

# AIRTIGHTNESS, VAPOUR CONTROL & BREATHABILITY

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This paper is part of a series of industry briefing papers aimed at generating a greater understanding of the roles, capabilities and related issues concerning natural fibre insulation (NFI). In doing this, we hope to enable industry to deliver better buildings designed to take advantage of the significant building performance benefits of NFIs.

Airtightness, vapour control and breathability play a critical role in the operational performance of buildings. Understanding how they work together enables us to control air leakage, maximise energy efficiency, optimise indoor air quality and ensures durability of the building fabric.

## Airtightness

Airtightness is a process that aims to minimise the amount of air that leaks from the building fabric in an uncontrolled way (through, gaps, cracks and ill-fitted components for example).

Because uncontrolled air leakage in airtight buildings is minimised, airflow can be very closely controlled and monitored. An airtight building can be ventilated in a very precise way that allows for very high standards of energy efficiency and indoor air quality.

There are degrees of airtightness. At the most basic level, ensuring that windows and doors are correctly fitted and installing draught proofing measures will result in improved airtightness providing a more energy efficient building.

At a more advanced level, installing specialist membranes and tapes and paying close attention to detail can result in an extremely airtight building fabric. Natural lime and clay plasters can also be used very effectively to create an airtight fabric.

Airtightness of the building fabric must be considered in conjunction with an appropriate ventilation strategy. Failure to do so can result in moisture imbalances within the building and a reduction in indoor air quality.



Image credit: Back to Earth

Natural plasters such as lime or clay used in conjunction with NFIs can be very effective in controlling moisture in the building fabric

## 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.

Damage can occur when warmer moist air is allowed to pass into cooler parts of the building fabric where the moisture condenses and is unable to escape. Controlling the amount of warmer moisture laden air entering the fabric can be achieved in a number of ways.

Commonly, a VCL or vapour control layer (a moisture impermeable sheet) is fixed on the inside of the wall or ceiling which blocks the movement of humid air into the fabric of the building. However, damage to the VCL or poor installation may result in humidity and moisture bypassing the vapour control layer where it can accumulate in the fabric.

As an alternative, a moisture variable membrane can be fitted on the inside of the wall or ceiling. This type of membrane provides high resistance against humid air but will allow moisture that does enter the building fabric to back diffuse out of the fabric and into the building as conditions become more favourable.

Another way of controlling vapour is to dispense with a membrane and construct the fabric in such a way that the moisture resistance of each layer becomes progressively less as you move from inside to outside.

The use of natural plasters (such as lime or clay) and natural fibre insulation can be very effective in this approach. Taking this approach eliminates bottle necks as moisture diffuses from inside to outside the building.

## Breathability

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

Harmful water increases humidity to a detrimental level and can alter the physical structure of materials. When water is capable of dissolving things or 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.

Breathable materials adjust their moisture content to be in balance with the surrounding humidity, they adjust surrounding humidity to be in balance with their moisture content, they are able to bind water molecules in a harmless way and they are vapour open.



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

## Working in balance

It is understandable to think that a building can't be breathable and airtight at the same time, however it can. Or that vapour control is not needed in breathable buildings, but it is. Airtightness, vapour control and breathability working in balance will help to maximise building performance. Here's how.

### Airtightness and breathability can work together

Airtightness relates to the leakage of air driven by air pressure through the building fabric and requires that gaps in the structure are minimised or eliminated. This allows the structure to resist the pressure of air that produces draughts and air leakage. Breathability relates to the diffusion and movement of 'water vapour' as a gas through the building fabric.

### Vapour control is needed in breathable systems

Even breathable systems should incorporate some form of vapour control layer in order to moderate the amount of water vapour that can penetrate the structure. Rapid and excessive ingress of humidity and moisture can overload any system.

Breathable structures are designed to remove and prevent the build up of excess moisture in the building. They work best when designed in accordance with appropriate ventilation and vapour control measures.

Incorporating an external layer that is 'permeable' or 'vapour open' will reduce risk. It is critical that moisture or water vapour is not trapped within the structure which in turn could damage the building fabric.

### Airtightness works with vapour control

Airtightness ensures the high performance of a well-insulated building but also requires either mechanical or natural ventilation in order to ensure clean and fresh air for the occupant. Airtightness measures are usually designed to also provide vapour control. It's therefore critical to consider both aspects in line with each other at the design phase.

## Conclusions

Airtightness, vapour control and breathability are not mutually exclusive. In fact, considering all three aspects and how they can work in balance is key to optimising building performance, health and durability. What's more, there are numerous ways to achieve an effective balance so the design possibilities are many.