Mark Lynn, ASBP Director & MD of Eden Renewables and Gary Newman, Executive Chair of the ASBP explain the concept of breathability in buildings.

ASBP The Alliance for Sustainable Building Products

AN INTRODUCTION TO BREATHABILITY

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This is the first in a planned series of ASBP industry briefing papers on the topic of breathability in buildings. Our aim is to explain breathability in a language that can be understood by building practitioners and provide guidance on how to design for breathability. In doing this, we hope to enable industry to deliver better buildings designed to take advantage of the significant building performance benefits of breathability.

Breathability is a measure aimed at complimenting other means of controlling moisture within the building and its fabric. When considering breathability, it is important to mention that the majority of internal moisture should be removed by good ventilation and the majority of external moisture should be eliminated through an effective weather protection surface, good guttering and drainage systems. Assuming most moisture is controlled in this way, breathability allows for the balanced removal of what moisture is left within the fabric (which although relatively small, has the potential to be very damaging to the building fabric and occupant health over a period of time).

Defining breathability

A breathable structure is one that allows the passage of moisture in order to prevent the accumulation of harmful water within the building fabric or its surroundings.

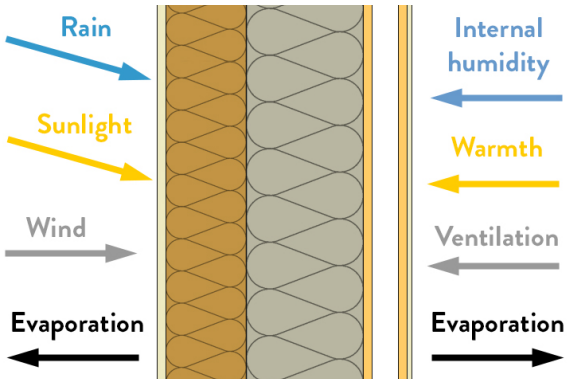
Harmful water is water that increases humidity to a detrimental level or which alters the physical structure of materials in a damaging way. When water is capable of dissolving things or is capable of supporting microbial growth, it risks causing harm.

Persistent liquid water or persistently high humidity is likely to be harmful. These often go hand in hand. Intermittent wetting, water vapour with a relative humidity below 70% as well as most water bound to a material (bound water) is unlikely to be harmful. Water vapour is a gas and shouldn't be confused with mist.

The four essential components of effective breathability

A moisture pathway - There must be a pathway for water vapour to move through breathable materials. Moisture can only move through materials that contain pores or holes of sufficient size to allow water vapour molecules to migrate and escape from within the building fabric. Materials or structures with this property are said to be vapour permeable.

Molecules of water vapour are incredibly small (less than 3 millionths of one mm) so very small pores can seem very large in relation to individual molecules. To give some idea of the scale, a water molecule passing through the eye of a needle is like a dingy sailing through the Pacific Ocean. This is why vapour permeable materials can appear solid to the naked eye but still allow large quantities of water vapour to pass through them.



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

A driving force - There must be a force to drive the movement of moisture. Moisture always moves from areas of high humidity to areas of low humidity so for moisture to move through the fabric we need different levels of humidity - known as a humidity gradient. It is this gradient that drives the rate and direction of moisture movement.

A sorptive fabric - There must be a way to suppress the harmfulness of any water during its passage through the fabric. In other words, while moisture is moving

through the fabric, it should be in a form that is least likely to cause harm. This is done by using materials that are capable of binding and releasing moisture as well as regulating humidity. Materials that can bind and release moisture are commonly referred to as breathable materials

Vapour control - There must be measures to regulate the amount of moisture able to enter and leave the building fabric. This is referred to as vapour control. Vapour control is achieved by ensuring components are organised in the correct order in terms of their resistance to moisture movement (vapour permeability).

Breathability in practice

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.

Moisture moves through vapour open materials at different rates making it important to install products in the right combination allowing for appropriate vapour control. This will prevent moisture bottle-necking that can create a damaging build-up of water during its transit. An effective combination of materials and products can be determined through moisture modelling and condensation risk analysis during the design stage.

In a properly functioning breathable structure, it is important that water moves around the fabric in a form that does not risk causing harm. This means that the accumulation of liquid water and persistently high levels of humidity should be avoided. The best way of achieving this is to incorporate sorptive materials which include natural fibre products (such as wood, wool, cellulose, straw and hemp) or mineral products (such as clay and lime) that are capable of binding and releasing moisture.

Sorptive materials temporarily bind moisture and lower humidity significantly suppressing the harmful effects of moisture as it moves through the building fabric. Because of this, the most effective breathable structures incorporate at least one sorptive material. In most cases this involves the incorporation of natural fibre insulation.

Types of breathable materials

Natural fibres - suppress or moderate potentially harmful water by binding and releasing moisture which helps regulate humidity levels as the moisture moves.

Minerals - can provide a porous surface through which potentially harmful water can move and have the ability to capture moisture.

Natural fibre materials are often used in conjunction with mineral products such as lime renders.

Breathable and moisture variable membranes - are flexible micro-porous or monolithic membranes that keep out liquid water and draughts whilst allowing the passage of moisture vapour.

Conclusions

Breathability is the most effective way of maintaining stable and harmless moisture levels within the building fabric. For effective breathability, all four essential components must be present – a moisture pathway, a driving force, a sorptive fabric and vapour control. Breathability is not a substitute for the main mechanisms of moisture removal and prevention in and around the fabric. Instead it should be seen as an effective mechanism for regulating levels of residual moisture within the fabric. In practice, a degree of moisture will inevitably penetrate the building fabric so having a strategy to deal with this is important for good design.

This paper has been peer reviewed and is supported by members of the ASBP's Natural Fibre Insulation Group. Find out more at www.asbp.org.uk.