BUILDING FABRIC 5 - AIR TIGHTNESS

From FIRST IN ARCHITECTURE

Why is air tightness important?

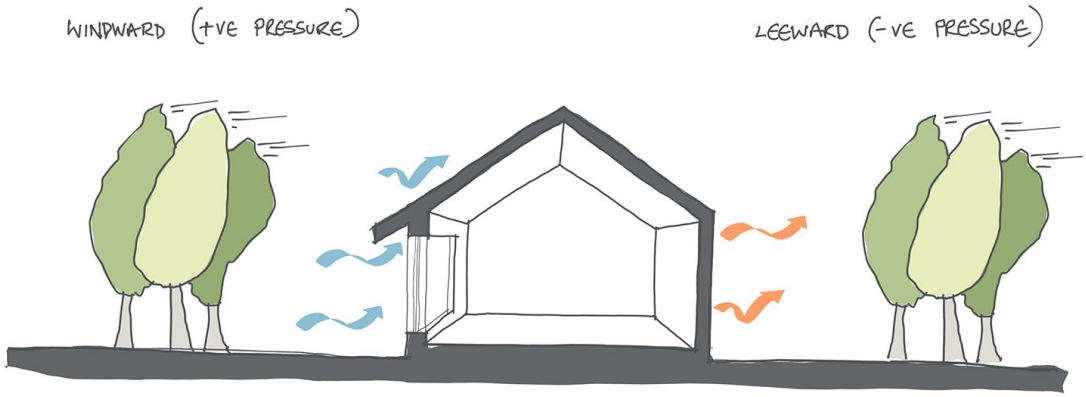
Air leakage results in increased space heating demand of a building. Achieving a good level of airtightness will improve the energy efficiency of the building and the comfort of the occupants by reducing drafts and maintaining a more constant temperature.

It is said that uncontrolled ventilation (air leakage) through cracks and gaps in the construction can cause up to 40% of heat loss.

This leakage occurs in two ways.

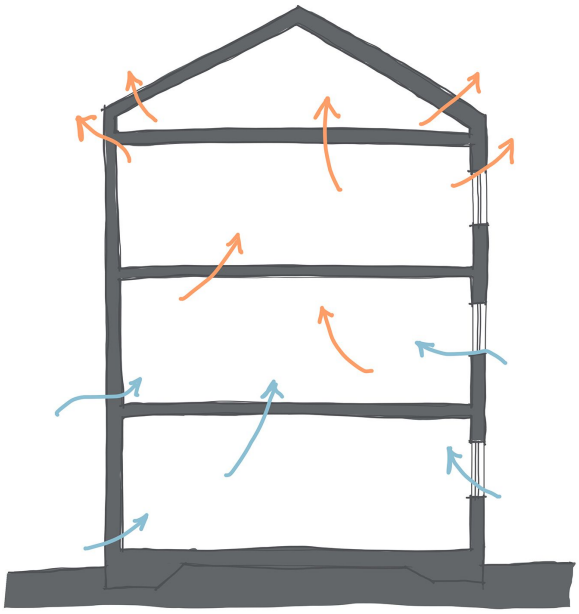
Wind

When wind blows against a building it creates pressure differences between the inside and outside of the structure. On the windward face of the building air is drawn into the construction by way of infiltration, through any gaps in the building fabric. On the leeward side of the building, the external air pressure is low and therefore the warmer air is drawn out of the building through exfiltration through any gaps or cracks in the envelope. This causes an uncontrolled background air leakage.



Air buoyancy

As warm air heats up in a building it is more buoyant than colder air outside. The warm air becomes less dense and rises upwards leaking out of any gaps at higher level. Cold air is then drawn into the building at lower level through any gaps in the envelope. Occupants would experience this effect as cold draughts. This effect is made worse when the air is particularly cold outside and particularly warm inside.



Current Buildings Regulations in England allow for a hole or crack the area of one side of a 20p piece per m2of fabric. As a comparison, a Passivhaus standard allows a hole of the equivalent of a 5p piece per 5m2of fabric.

Building Regulation Requirements for Airtightness

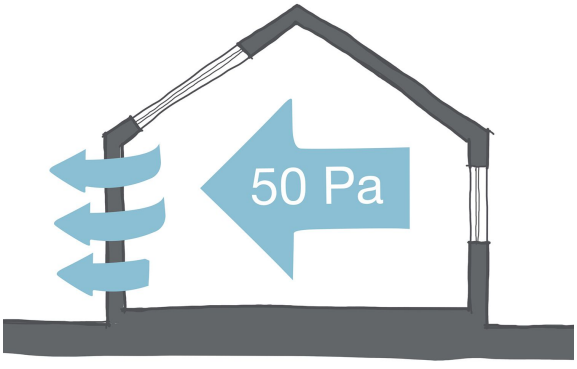
Air leakage is defined as the amount of air exchanged through 1m2of thermal envelope. The standard UK convention of expressing airtightness is given as m3per hour, divided by the internal area (in m2) of the building fabric at 50 Pa (pressure).

So, air permeability is:

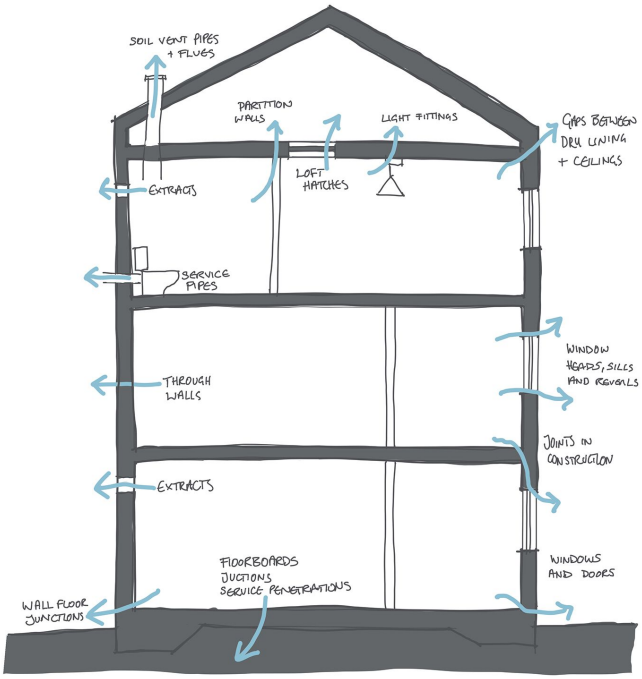
$m^3/h.m^2$ at 50 Pa

Currently, the Building Regulations specify a limit of 10 $m^3/h.m2$at 50 Pa. A lower value demonstrates better airtightness. As a comparison, the Passivhaus standard for air permeability is <1 $m^3/h.m^2$ at 50 Pa.

As airtightness increases, the need for heating and cooling reduces, but the need for controlled ventilation increases. If a value of 3$m^3/h.m^2$ at 50 Pa or less is achieved it is important that mechanical ventilation is included in the design to ensure best air quality for the occupants.



Common Air Leakage Paths

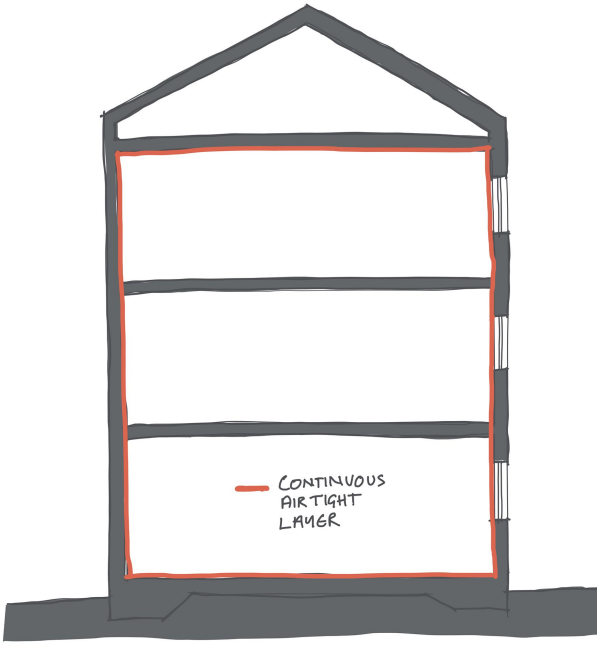


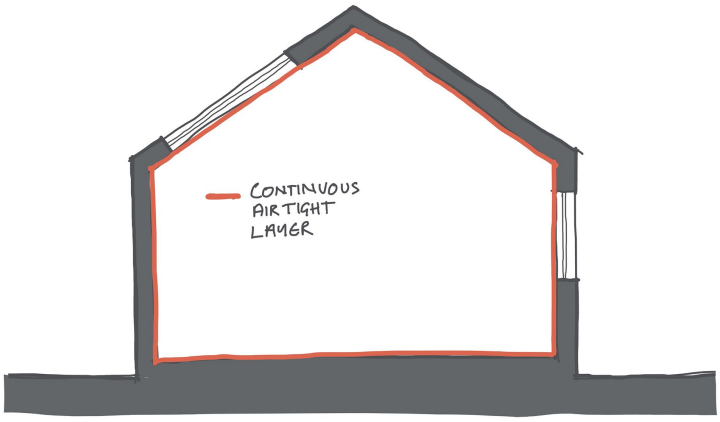
Methods for achieving airtightness

The most important factor for achieving airtightness is to create a continuous robust single airtight layer or air barrier.

The airtightness zone can be achieved:
- with monolithic construction of airtight materials
- with an airtightness membrane over materials that are permeable
- taping all joints and junctions and lapping and taping all membranes

This barrier will surround the heated volume of the building and generally should be located on the warm side of the insulation.





An air barrier must be impermeable or virtually impermeable, meaning that air will not be able to pass through at 50 Pa. Air barrier materials include:

- Vapour control layer membranes
- Concrete
- OSB (used for SIPS panels and sheathing in timber frame construction)

- Cross laminated timber
- Parging coat – applied to masonry

It is important to select materials that are robust, and suitable to form the air barrier.

The role of air barrier is to separate the heated spaces from the unheated spaces. Generally, in dwellings, the barrier will be within the external walls, the ground floor and line of the roof or the upper most ceiling depending on the roof construction. The most vulnerable areas are joints between constructions, wall to floor, floor to ceiling or roof etc.

It is important that the line of the air barrier is clearly identified on drawings, and that it is continuous. Where possible, avoid complex detailing which will prove difficult to achieve on site.

Floors

With a ground bearing slab a damp proof membrane provides suitable protection and must be lapped to achieve good seals and joints. Any penetrations through the membrane must be sealed.

A suspended beam and block floor would provide a good standard of airtightness if a membrane is laid over the block floor. The membrane must be lapped and sealed at joints. Any service penetrations through the barrier must also be sealed.

Masonry Walls

Air leakage has a tendency to occur in cavity walls, this can be remedied by sealing the internal blockwork wall be ensuring the mortar joints are suitably filled. Any penetrations into the blockwork must be sealed appropriately. A parging layer can be used to cover the blockwork (which can then be dry lined afterward).

Cavities must be closed at window and door openings using cavity closers and sealed appropriately.

Joists built into the wall must be sealed as these are considered to be problem areas. They can be sealed with flexible sealant or a joist sealing box.

All service penetrations into the wall must be sealed, using either flexible sealant, or spray applied foams. Application must be according to manufacturing instructions.

Timber Frame Walls

The sole plate and floor slab junction must be sealed using gun applied flexible sealant or foam tape to ensure air tightness.

A vapour control membrane is a suitable material to achieve a good level of airtightness. All joins must be lapped and well sealed.

Any gaps or penetrations into the membrane must be taped or sealed, with any damages being repaired.

Roof and Ceiling

Seal between ceiling boards and the external wall. Any recessed lighting that penetrates the air tight layer can be treated with airtight backing caps to ensure a good seal.

Other considerations

Ensure all windows and doors specified provide a suitable airtight seal when closed. Draught excluders can be fitted around external doors to avoid air leakage.

Loft hatches can suffer with air leakage, which can be remedied by using a suitable draught seal.

Although careful design and detailing are of utmost importance in creating a good airtightness level, much of the work is to be carried out on site. It is recommended that an 'airtightness champion' is appointed for the project who can ensure all site operatives are aware of the importance of the airtight barrier throughout the build. The 'airtightness champion' will often have a checklist of duties that will assist in achieving this goal, including communications, supervising, site testing and readings, checking materials, preparing for testing, and many other duties. This person would be site based to ensure good communication with all sub contractors and trades visiting the site.

Read the original post here:

https://www.firstinarchitecture.co.uk/building-fabric-05-airtightness/

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