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# Insulation – more than just U-values

## Healthy Buildings 2020, 27th February, London

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Vice-Chair

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# NATURAL FIBRE INSULATION GROUP

***An industry collaboration to better communicate the benefits of natural fibre insulation products and systems***

backtoearth

ecological BUILDING SYSTEMS

ecomerchant ETHICAL · HEALTHY · SUSTAINABLE

lime|green®

MIKE WYE & ASSOCIATES

NBT Natural Building Technologies SOPREMA

pavatex SOPREMA

SCHOOL OF NATURAL BUILDING

STEICO engineered by nature

therma fleece® Nature's finest insulation

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# Group activities

## Education, training and events

### CPDs/events/trade shows

- Developed a CPD – ‘An introduction to natural fibre insulation’.
- Regular appearances at trade shows such as Futurebuild, Timber Expo/UK Construction Week.

### Briefing papers

- 3-part series on Environmental Product Declarations (EPDs)
- The multiple roles of insulation
- An introduction to breathability
- Health and wellbeing benefits of natural fibre insulation products and systems


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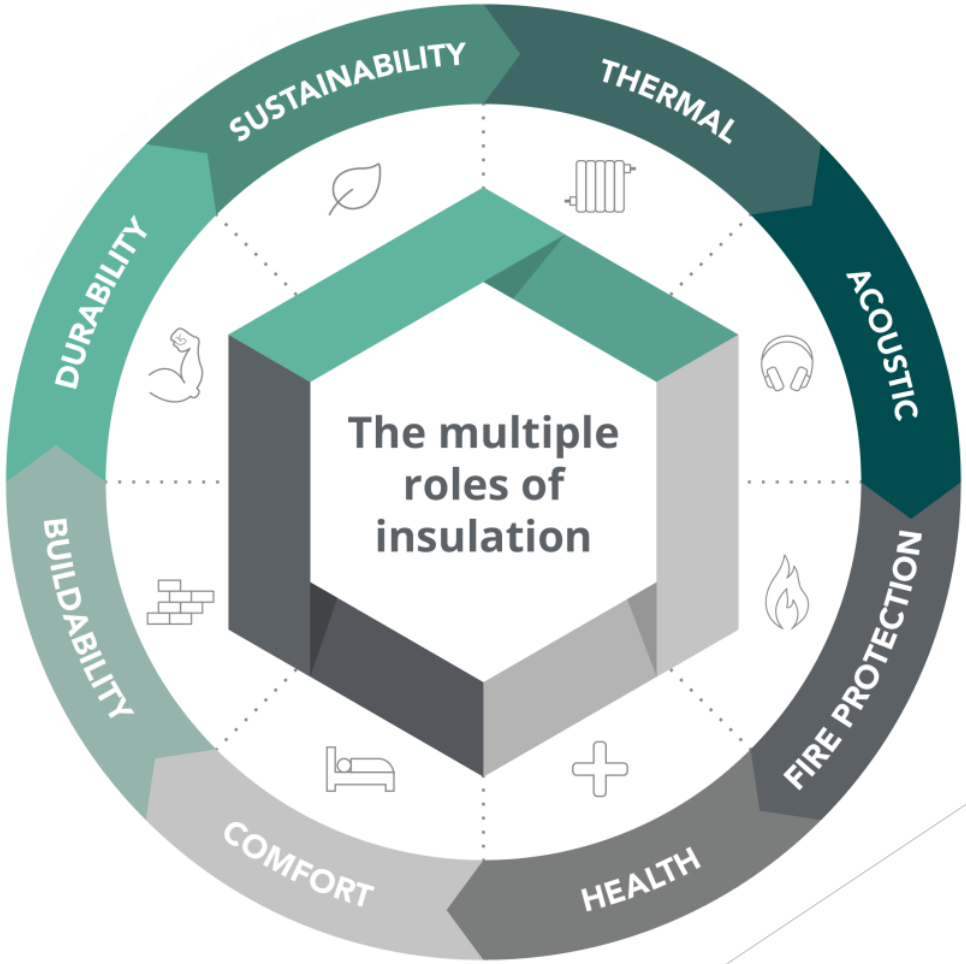
# The Multiple Roles of Insulation

**Insulation is approx. 50% of the volume of a building's fabric and profoundly influences many aspects of building performance**

**Balanced consideration of this multi-functionality often makes natural fibre insulation the superior choice**

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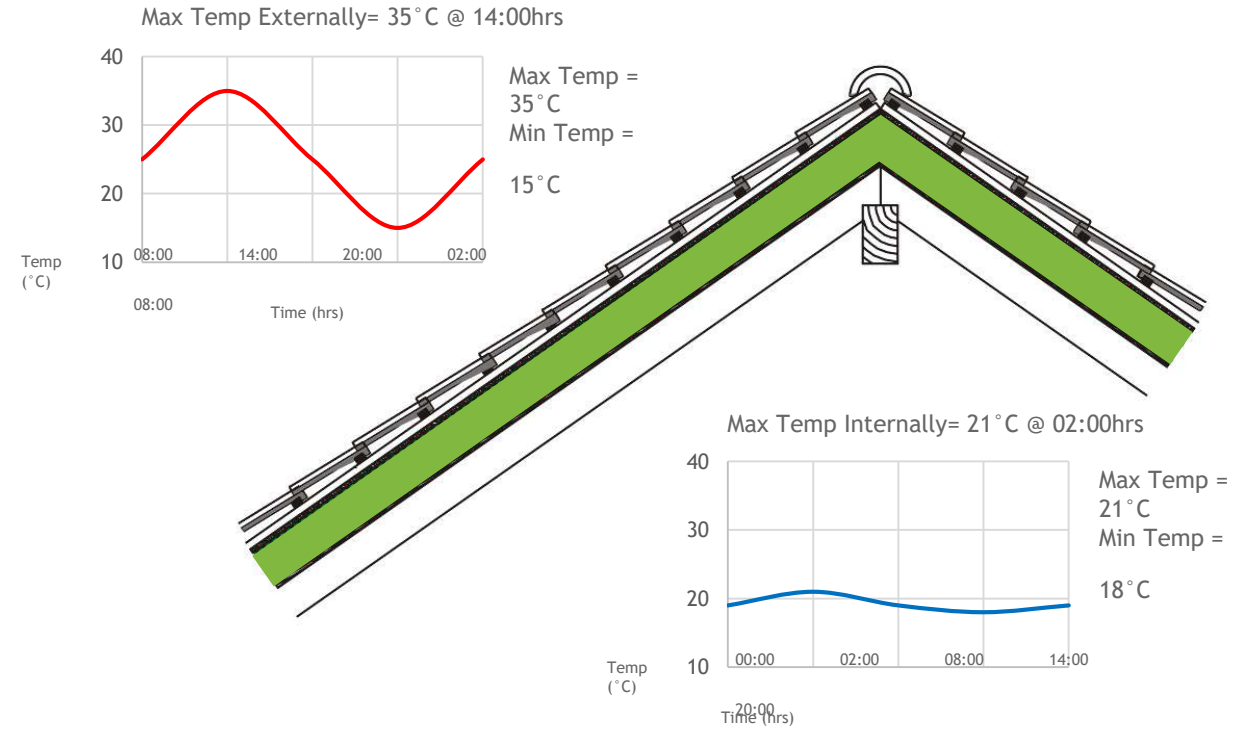
# Thermal Performance

- U-value uses steady state thermal conductivity measurements.
- Ignores ability of materials to absorb, diffuse and release heat.
- Doesn’t consider how building fabric modulates heat cycles.
- We should consider how Internal and external heat cycles are phased in relation to each other.
- We should consider how peaks and troughs in internal temperature are moderated.
- Means **Phase Shift** should be a design consideration.

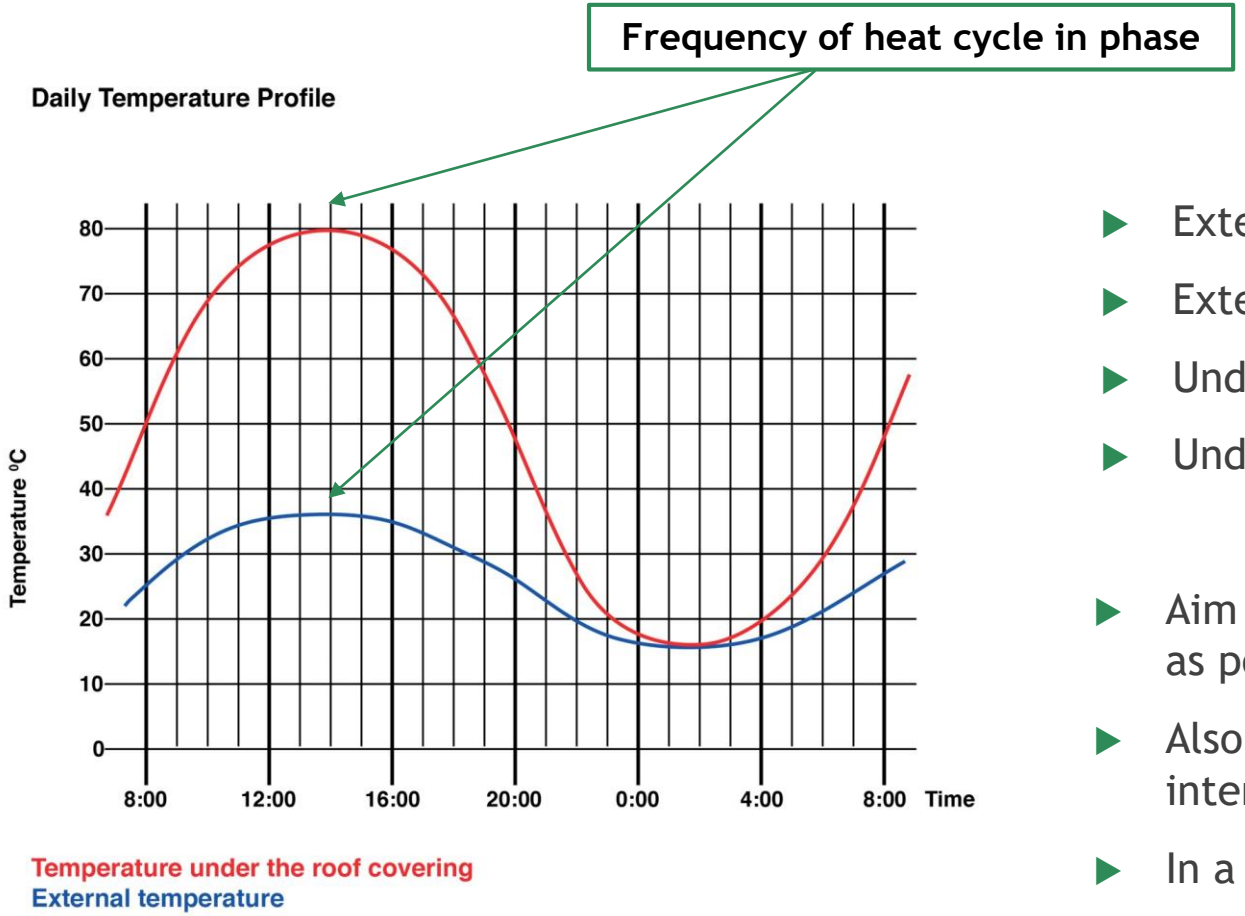
# Phase Shift Explained

- Internal and external temperature goes in cycles.
- When the peaks of each are in line, the temperature cycles are in phase.
- When they don't the cycles are out of phase.




- Phase shifting takes the peaks of heat cycles out of phase as far as possible.
- **NOT to be confused with phase change.**

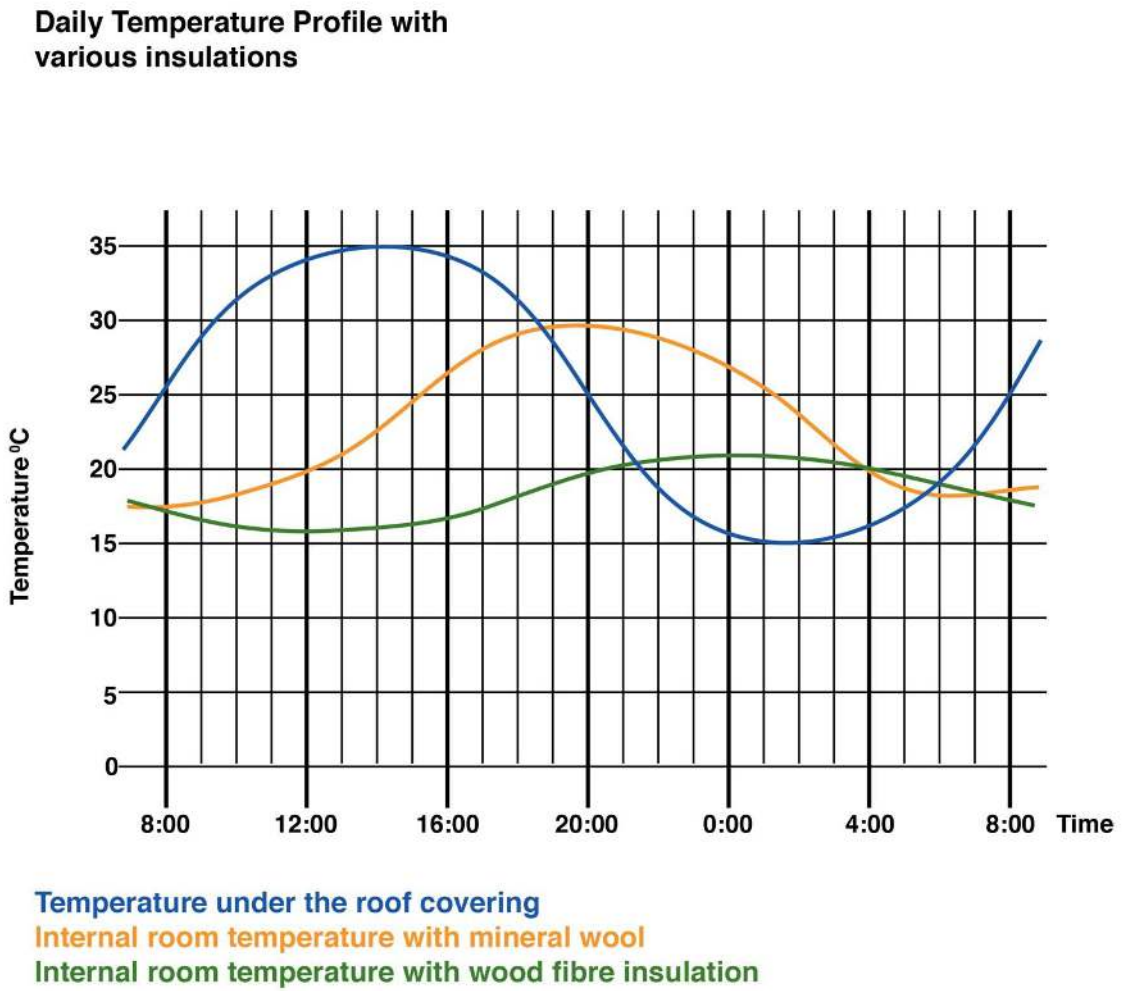
# Phase Shift Explained




- External Tº max – 35 °C @ 14:00 hrs
- External Tº min – 15 °C @ 02:00 hrs
- Under Roof Tº max – 80 °C @ 14:00 hrs
- Under Roof Tº min – 15 °C @ 14:00 hrs

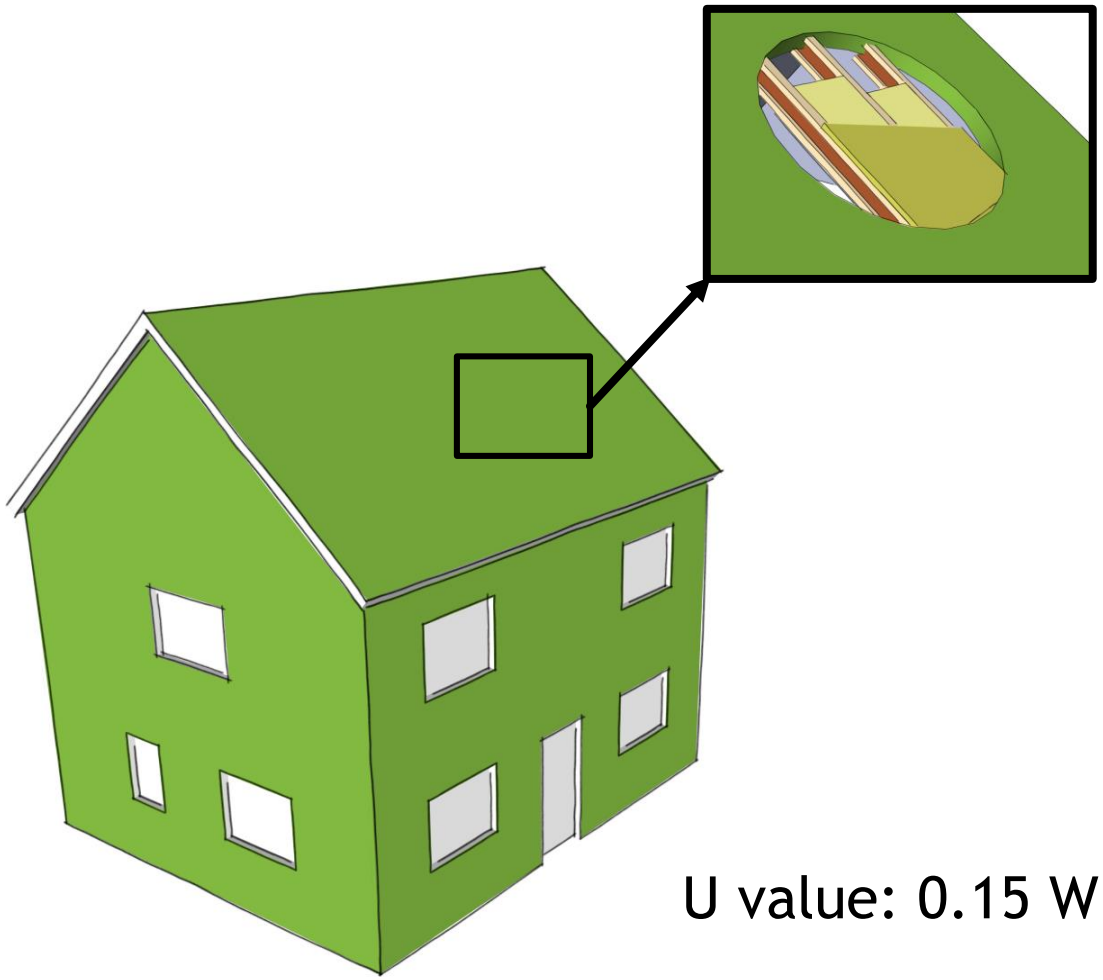
- Aim is to shift maximums as far apart as possible.
- Also need to lower amplitude or intensity of heat inside.
- In a 24hr cycle optimum shift is 12hr.

# Phase Shift Explained




- Frequency of heat cycles out of phase.
- Wood fibre – heat maximums out of phase by 12hrs = **12hr phase shift.**
- Mineral wood – heat maximums out of phase by 6 hrs = **6 hr phase shift**
- Achieved by:
  - Higher density
  - Higher specific heat capacity
  - Low thermal conductivity

# Comparative Performance

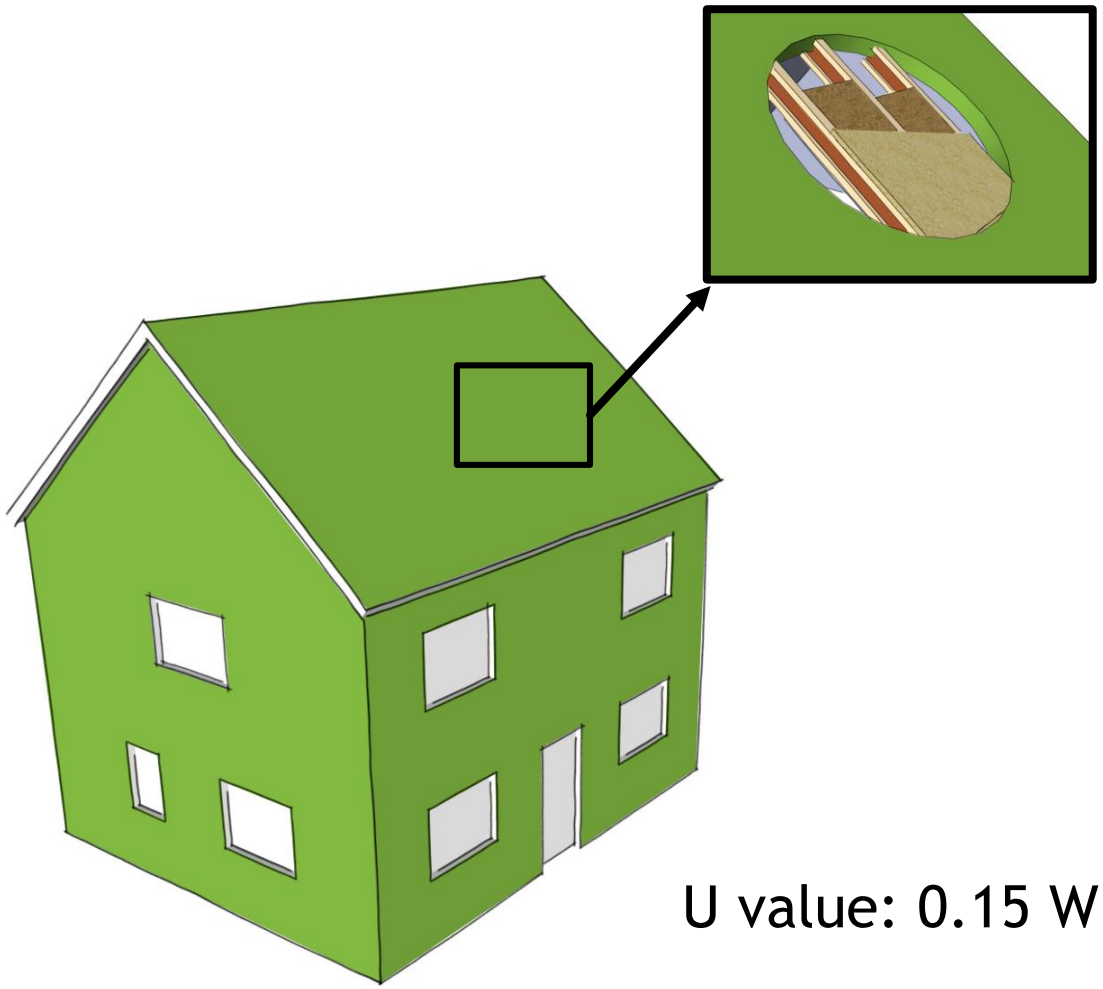


Roof build up:

- 12.5mm Plasterboard
- Vapour control layer
- 240mm I-joist with Glass wool insulation
- 40mm Mineral wool
- External roof finish

U value: 0.15 W/m$^2$K. Phase Shift: 7.1 hours

# Comparative Performance

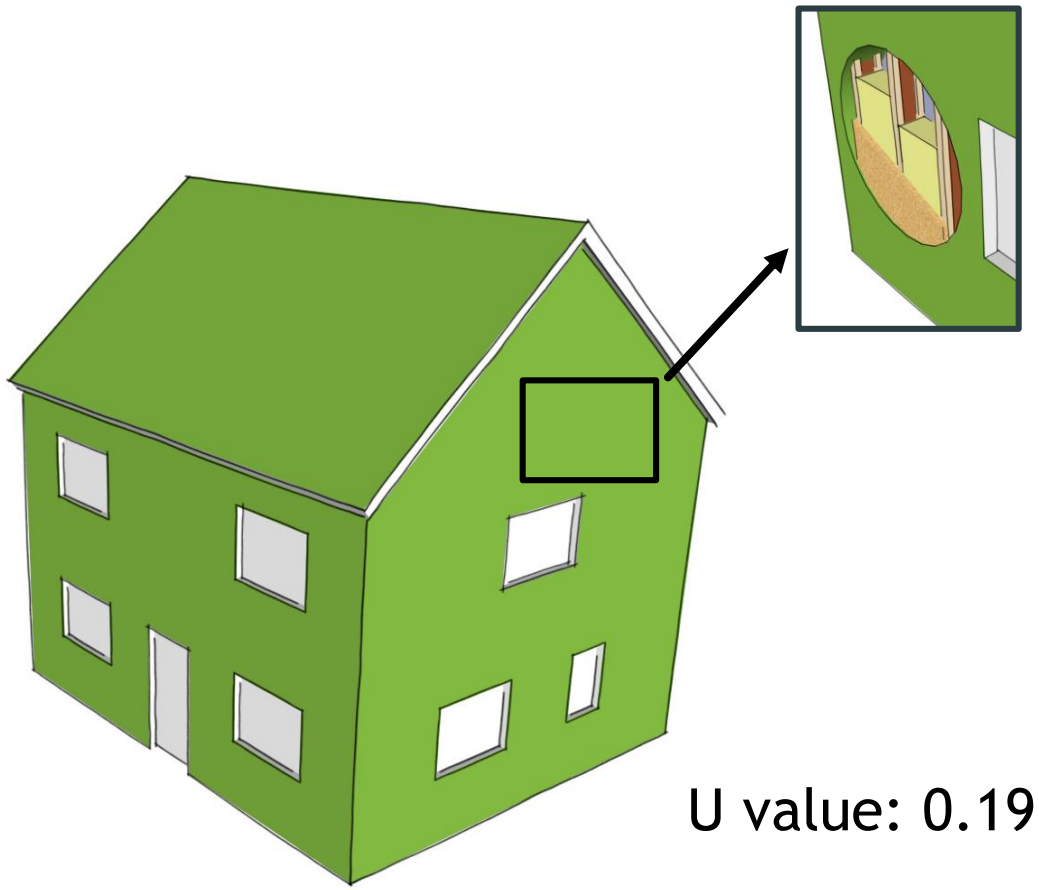


Roof build up:

- 12.5mm Plasterboard
- Vapour control layer
- 240mm I joist with flexible wood fibre insulation
- 40mm wood fibreboard
- External roof finish

U value: 0.15 W/m$^2$K. Phase Shift: 13 hours

# Comparative Performance

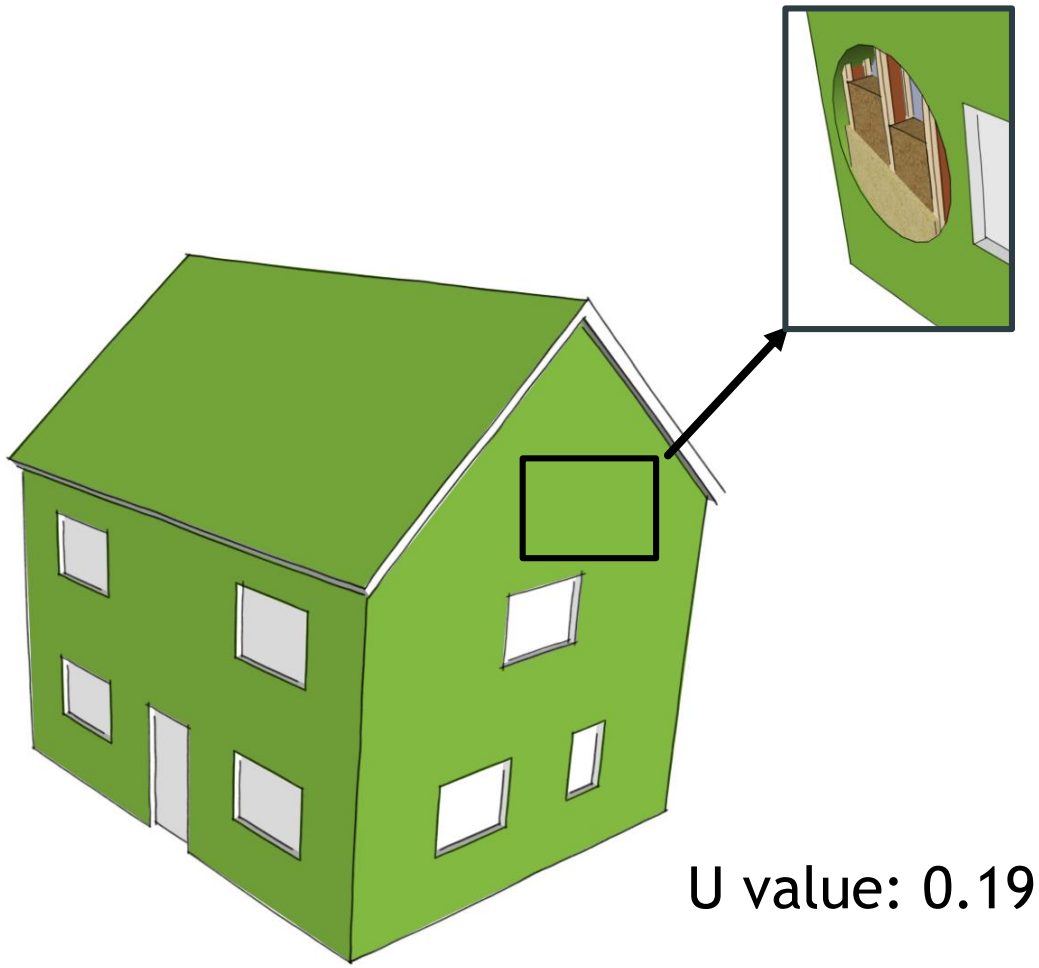


Conventional Wall build up:

- 12.5mm Plasterboard
- Vapour control layer
- 140mm PIR
- 11mm OSB
- Breather membrane
- Cavity / Brickwork

U value: 0.19 W/m$^2$K. Phase Shift: 6.8 hours

# Comparative Performance



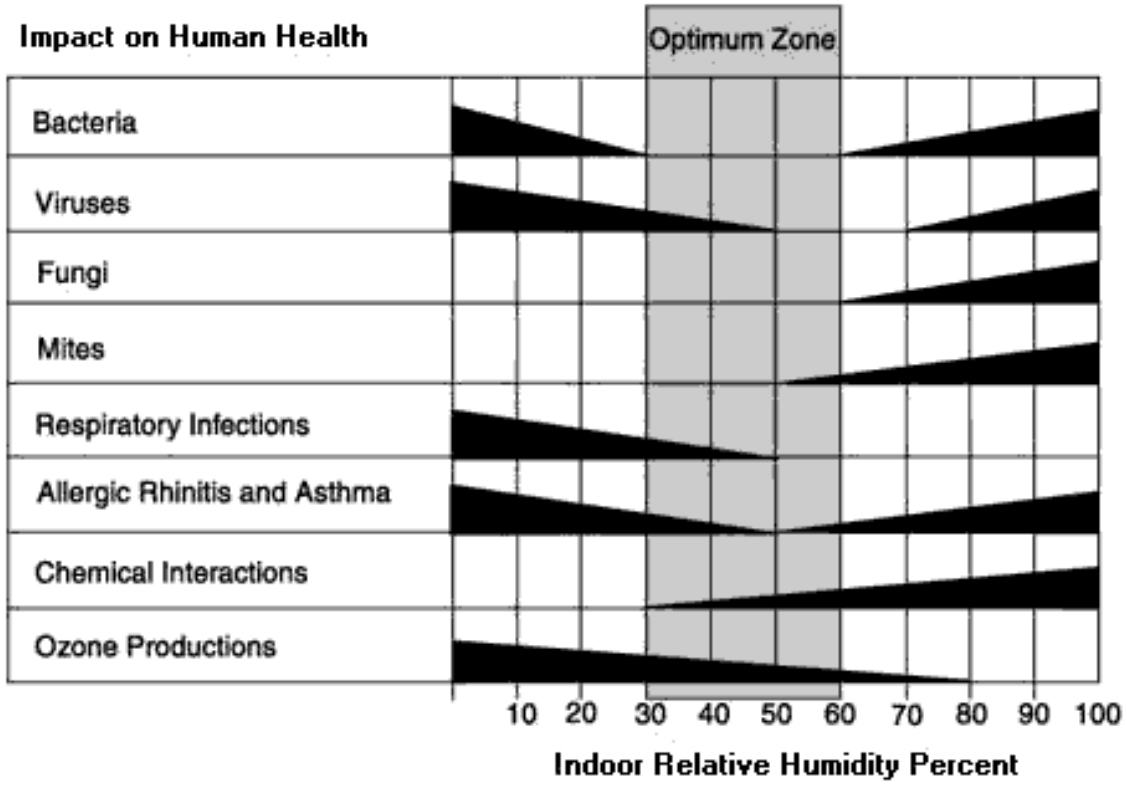
Reverse Wall build up:

- 12.5mm Plasterboard
- 15mm OSB
- 140mm flexible wood fibre
- 60mm wood fibreboard
- Cavity / Brickwork

U value: 0.19 W/m$^2$K. Phase Shift: 12 hours

# Humidity Regulation

- Moisture can cause health problems and damage the building fabric
- Breathable materials help keep humidity within the optimum zone for human health.
- Breathable materials bind moisture in a harmless way.

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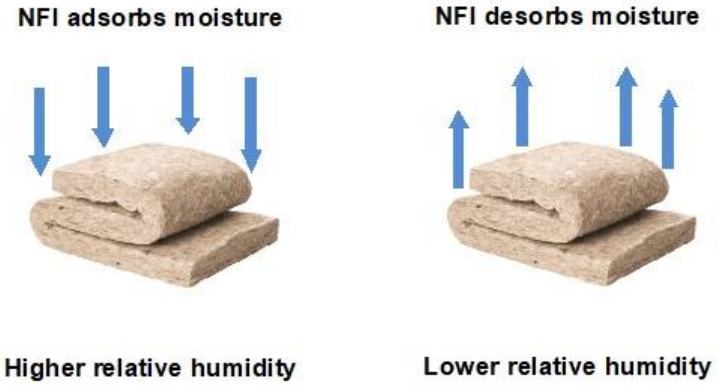
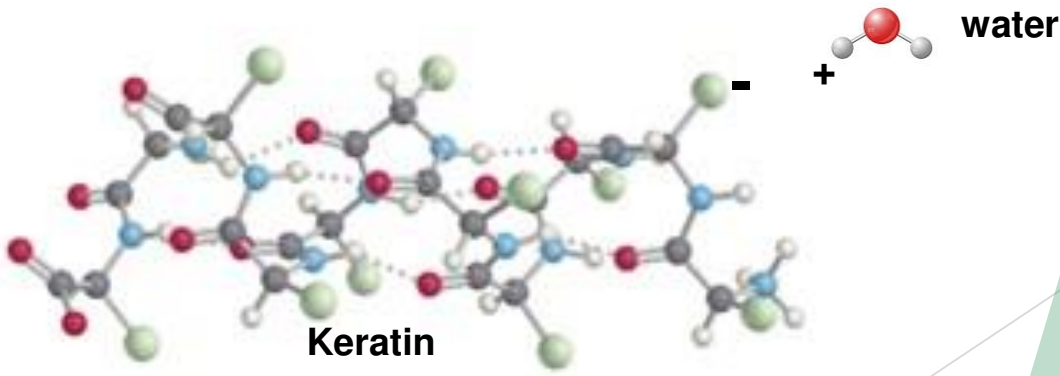
# Breathable Natural Fibre Insulation

- Adjusts its moisture content to be in balance with surrounding humidity. Adjusts surrounding humidity to be in balance with its moisture content.

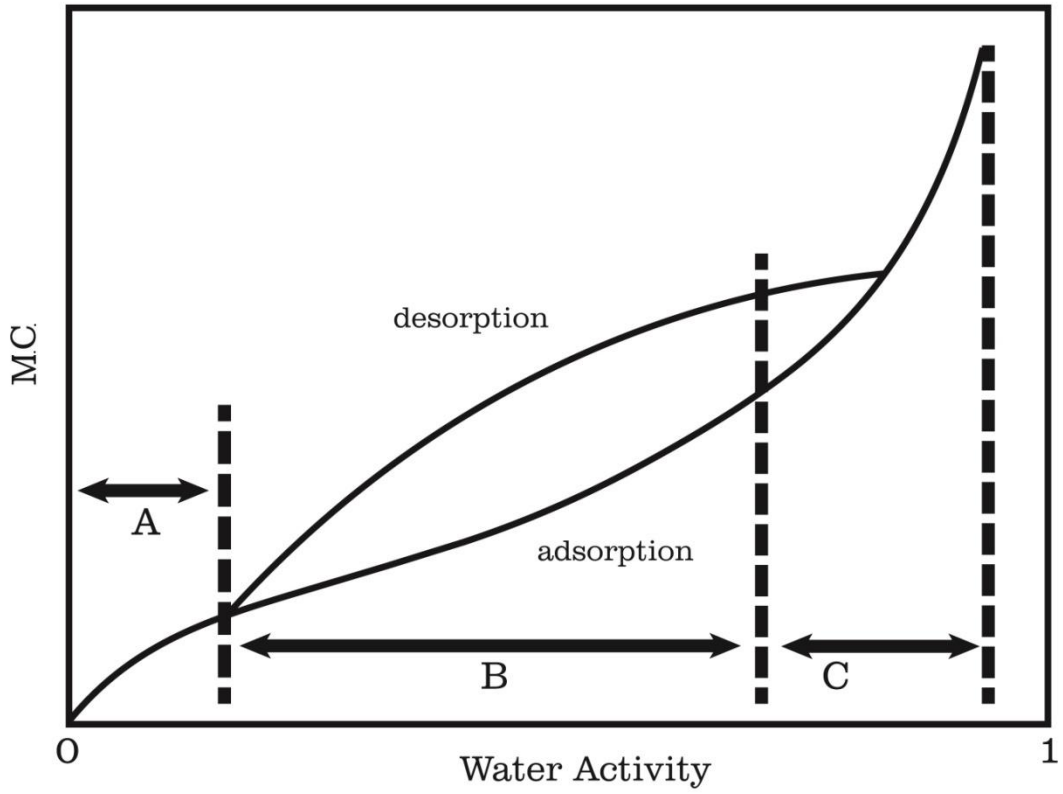



- Is able to bind water molecules in a harmless way.




- Is vapour open

# Humidity Buffering




**A –** strongly bound

**B** – less strongly bound

**C –** free water

**Zone B** is the humidity buffering zone

# 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 |

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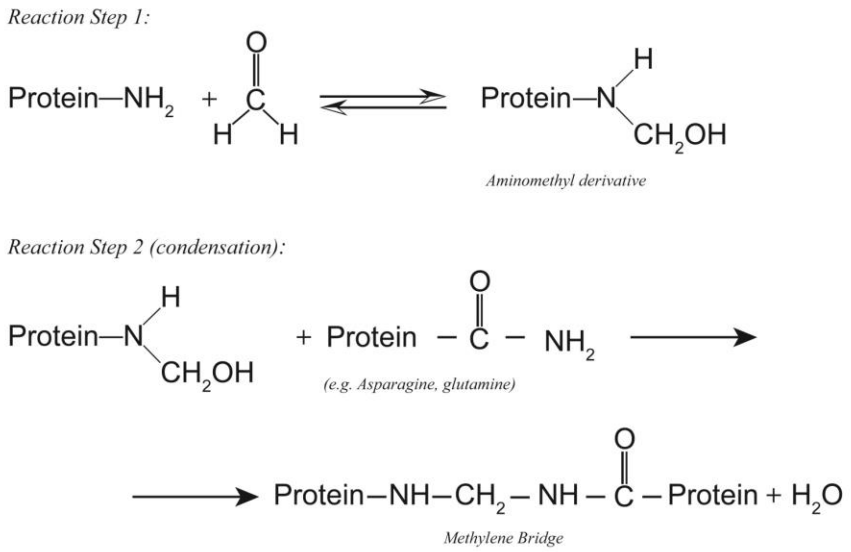
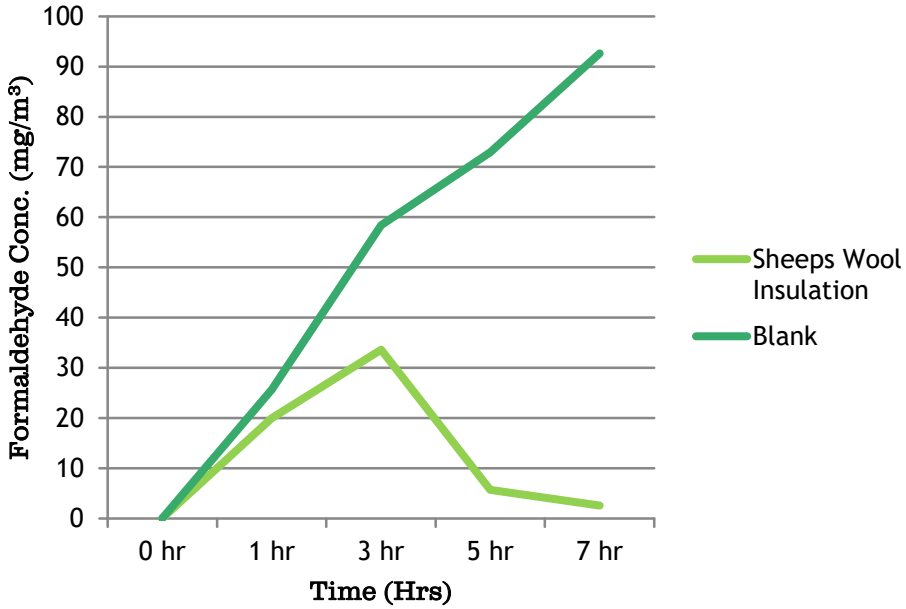
# Formaldehyde Reduction – Sheep's Wool Insulation




- 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.

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# Acoustic Absorption

| | | Practical Absorption Coefficients (BS EN ISO 354:2003) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Product** | **Thickness** | **125 Hz** | **250 Hz** | **500 Hz** | **1kHz** | **2kHz** | **4KHz** | $\alpha_w$ |
| **Rockwool RWA45** | 50 mm | 0.1 | 0.54 | 1 | 1.05 | 1.04 | 1.02 | 0.85 |
| **Thermally Bonded Sheep's Wool 31kg/m³** | 50 mm | 0.2 | 0.55 | 0.85 | 0.9 | 1 | 1 | 0.85 |

- Sheep's wool has similar performance to Rock at 70% of the density.

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# Fire

- NFI's treated with inorganic mineral based fire retardants – free from halogens & organo-phosphorus.
- NFI's are appropriate to use in accordance with relevant sections of Part B of UK Building Regulations.
- NFI's don't play a role in the developmental stages of a fire.
- NFI's have natural charring behaviour limits flame spread.

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