ASBP The Alliance for Sustainable Building Products

Natural Fibre Insulation:

Thermal Performance, Moisture Control & Indoor Air Quality

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Balancing Heat and Moisture

Need to strike a balance between insulation thickness, energy savings, condensation risk and return on investment.

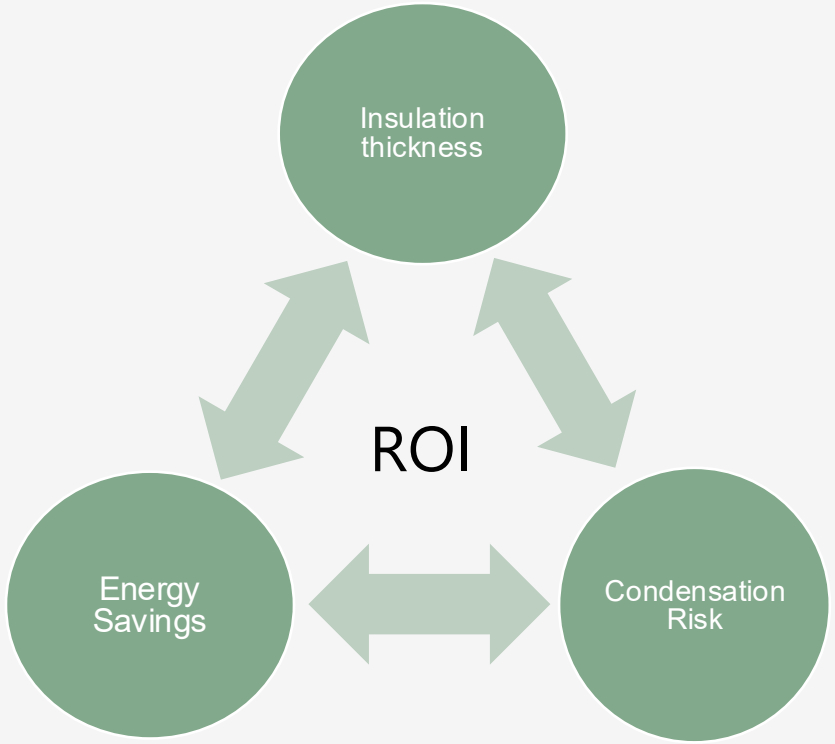
Not about lowest U-value.

High insulation thickness can introduce condensation risks.

Over-heating can’t be ignored.

Thin insulation provides safety and savings.

IAQ intertwined with moisture & humidity.



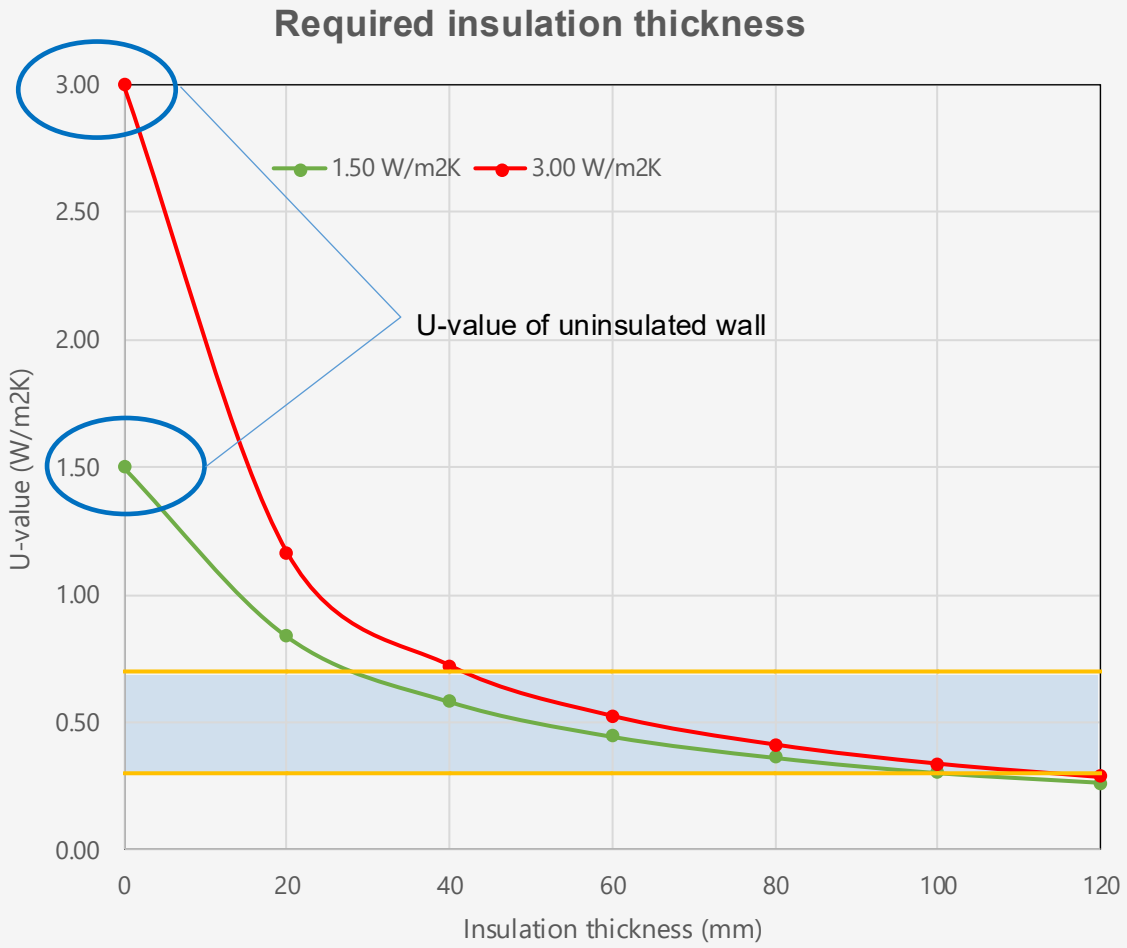
Performance requirements – U-values

The Building Regulations sets out a target U-value of 0.30W/m2K for existing walls with a threshold value of 0.70W/m2K.

Means the performance level can be anywhere within this zone but U-values above 0.30W/m2K need to meet certain criteria (not onerous)

Requirements are more flexible for historic properties.

Impact of Insulating Solid Wall with NFI

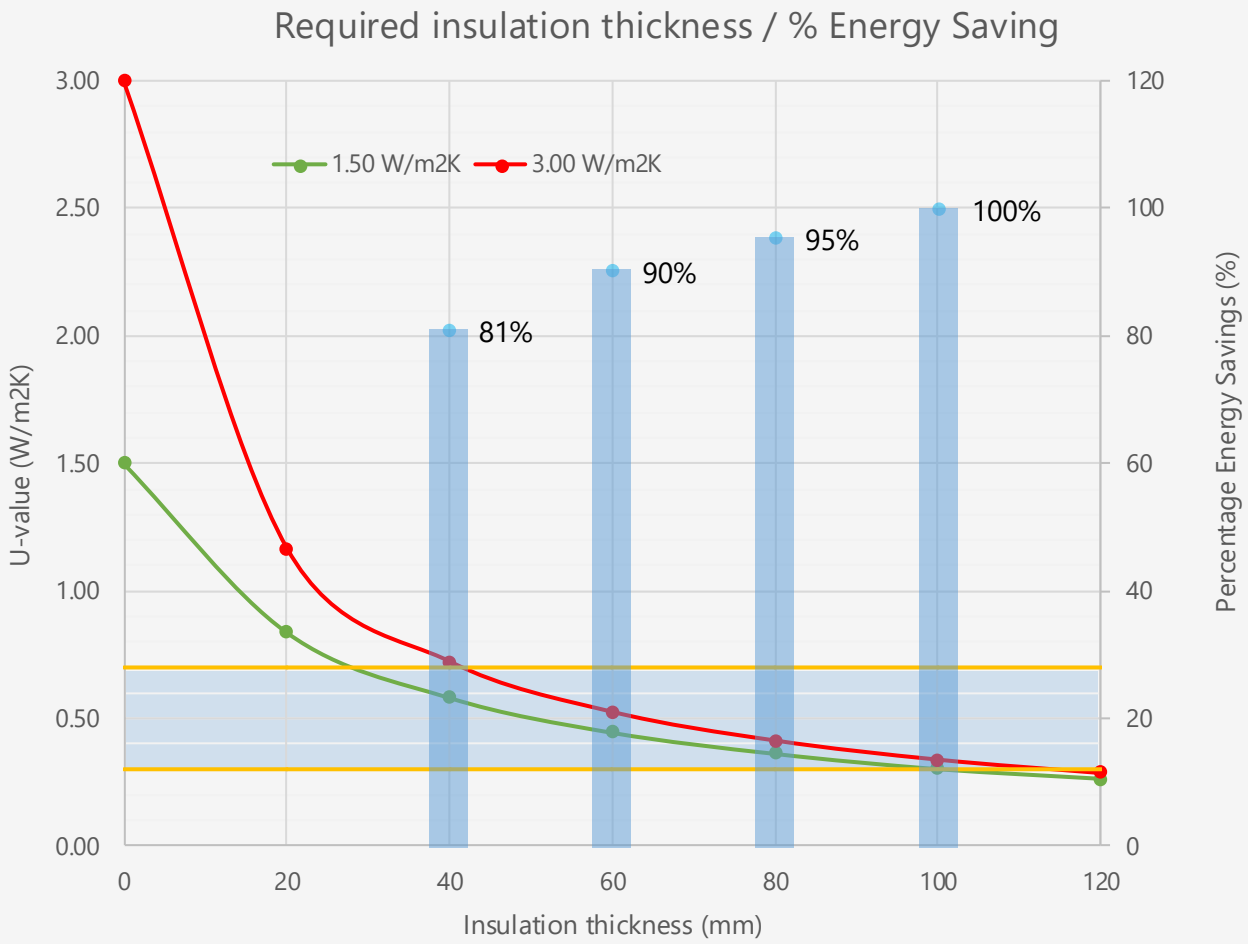


A relatively thin layer of insulation dramatically improves the performance and we start to enter the threshold zone with only 40mm of insulation.

A 60mm layer puts performance right in the middle of this zone.

Performance improvement is more dramatic the higher the U-value of the uninsulated wall.

Energy Savings



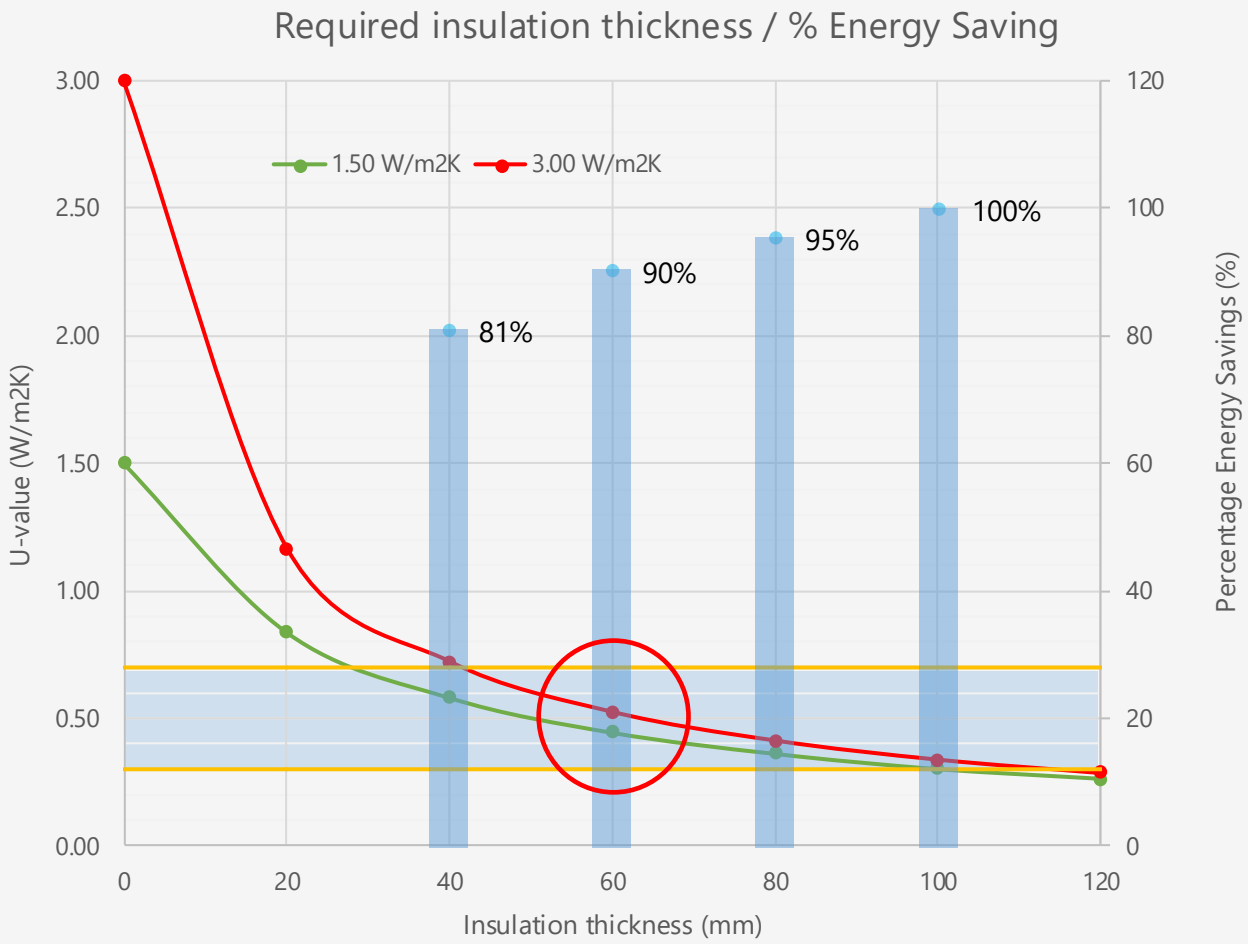
When we look at this in terms of energy savings we see that a thick layer, potentially greater than 100mm, gives us the required performance level of 0.30W/m2k but that a thinner layer also achieves a significant percentage performance improvement.

80mm = 95%

60mm = 90%

40mm = 81%

Optimum Thickness

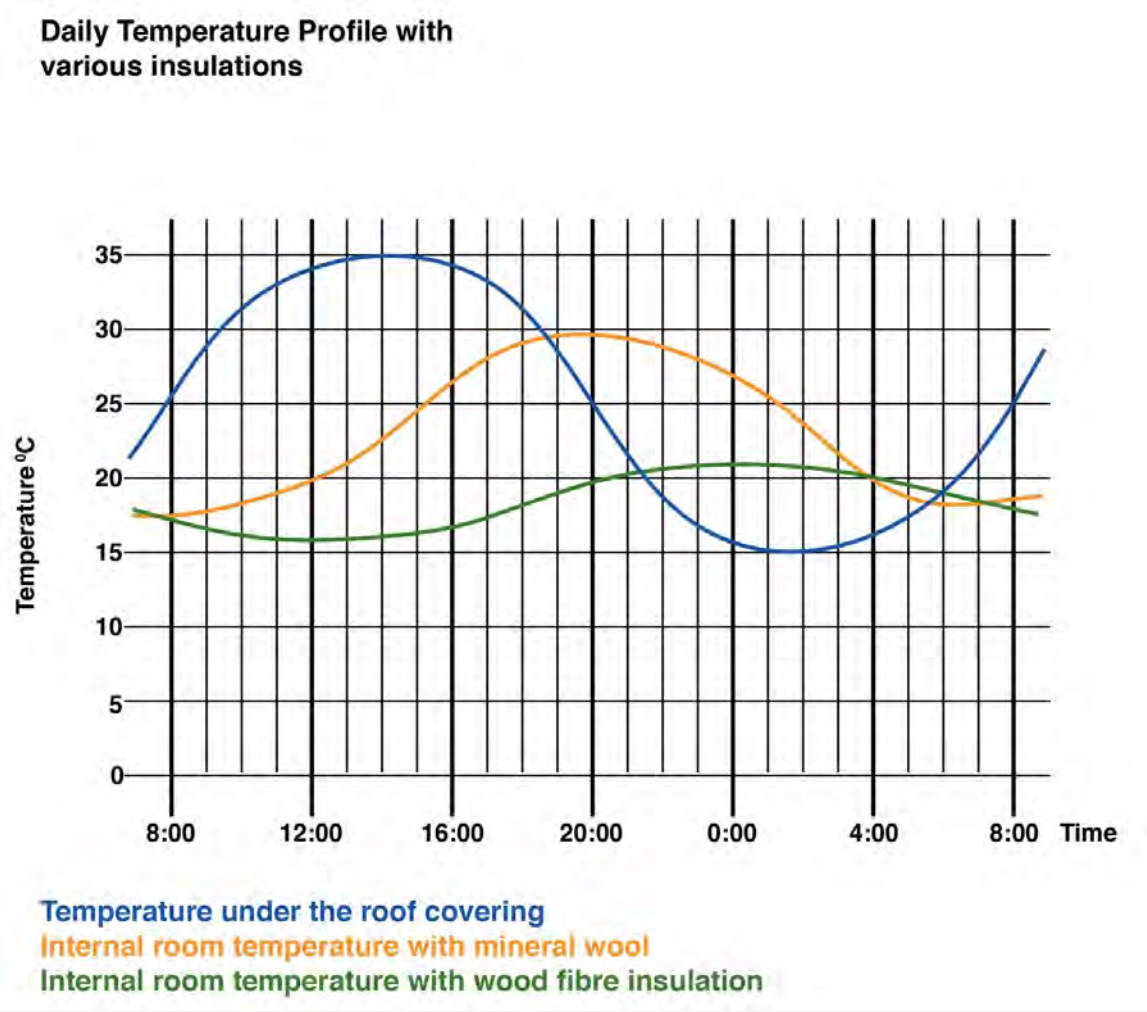


There is a sweet spot for IWI that hits the majority of drivers.

60mm of insulation achieves 90% of potential Energy Savings compared to Building Regs target.

60mm also provides a low risk option for potential of interstitial condensation at the internal wall interfcae.

Thermal Mass and Heat Moderation through Phase Shift



Heat buffering shifts frequency of heat cycles out of phase.

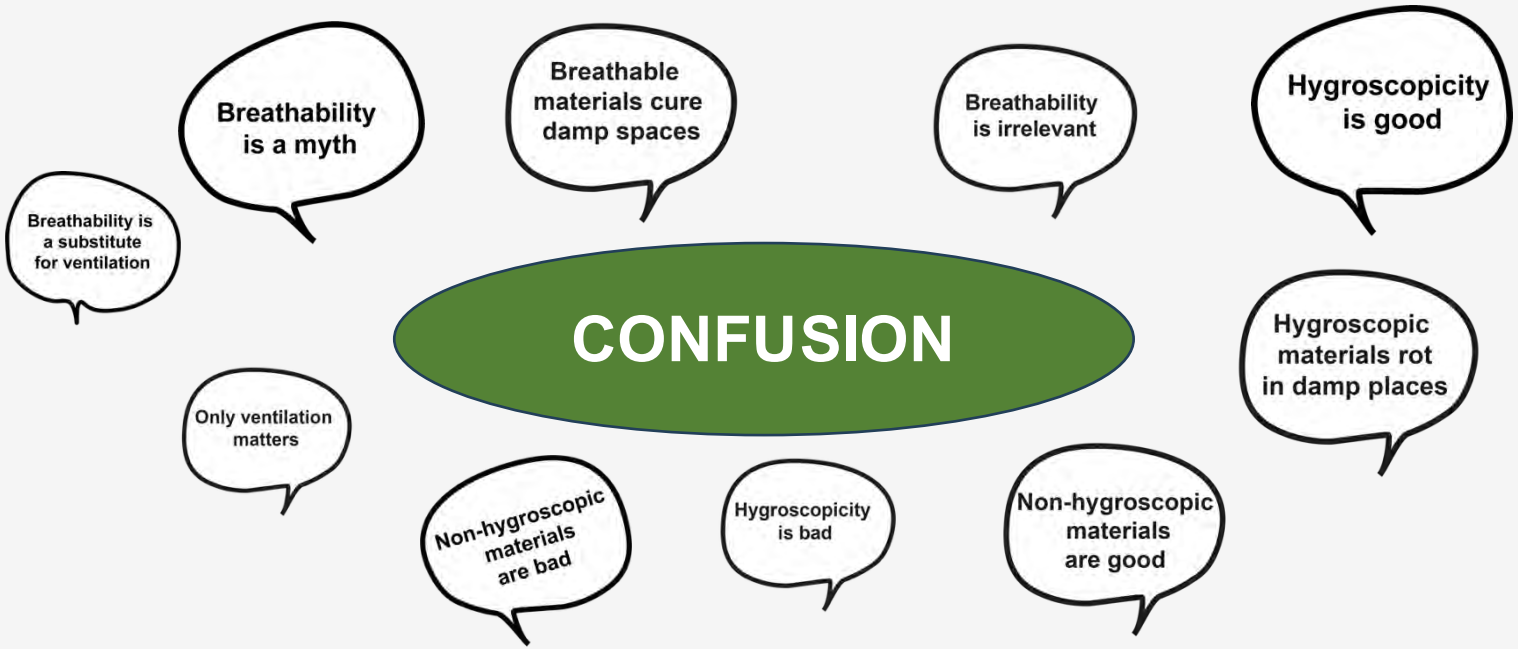
Wood fibre – heat maximums out of phase by 12hrs = **12hr phase shift**.

Mineral wool – heat maximums out of phase by 6 hrs = **6 hr phase shift**

Achieved by:

- Higher density
- Higher specific heat capacity
- Low thermal conductivity

The Challenge with Breathability



Need to understand:

- What breathability is and what it does within the building context.
- What Building Regulations and standards say about it.
- What hygroscopicity is and its role in moisture buffering (important for NFI).

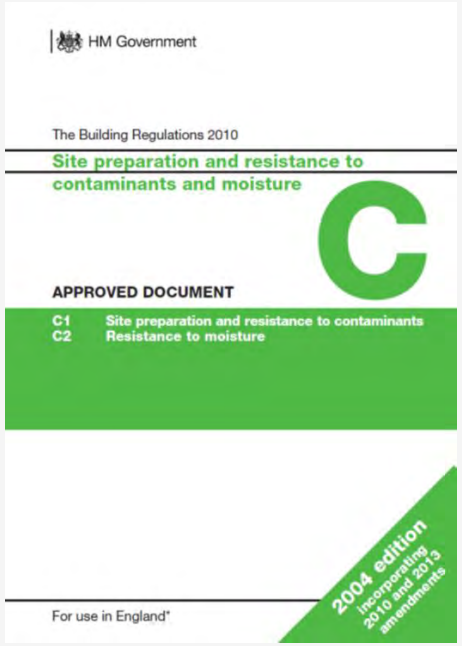
What is Breathability

- A system that allows the safe transmission and removal of excess water vapour.
- Needs a degree of vapour control, pathways for moisture movement and materials to buffer humidity fluctuations to function most effectively.
- Allows for the unventilated dispersal and removal of water vapour from within the building fabric preventing the accumulation of harmful water and persistently high humidity.
- Principally provides a means of mitigating the risk of interstitial condensation, i.e. condensation within the building fabric.
- Provides a marginal benefit in mitigating surface condensation risk (primarily driven by internal humidity, ventilation and surface temperature).
- Breathability is not a substitute for ventilation.
- Breathability is recognised in building regulations.

Aspects of Breathability

- **Vapour control** – Could include AVCL such as intelligent membranes, positioning components according to vapour resistance and limiting voids. Prevents moisture over-loading and bottlenecks.
- **Pathways** – Requires higher degrees of vapour openness. Provides a means of egress for water vapour and prevents moisture over-loading and bottlenecks.
- **Buffers** – Requires certain types of hygroscopicity. Provides a means of dampening fluctuations in humidity and storing water in a safe form during transient periods of high humidity.

Building Regulations – Part L (Energy) & Part C (Moisture)



How Part L Interacts with Part C

0.20 *This approved document, Approved Document L, Volume 1, provides guidance and examples on upgrading thermal elements. For interstitial and surface condensation, a lesser standard may be acceptable. Guidance in Approved Document C should be followed.*

Appendix C: Work to thermal elements

*Assess condensation risk in roof space and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation (**BS 5250** and **BS EN ISO 13788**).*

British Standard – BS5250:2021

Recommendations for the management of moisture in buildings using an integrated and pragmatic approach.

This includes the management of moisture risk from interstitial and surface condensation, from too high or too low internal relative humidity, and from rain penetration or high levels of ground water.

States of water as gas, liquid and solid, and the interactions between these states. Although it doesn't explain 'bound water'.

Describes the principal sources of moisture in buildings, its transportation and deposition and provides recommendations and guidance on how to manage those risks during the assessment, design, construction and operation of buildings.

Includes BS EN 15026 for condensation risk assessment (dynamic modelling) in addition to BS EN ISO 13788 (steady state modelling).

Breathability – Moisture Buffering

BS5250 – What it Says About Hygroscopicity

Hygroscopic materials can be beneficial….

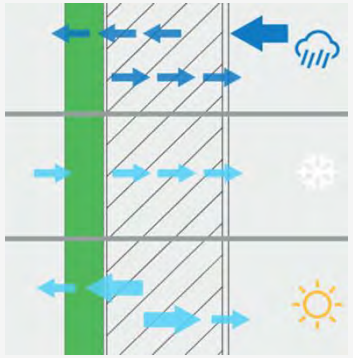
D.4 Hygroscopic materials

Most materials are hygroscopic (able to absorb and desorb water vapour). This can have a beneficial buffering effect, reducing the risk of both surface and interstitial condensation during rapid fluctuations of temperature and vapour pressure. However, hygroscopic materials exposed to high levels of humidity can, over time, absorb sufficient moisture to cause damage to elements of structure, to finishes, to furniture and to furnishings.

…providing we avoid conditions of persistently high humidity

Is Breathability Needed?

- BS EN ISO 13788 condensation risk analysis assumes a steady state in the building fabric, but the building fabric is not in a steady state.
- Building fabrics are dynamic. Factors that influence ongoing humidity within the fabric include:
  - Air movement/air flow
  - Interfaces & junctions
  - Solar & long wave radiation
  - Precipitation, wind speed & direction
  - Moisture in materials & rainwater absorbed during construction



- BS EN 15026 non-steady state modelling incorporates most of the above.
- Through a set of limiters, pathways and buffers we can naturally regulate humidity levels within the fabric.

BUILDING FABRICS HAVE DYNAMIC HUMIDITIES, WE CAN'T RELY ON AVCL ALONE TO MINIMISE CONDENSATION RISK – WE NEED ADDITIONAL MEANS INCLUDING BREATHABILITY

NFI is Truly Breathable (Vapour Open & Sorptive)

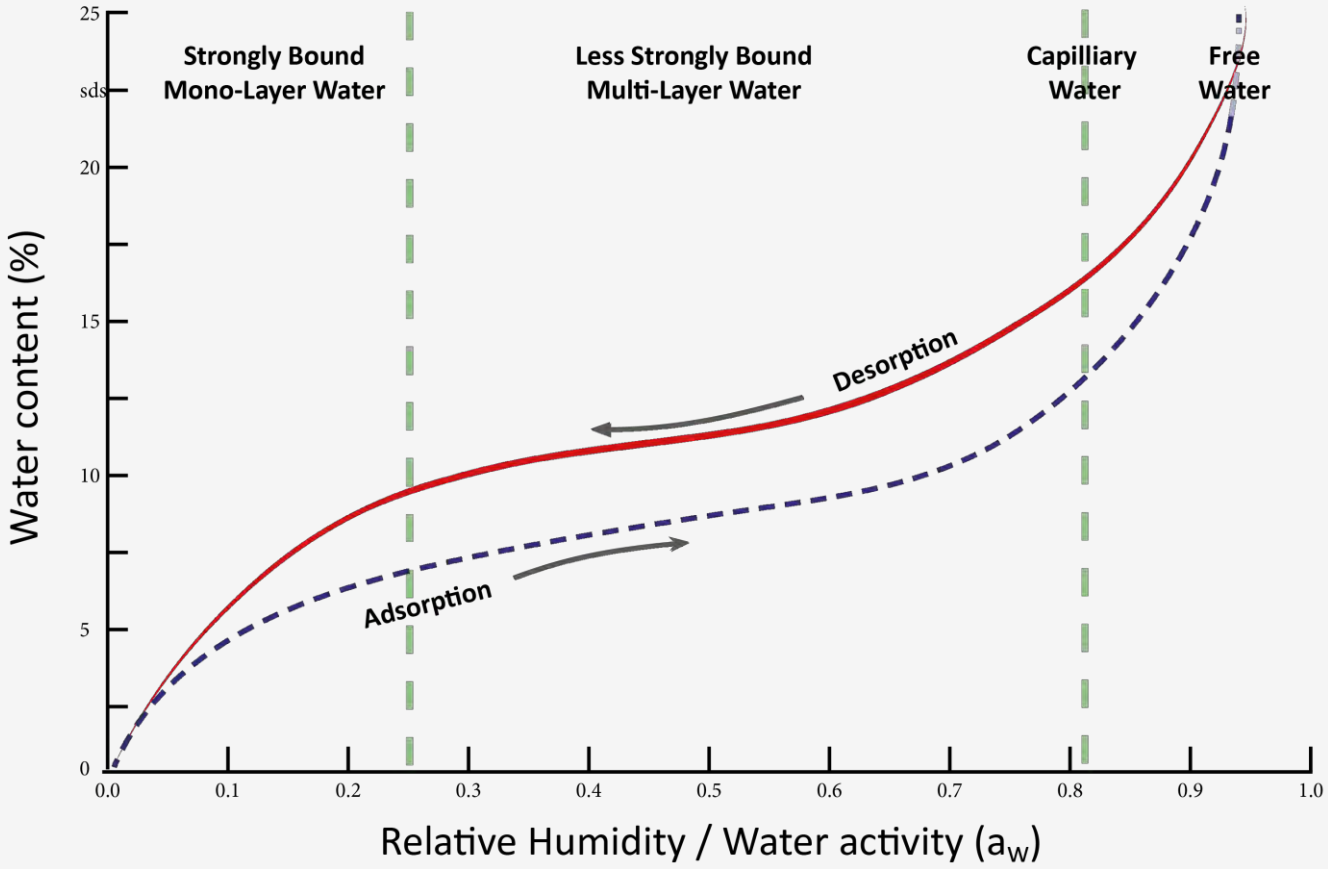
Sorption is an important aspect of a fully functioning breathable structure.

Sorption enables NFI to pull humidity away from the dew point as temperature falls.

NFI forms bound water which is less damaging than liquid water.

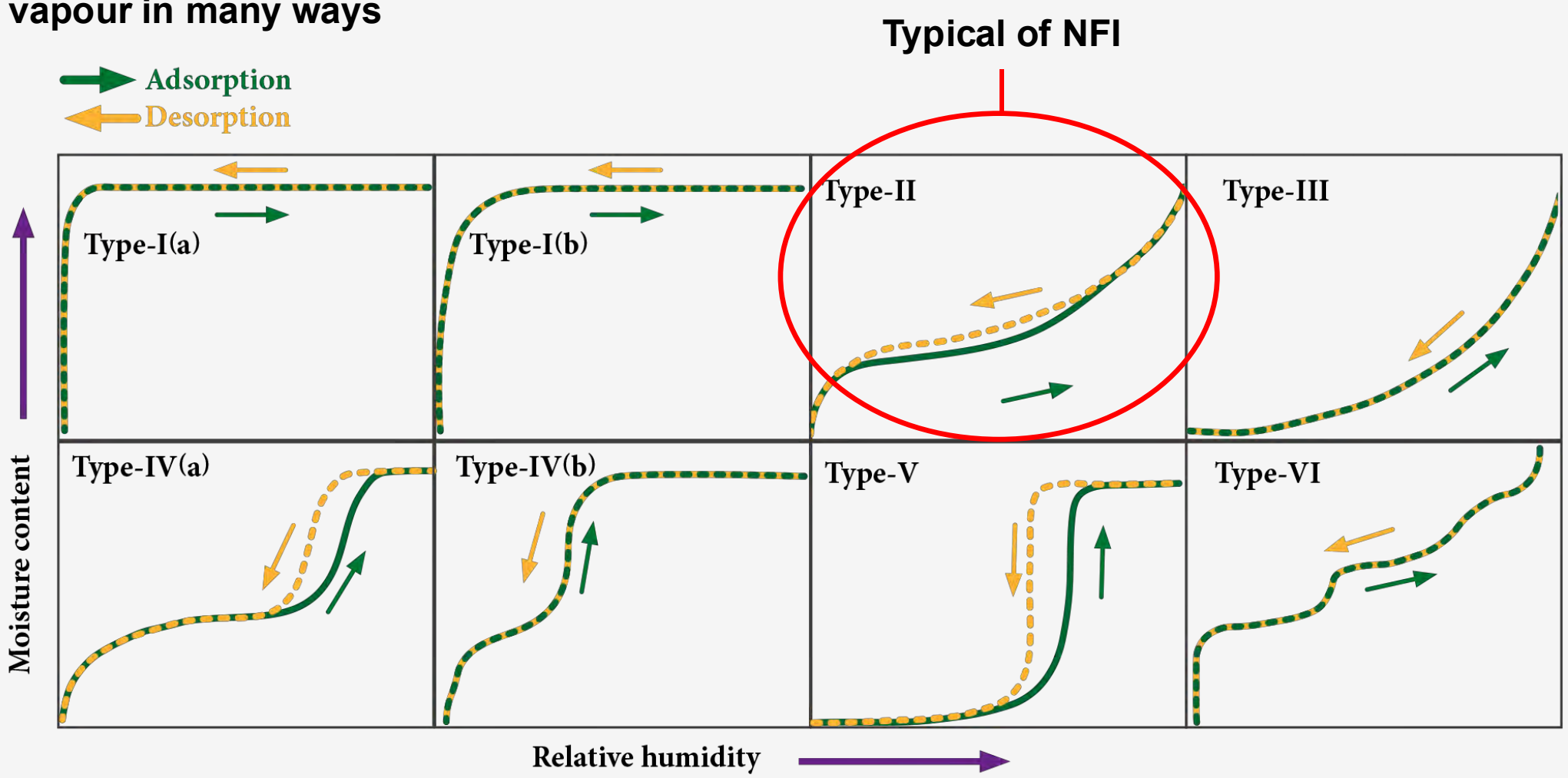
NFI transforms the building fabric into a safe moisture buffer.

Sorption is a predictable property that enables accurate modelling.



Water Sorption Isotherms

Hygroscopic materials adsorb water vapour in many ways

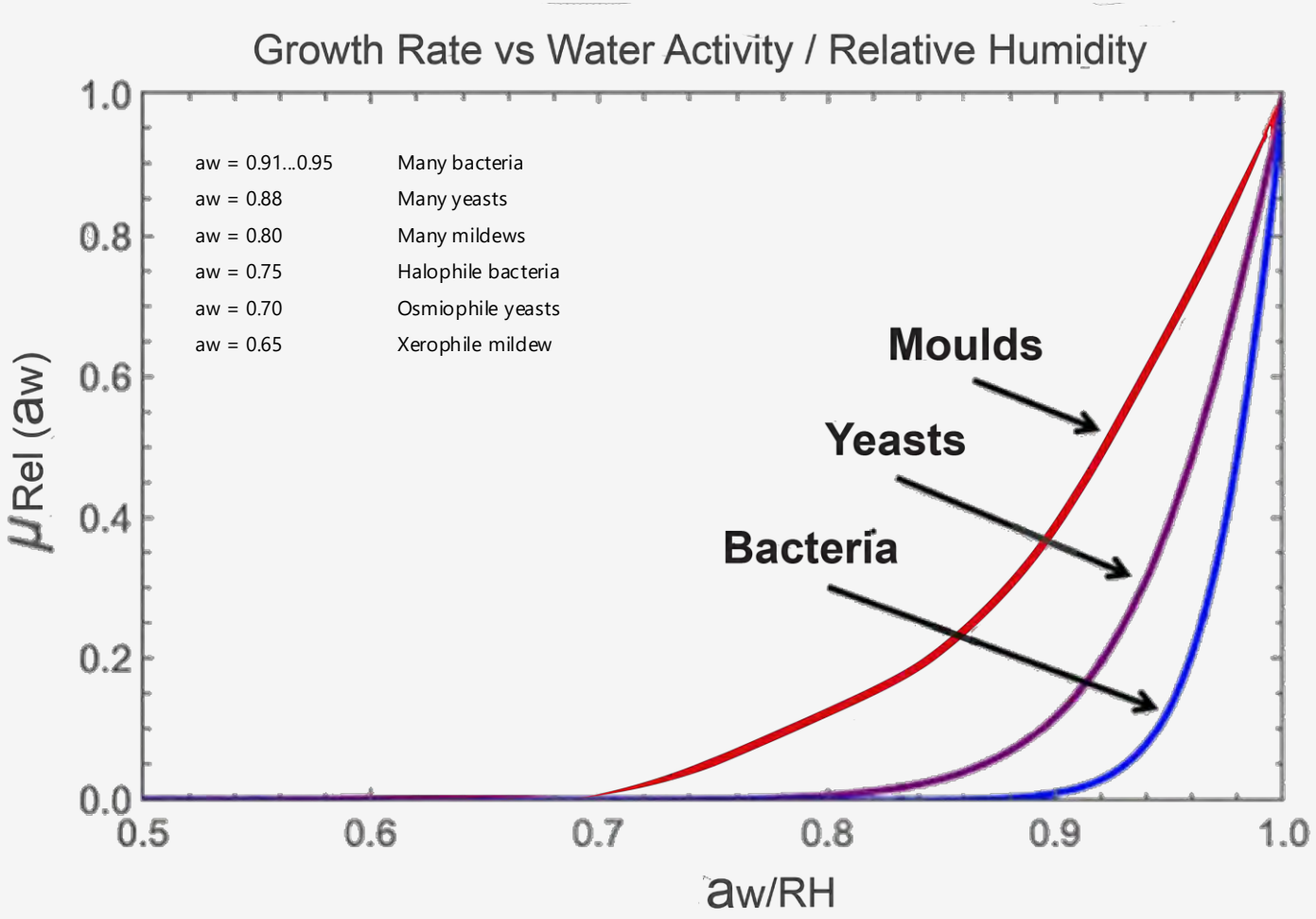


Microbial growth & Humidity/Water Activity

Almost all surfaces contain enough food for microbes to live off given sufficiently high humidity.

Mould, yeasts and bacteria can grow on hydrophilic and hydrophobic surfaces if the humidity and surface water activity is high enough.

IAQ significantly affected by Microbial VOC's and respirable particles <0.1 micron.

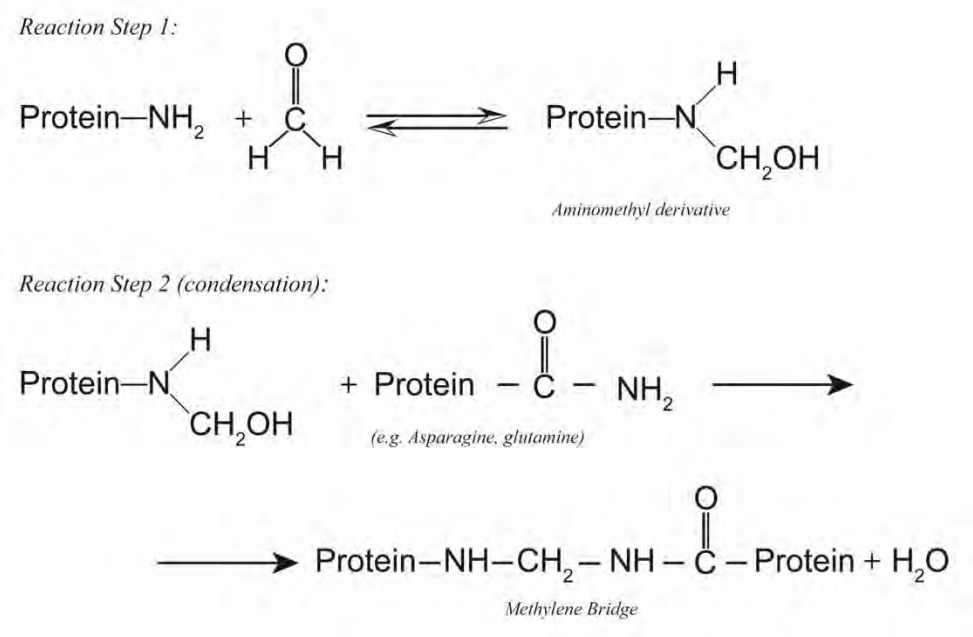


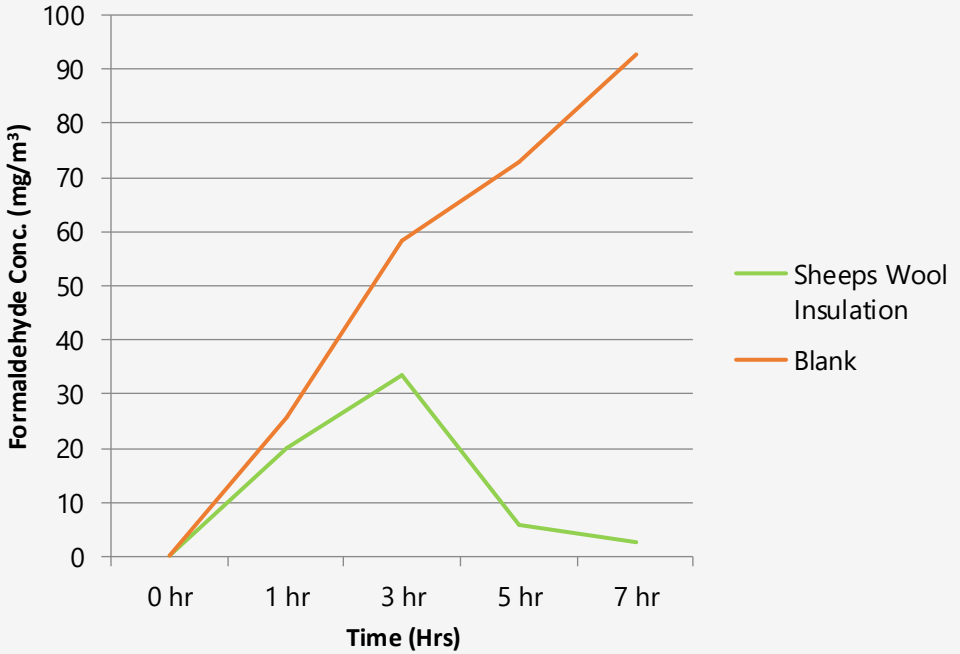
Low VOC’s

Parameter	3 Day			28 Day		
	Thermally Bonded Sheep's Wool	Thermally Bonded Flexi Wood Fibre	AgBB Requirement	Thermally Bonded Sheep's Wool	Thermally Bonded Flexi Wood Fibre	AgBB Requirement
TVOC	< 0.01 mg/m³	2.0 mg/m³	≤ 10 mg/m³	< 0.01 mg/m³	2.0 mg/m³	≤ 1 mg/m³
CMR Substances	< 1 µg/m³	<1 µg/m³	≤ 10 µg/m³	< 1 µg/m³	<1 µg/m³	≤ 10 µg/m³
Formaldehyde	< 0.01 mg/m³	< 0.01 mg/m³	-	< 0.01 mg/m³	0.019 mg/m³	≤ 0.12 mg/m³

Parameter	Wood Fibreboard (under floor)			
	3Day	AgBB Requirement	28 Day	AgBB Requirement
TVOC	0.52 mg/m³	≤ 10 mg/m³	0.02 mg/m³	≤ 1 mg/m³
CMR Substances	< 1 µg/m³	≤ 10 µg/m³	<1 µg/m³	≤ 10 µg/m³
Formaldehyde	< 0.01 mg/m³	-	0.003 mg/m³	≤ 0.12 mg/m³

Formaldehyde Reduction – Sheep's Wool





Sheep's wool achieved a reduction from 90 mg/m^3 to <3 mg/m^3 Formaldehyde in 7 hrs with 10-15% desorption.

Similar tests by WRONZ achieved reduction from 7mg/m^3 to <0.1mg/m^3 in 45 mins with no recorded desorption.

Summary

- Thinner layers of NFI in retrofit provide safer systems and significant savings.
- With NFI as little as 40mm of IWI complies with Building Regs.
- NFI is best suited for reducing overheating risks.
- NFI is sorptive & vapour open = truly breathable.
- Breathability is not a substitute for ventilation.
- NFI can buffer moisture and hold it in a safe less active form.
- MVOC’s are a significant source of VOC’s and risk to health.

Thank you

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therma fleece®
British Wool Insulation