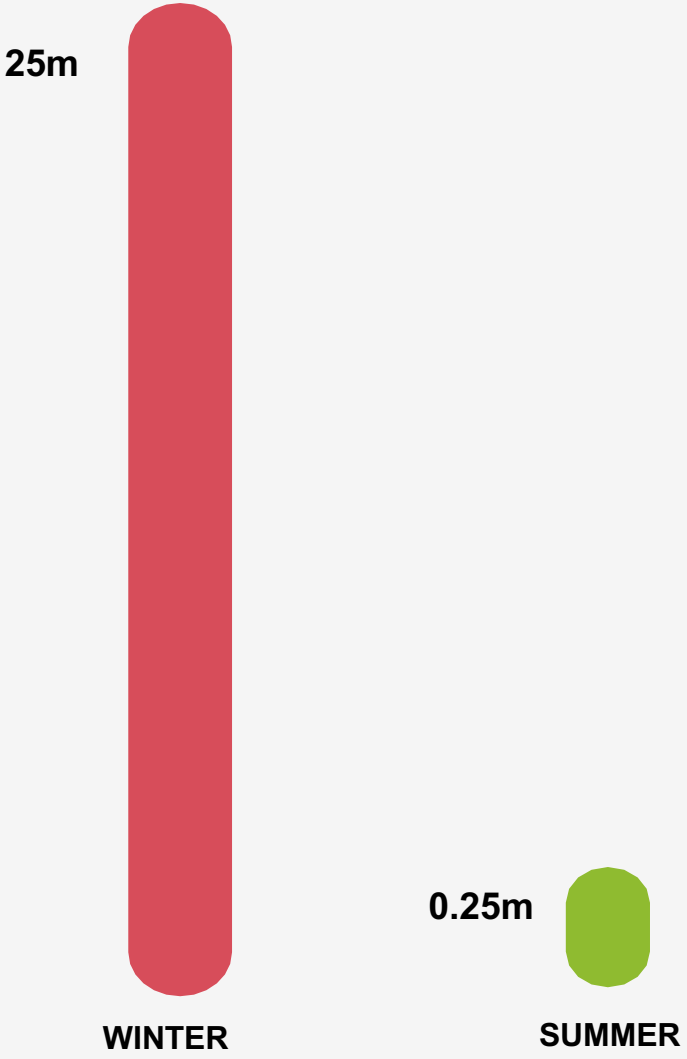
Moisture Vapour diffusion resistance

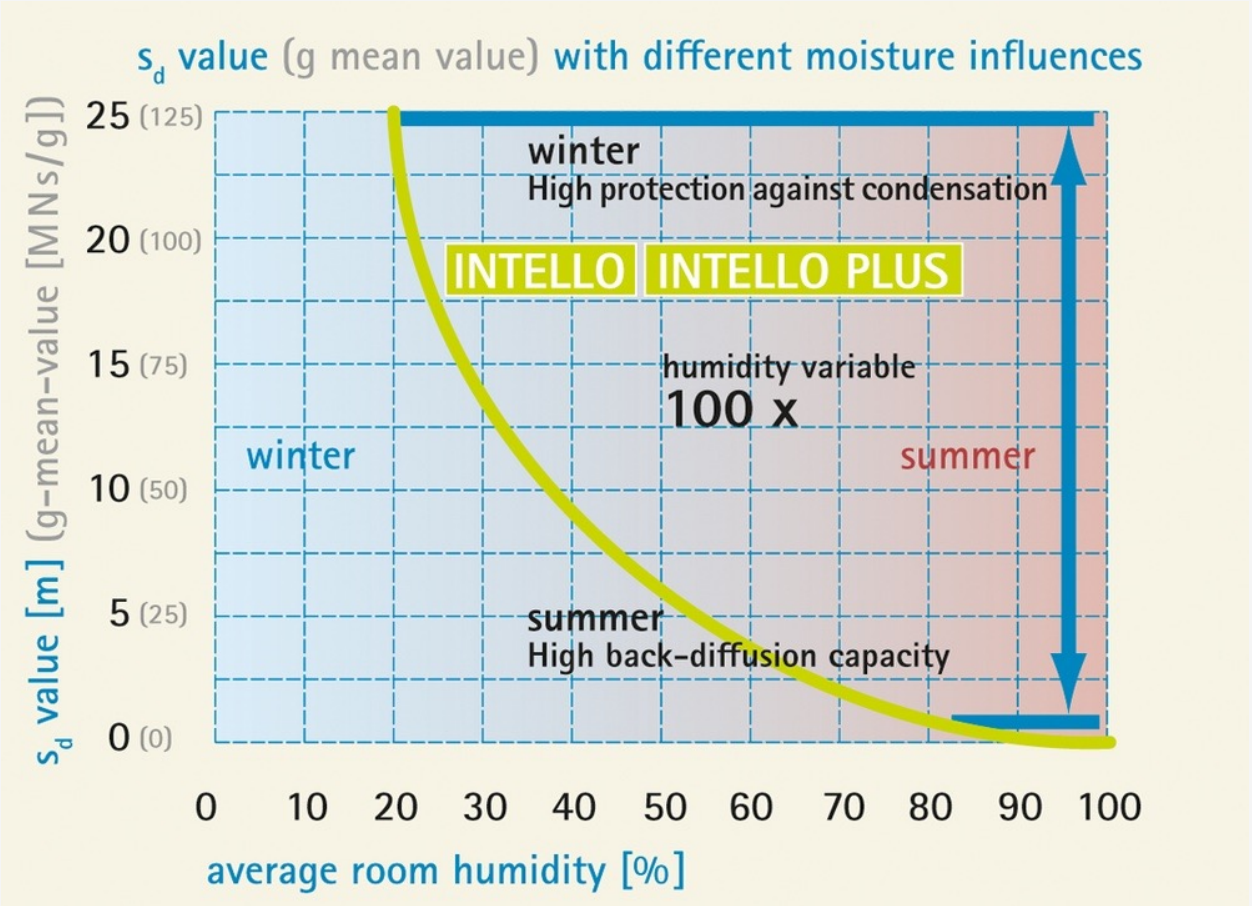
MOISTURE MOVEMENT THROUGH MATERIALS



VARIBLE VAPOUR DIFFUSION RESISTANCE

Humidity Variable Membranes: Combining with Natural Breathable Insulation





VARIBLE VAPOUR DIFFUSION RESISTANCE

Moisture Sorptive/hygroscopic materials

Absorption of moisture when in high humidity condition results in a lower Sd value

Higher moisture content under higher humidity assists diffusion via capillary action

So called **‘wet cup’** and ‘**dry cup’**

Wet cup is based on external use and dry cup based on internal use

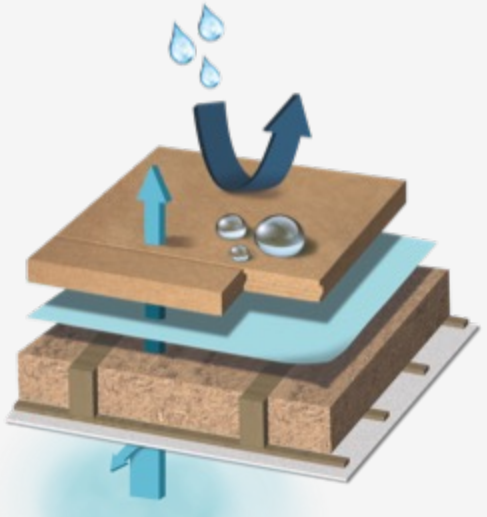
Example design values listed in EN10456

Combined Breathability and Air Tightness

- A material can indeed be airtight/have high air flow resistance and breathable - !
  - High density natural fibre insulation
  - Monolithic breathable membranes

Best non-construction example

Goretex Jacket

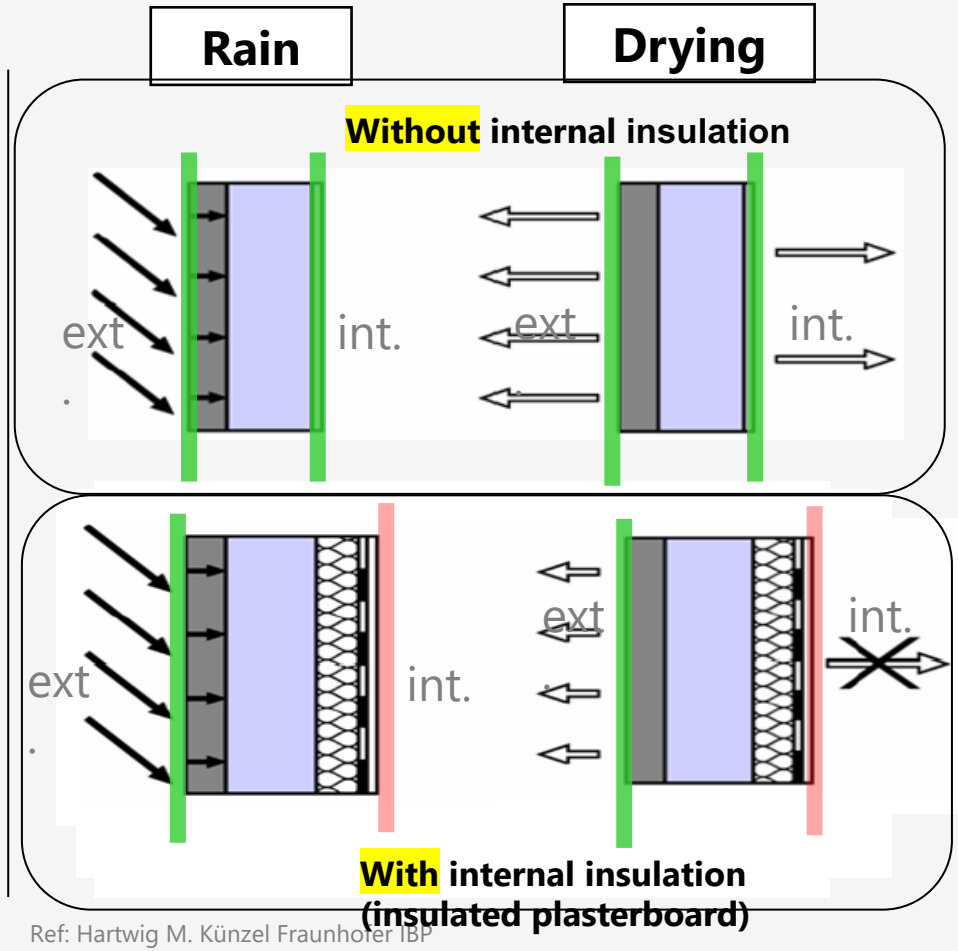


Importance of breathable insulation in Construction: Internal Wall Insulation Solid Masonry Example

Moisture can penetrate the wall

- **Wind driven rain**
- **From the ground**
- **Internal moisture vapour**

Breathable natural fibre insulation Allows moisture vapour to diffuse from External to internal



Non breathable insulation prevents diffusion from external to internal

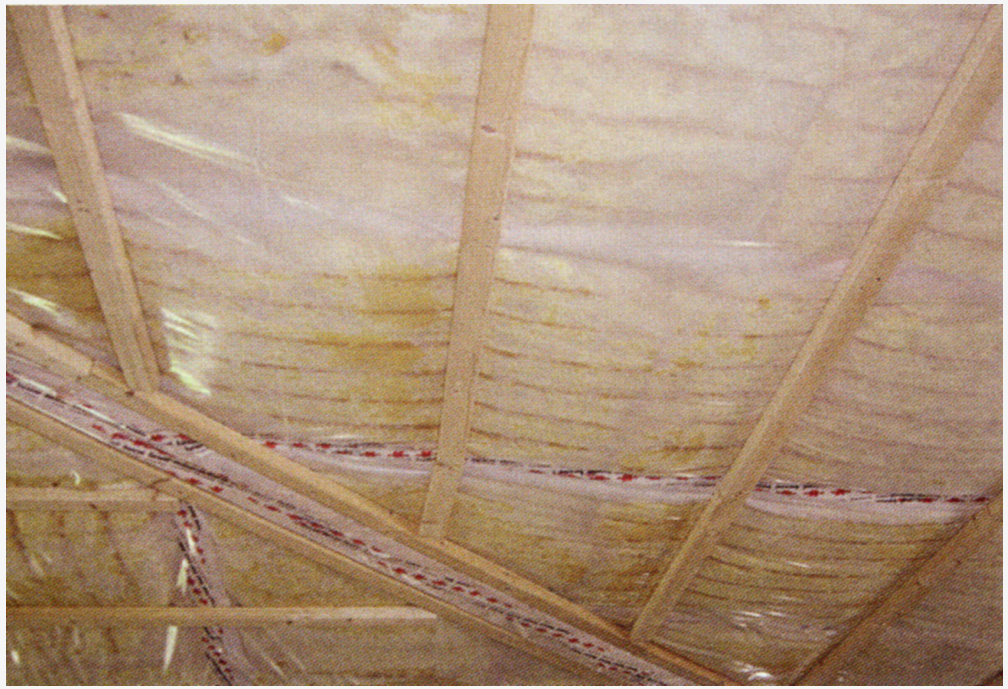
Ref: Hartwig M. Künzel Fraunhofer IBP 2006

Importance of breathable insulation in Construction: New Build Construction Example

Release of Built in Construction Moisture

Problem:

Sweating in the summer behind vapour closed barrier (or non breathable insulation below rafter)



Solutions:

Combine
breathable natural
insulation
with variable diffusion membrane

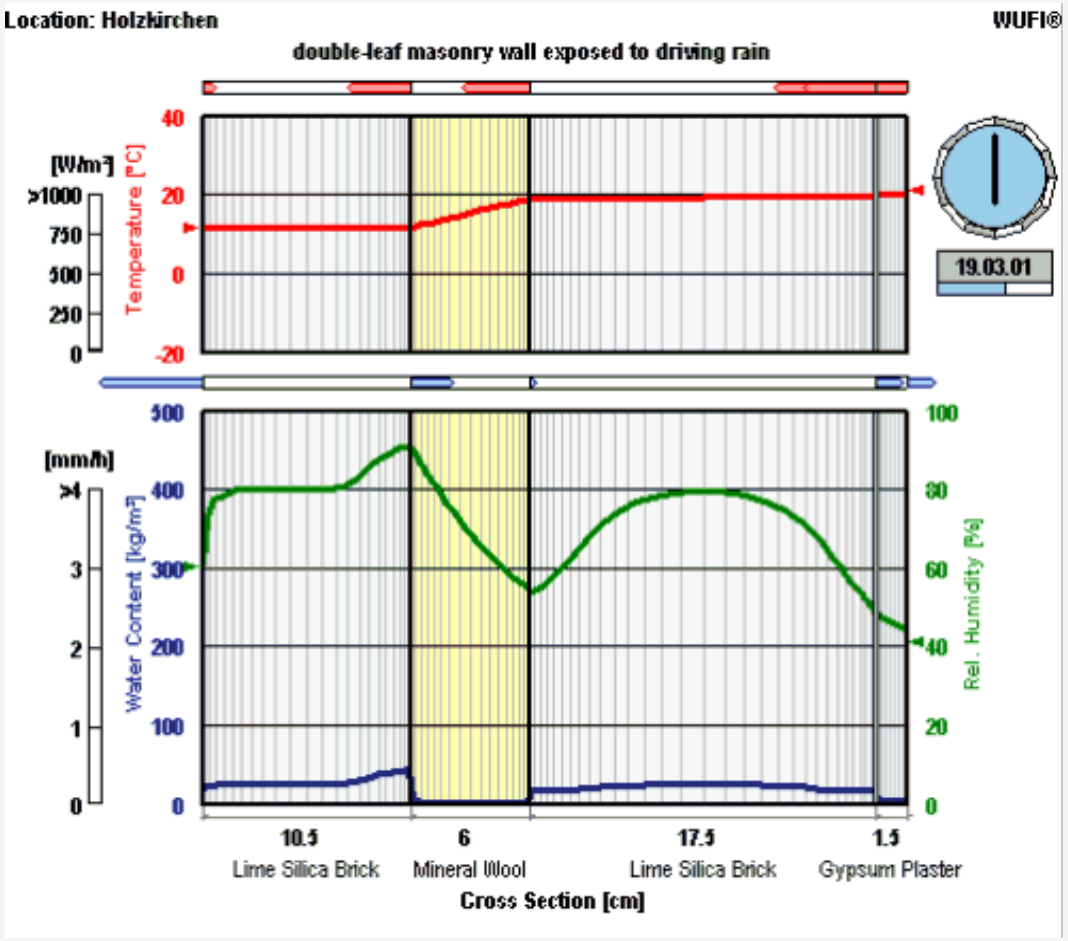
Breathable internal finish with
breathable insulation between rafter
And ventilation directly above

Assessing the Moisture Risks

Computer- assisted simulation program for heat and humidity transports (dynamic) WUFI

- Moisture load needs to be less

  than drying reserves



Current EN 15026: 2007 provides higher accuracy compared with EN 13788:2011 in BS 5250.

Thank you

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BUILDING SYSTEMS
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www.ecologicalbuildingsystems.com

info@ecologicalbuildingsystems.com

Irl: 046 9432104

UK: 01228 711 511