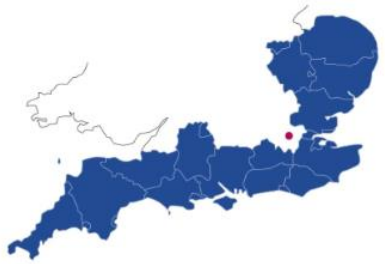

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European Regional Development Fund

BIO-CIRC Project

Bio(and)**C**ircular **I**nsulation for **R**esourceful **C**onstruction

A-Z of Natural and Recycled Fibre Insulation

NRFI Awareness and Understanding Training Content

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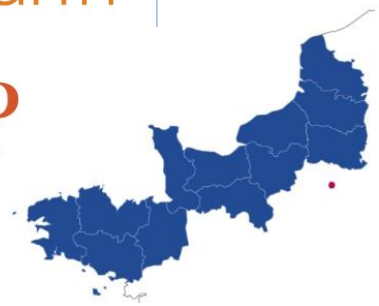
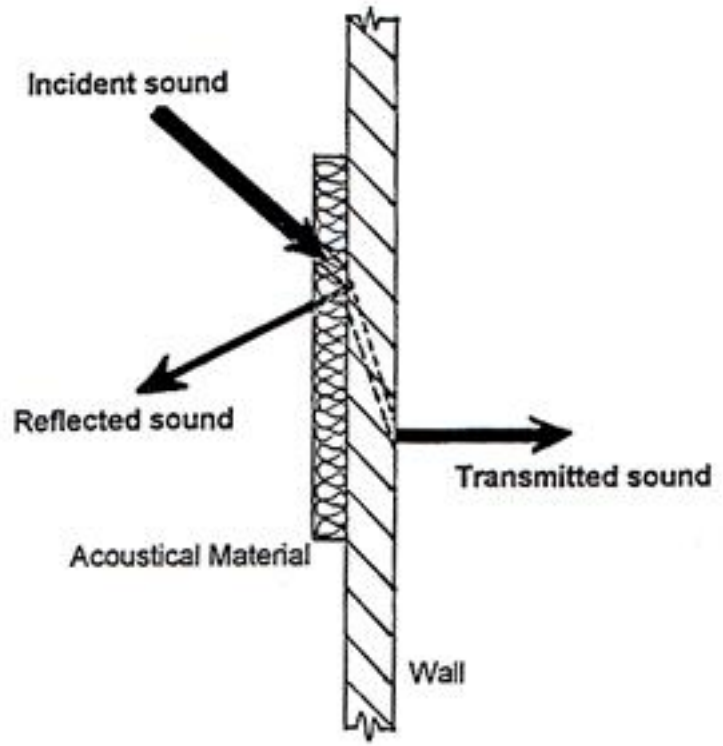


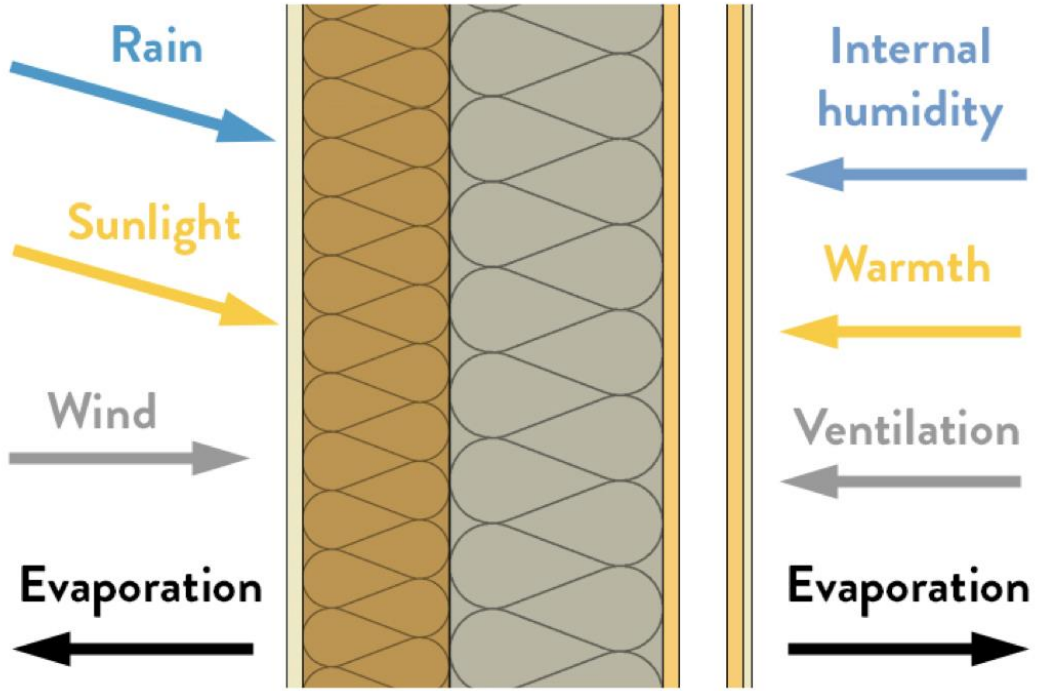
A Acoustics

- The acoustics within our living spaces has a significant bearing on our quality of life and is one area that considered use of NRFIs can greatly enhance.
- Many of us do not draw a connection between thermal insulation materials and acoustic insulation materials, instead believing that acoustic insulation is a specialist material that needs to be treated separately to thermal insulation. In the case of man-made materials, this is often the case. However, in most cases, NRFIs act as both a thermal and acoustic insulator.
- The excellent acoustic performance of NRFIs is down to their relatively high density. The non-uniform size, shape, texture of the fibres themselves helps the insulation absorb sound across a wide range of frequencies.



B Breathability

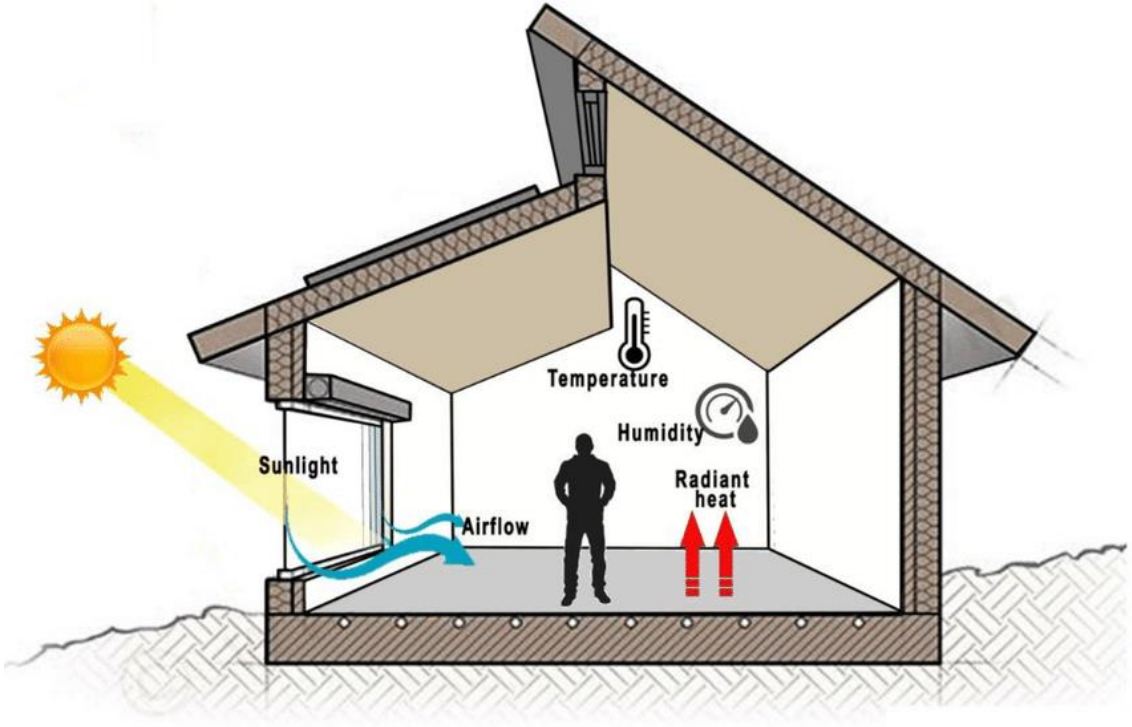
- Breathability is a property that prevents or limits the build-up of harmful moisture within the building fabric. As such breathable structures are most effective when the amount of moisture capable of entering the building fabric is regulated.
- Internal moisture is best regulated by effective ventilation, limiting sources of high humidity, using appropriate vapour control measures and preventing uncontrolled air leakage into and through the building fabric. The latter is best achieved by following an appropriate air-tightness and vapour control plan.
- External moisture is best managed with effective weathering surface and ensuring that guttering and drainage systems are installed and maintained correctly.
- For more information, see https://asbp.org.uk/briefing-paper/an-introduction-to-breathability.



Vapour transfer across a typical timber frame stud wall with natural fibre insulation.

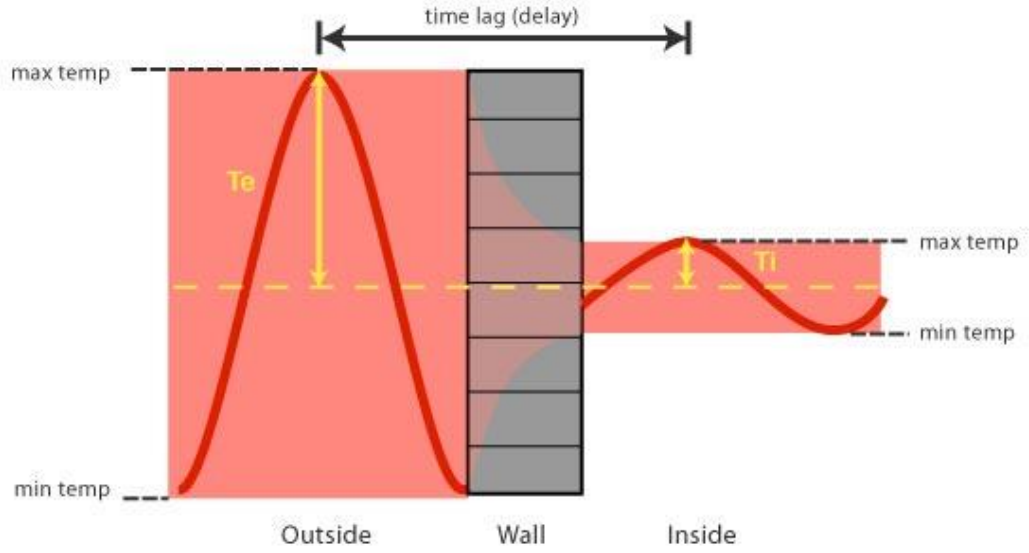
C Comfort

- The extent to which a building provides an environment that is comfortable for its occupants is one of the most important considerations. Comfort is affected by a number of different factors which can, if not addressed properly, lead to poor levels of comfort, or can even cause harm and ill health to occupants.
- Aspects of comfort include; health and wellbeing, personal factors, thermal comfort (i.e. temperature, humidity, air movement) indoor air quality, visual comfort and noise.
- Natural fibre and recycled insulations can play a major role in delivering high levels of thermal comfort due to their high performance; and improve health and wellbeing/indoor air quality due to their low VOC content.
- For more information, see https://asbp.org.uk/briefing-paper/the-multiple-roles-of-insulation.



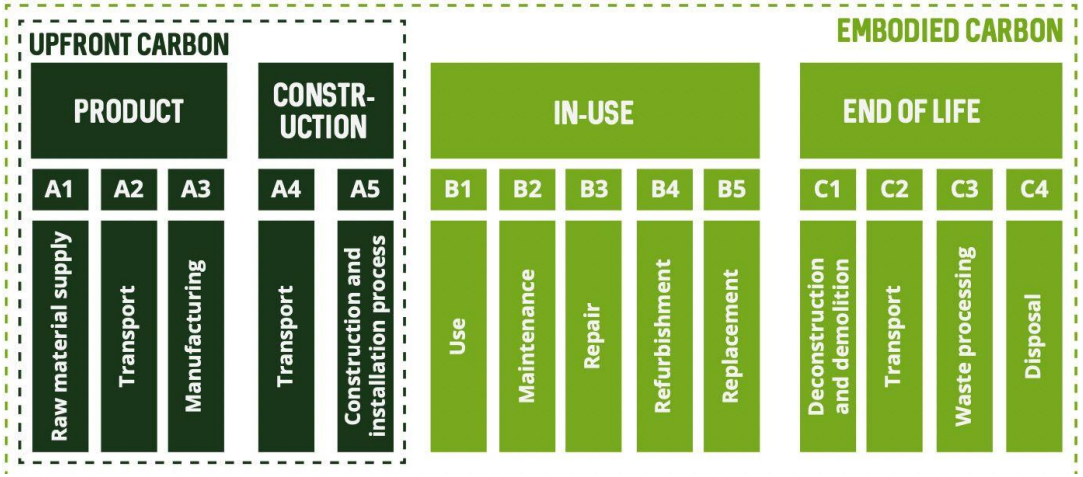
D Decrement

- Decrement describes the way in which the thermal conductivity, density and heat capacity of a material, can slow the passage of heat from one side to the other, and also reduce those gains as they pass through it. This has an influence on the thermal performance of a building during warmer periods.
- Compared with conventional insulation materials like glass wool, natural fibre insulation products such as wood fibre insulation are higher in density. This density is the key to summer heat protection as mass acts as a heat buffer, delaying heat transfer through the fabric of the building so that the high midday temperatures would only reach the internal side when it is cooler outside.



E Embodied carbon

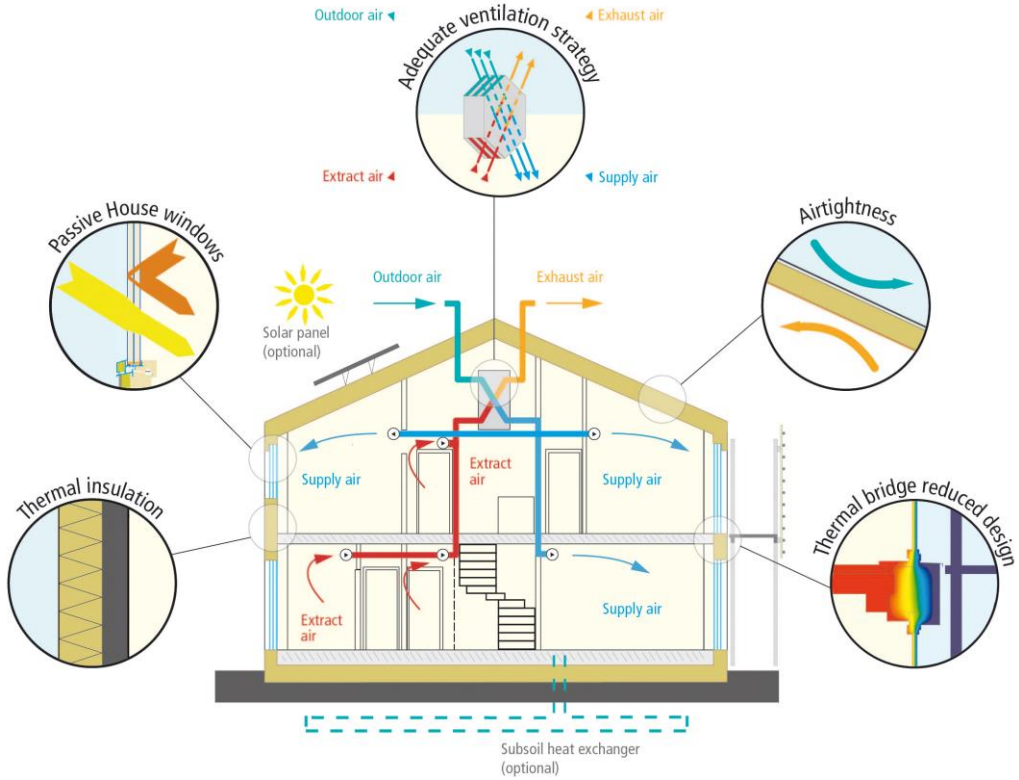
- Embodied Carbon is the total greenhouse gas (GHG) emissions generated to produce a product or building. It covers the emissions that arise from the energy and industrial processes used in the processing, manufacture and transportation of the materials, products and components required to construct, maintain and refurbish a building such as a house. It also includes deconstruction, disposal and end of life aspects. It does not include operational carbon.
- The Embodied Carbon which relates to emissions from the material production and construction phases before the building has been completed is known as 'upfront carbon'. These emissions have already been released into the atmosphere before the building is occupied.
- NRFI materials often have a much lower embodied carbon compared to conventional insulation products. Environmental Product Declarations (EPD) are key in transparently showcasing this information.
- For more information, see https://asbp.org.uk/workstream/embodied-carbon-2.



Credit: Woodknowledge Wales

F Fabric efficiency

- A ‘fabric first’ approach involves focussing on the performance of the materials, products and systems that make up the building fabric, before considering the use of building services systems, and renewable energy technologies which can have high capital costs and embodied energy.
- This approach helps to improve energy efficiency and reduce operational costs and emissions. However, the embodied carbon of the building fabric should be considered equally alongside reducing operational emissions.
- Passivhaus is a well-known fabric-first approach to energy efficiency.
- Natural and recycled fibre insulations are ideal for a fabric first approach, helping to satisfy both operational energy requirements AND lower embodied carbon targets.



Greenhouse gases (GHG)

- The building sector is a key contributor to greenhouse gas (GHG) emissions, representing around one third of energy related EU emissions, and 25% of GHG emissions in the UK.
- Over the last two decades, built environment emissions have reduced by c.30%. This is largely due to a reduction in operational emissions, most of which are attributable to rapid decarbonisation of the electricity grid in recent years, rather than improvements in the energy efficiency of buildings.
- Newly constructed buildings are more energy efficient, but 80% of buildings in 2050 have already been built, so a major priority is decarbonising our existing stock.
- The multiple characteristics of NRFI make them particularly suitable for retrofit, particularly hard-to-retrofit solid wall buildings which require a breathable fabric.

Health & wellbeing

- Everything we experience within the built environment has a direct impact on our health and wellbeing. Promoting healthy living includes factors such as thermal comfort, indoor air quality, daylighting, acoustic performance, incorporation of natural elements, as well as avoidance of materials containing chemicals harmful to health.
- Creating and maintaining a healthy and comfortable indoor environment is a complex and difficult challenge. Temperature and humidity must be maintained at safe and comfortable levels. Moreover, the introduction of pollutants such as particulates and volatile organic compounds (VOCs) greatly influences indoor air quality. A robust ventilation strategy is clearly critical to CO2 levels, but the building fabric can play an important role in helping to manage temperature, humidity and pollution levels.
- For more information, see https://asbp.org.uk/briefing-paper/health-and-wellbeing-benefits-of-natural-fibre-insulation-products-and-systems.

Insulation

- In buildings, insulation is material designed to prevent heat or sound from being transmitted from one side of a building element to another, commonly externally to internally.
- Insulation can be installed in roofs/lofts, cavity walls, solid walls, floors and around pipes. It can take the form of rolls, batts, rigid boards, foams and more.
- Insulation can significantly improve the thermal performance of the building fabric. Thermal performance is measured in terms of heat loss and is commonly expressed in the construction industry as a U-value or R-value. There are also a number of further terms which must be understood (discussed in this training).
- Natural fibre insulations include wood fibre, hemp, straw, cellulose, wool, cotton and flax. Recycled fibre insulations can be made from recycled polyester (PET) from bottles and in the case of BIO-CIRC – waste duvets and pillows.

Credit: Thermafleece

Joists and rafters

- To insulate a loft at the joists but still use the space storage, boards need to be laid over the joists. However if you only insulate between the existing joists, the insulation will not be thick enough to provide adequate thermal performance. The floor level can be raised using timber battens or purpose-built plastic legs so that sufficient insulation can be installed (recommended 270mm).
- An alternative way to insulate your loft is to fit the insulation between and/or over the rafters. This allows the floor to be boarded for storage without having to raise it to create extra depth. However insulating at rafter level is can be considerably more expensive. As well as insulating the roof, any gable walls, party walls and chimneys in the loft space need to be insulated, or heat will bypass the insulation making it ineffective.

Credit: Steico

K k-value

- Thermal conductivity (k-value) is the ability of a material to conduct heat. Consequently, a high thermal conductivity means that heat transfer across a material will occur at a higher rate. The units of thermal conductivity are W/m·K.
- Unlike U-values and R-values however, k-values are not dependent on the thickness of the material in question.
- The lower the K-value, the better the performance. NRFI often have a K-value of between 0.035-0.04 W/m·K.

Credit: Thermafleece

Loose fill, rigid, batts and rolls

- Insulation can come in many forms including loose fill, rigid or as flexible batts and rolls.
- Loose fill insulation, also known as blown insulation, is both versatile and affordable. Loose fill insulation can be made from a variety of materials such as cellulose.
- Flexible batts and rolls are usually fitted between studs, joints and beams and in the case of NRFI can be made from wood fibre, sheep's wool and hemp, amongst others.

M Moisture

- Many problems in buildings are caused by excessive or insufficient moisture. If not addressed, these can lead to serious health issues for occupants.
- Moisture can be found in water vapour, condensation, and in or on the fabric of a building and can cause damp resulting in problems such as staining, mould growth, mildew and poor indoor air quality, and so on.
- The common sources of moisture in buildings include:
  - Condensation
  - Penetrating damp
  - Leakage from pipes
  - Rising damp
  - Building defect, e.g. lack of adequate ventilation, poorly installed insulation, application of paint or plaster that affects the breathability of the building element
  - Indoor moisture sources from cooking and washing

N Natural materials

- Natural fibre insulation (NFI) products and systems are derived from natural materials such as wood fibre, hemp, straw, cellulose, wool, cotton and flax.
- The term ‘natural materials’ refers to those substances that are found in nature and which can either be used directly for a particular building function or require some form of processing to make them usable.
- Some materials require more processing than others. For example, wood can be used to build structures with little processing, but woodfibre insulation requires a refining and forming process. Clay is also a natural material but requires significant processing to turn it into bricks, such as shaping, firing and drying.

Credit: EcoCocon

O Objectivity/transparency

- Ethics and Transparency is one of ASBP's 'Six Pillars of Sustainable Construction', which set the focus for its activities and ethos.
- *"The accelerated adoption of best practice requires unprecedented levels of collaboration. This means we need a better construction culture that engenders greater trust. Focus on supply chain relationships, commitment to meeting standards and the integrity of your approach."*
- A transparent approach to product marketing and information sharing is encouraged via the adoption of third-party verified mechanisms such as Environmental Product Declarations (EPD) and by developing a 'Green Claims Policy' by signing the Anti-Greenwash Charter.

ASBP's 'Six Pillars of Sustainable Construction' - Health & wellbeing, resource efficiency, whole life carbon, ethics & transparency, technical performance, social value.

P Permeability

- NFIs breathe in a way no other insulation does. Not only is natural fibre insulation highly vapour-permeable, the fibres bind and release water molecules like tiny magnets depending on the humidity of the surrounding air.
- When this happens, the moisture is bound in a much less harmful form than liquid water droplets. This enables NFI to be truly breathable, helping prevent the accumulation of harmful moisture and ensuring the insulation performs consistently across a wide humidity range.

Q Quality/workmanship

- Workmanship and quality of installation can strongly affect the performance of insulation and comfort of occupants.
- Poorly fitted insulation, with gaps and cold bridges, can have a thermal transmittance (U-value) considerably higher than expected.
- Poor quality workmanship can also lead to condensation and mould problems. This can lead to poor occupant comfort (i.e. draughts) and health & wellbeing issues.

R-value

- Thermal insulance (r-value) is the converse of thermal transmittance; in other words, the ability of a material to resist heat flow.
- The units of measurement for thermal insulance are m^2K/W and a higher figure indicates better performance.

Solid walls

- Solid wall buildings, generally built pre-1919, were constructed so that water could pass through the complete structure. When retrofitting a solid wall building with insulation, it is vital to take this into account and allow water vapour to pass through the structure.
- Natural and recycled fibre insulation materials are breathable and can be used to insulation solid wall buildings both internally and externally.
- Many conventional insulation materials are unsuitable for solid walls as they stop internal moisture from evaporating to the outside, which can lead to damp and mould.
- There are some NRFI insulations on the market such as wood fibre boards which are specifically made for uneven solid walls.

Thermal bridge

- A thermal bridge, also called a cold bridge, typically occurs when there is either a break in the insulation or the insulation is penetrated by an element with a higher thermal conductivity. This can lead to additional heat loss and condensation problems.
- Thermal bridges can be caused by poor design and/or workmanship and often occurs around glazing, ceiling junctions or balcony slabs.
- As buildings have become better insulated, thermal bridges play a more significant role in terms of the building's overall performance. Minimising thermal bridges is key to delivering both an energy efficient and comfortable building.

U-value

- The U-value, or thermal transmittance, is the rate of transfer of heat through a structure divided by the difference in temperature across that structure. The units of measurement are W/m^2K.
- The better-insulated a structure is, the lower the U-value will be. Thermal transmittance takes into account heat loss due to conduction, convection and radiation.
- U-values can be calculated by finding the reciprocal of the sum of the thermal resistances of each material making up the building element in question. Note that the external and internal faces also have resistances, which must be added to the calculation.
- Design calculations are theoretical but post-construction measurements can also be undertaken using a heat flux meter. The accuracy of measurements is dependent on a number of factors including temperature difference, duration of monitoring and weather conditions.

V Vapour control

- Vapour control involves limiting the amount of moisture that is able to enter and accumulate within the building fabric. Vapour control can be achieved in a number of ways and is an essential requirement of any building design.
- Moisture laden air has the potential to cause moisture to build up in the building fabric causing severe damage. Moisture in the air takes the form of water vapour which is essential for good indoor air quality. However if the water vapour becomes saturated, then problems may arise.
- The use of natural plasters (such as lime or clay) and natural fibre insulation can be very effective in controlling vapour.
- For more information, see https://asbp.org.uk/briefing-paper/airtightness-vapourcontrol-breathability.

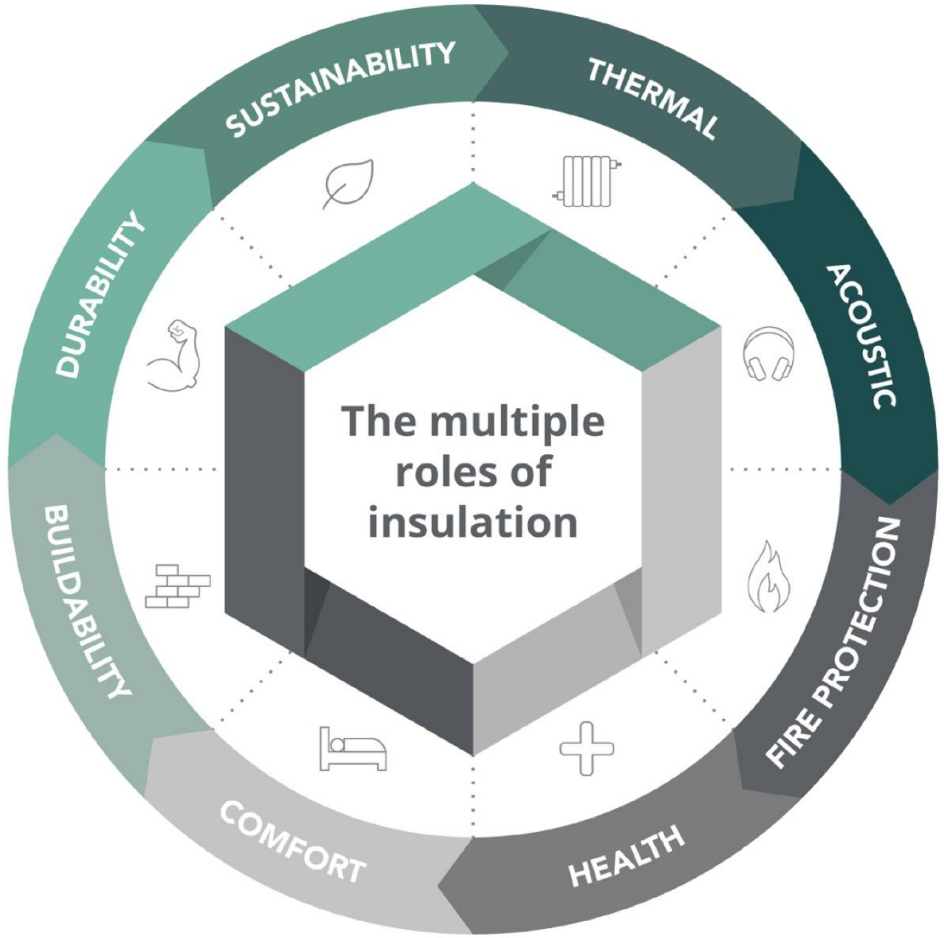
'Vapour open', breathable materials such as natural fibre insulation help to regulate humidity and improve indoor air quality.

W Water activity

- Water activity (aw) is equivalent to the relative humidity a material creates in an enclosed environment. It is important because it provides an indication of how much moisture is bound by insulation material.
- Creating 'bound water' is an important property of natural fibre insulation and a key aspect of breathability. Natural materials such as cellulose, lignin and keratin contain active sites that physically binder water molecules, which reduces humidity.
- Using insulation that contributes to a water activity below 0.7, greatly reduces the risk of microbial growth and other harmful effects of free water.

X E(x)tra benefits/roles

- Most of us recognise the importance of insulation in preventing heat loss and saving energy within the building but few of us connect insulation with other aspects of building performance.
- Insulation can account for more than 50% of the volume of the building fabric so it's important to appreciate what insulation is capable of doing. In fact, insulation and NFIs in particular play a significant role in at least eight aspects of a building's performance.
- These aspects include: thermal performance, acoustics, durability, sustainability, indoor air quality, fire, buildability, health and comfort.
- For more information, see https://asbp.org.uk/briefing-paper/the-multiple-roles-of-insulation.



Y Y-value

- The ability of a material to absorb and release heat from an internal space, as that space's temperature changes, is termed thermal admittance, or heat transfer coefficient. The higher the thermal admittance is, the higher the thermal mass will be.
- Thermal admittance is similar to thermal transmittance (and uses the same units of measurement). However, it measures the thermal storage capacity of a material, i.e. the ability of a material to store and release heat over a period of time, typically 24 hours.
- The thermal admittance 'Y-value' should not be confused with thermal bridging factor 'y-value'.

Z Part Z

- A proposed amendment to the UK building regulations to regulate embodied carbon on all major construction projects.
- The amendment, if introduced (currently only an industry proposal, and not backed by government), would require whole life carbon assessments and compliance with embodied carbon limits for projects greater than 1000m2 (or 10 dwellings).
- Natural and recycled fibre insulation products often have lower embodied carbon than conventional insulation materials.
- For more information, see https://part-z.uk.