Air tight constructions

There are several reasons why an airtight implementation of the building envelope is very important:

- The reduction of heating demand: Especially during the winter the thermal lifting results in a high temperature difference between the inside and the outside of a building. Consequently, in the upper part of the building the warmed air flows through points of leakage to the outside (exfiltration), whilst in the lower part of the building cold air pours through untight locations to the inside (infiltration). There is also infiltration due to wind pressure to assure a convenient indoor climate, the cold air has to be warmed up, so that the unintentional air exchange results in a higher heating demand.

- Comfort: As a consequence of the thermal lifting, the inward flow of cold air into the building generates inconveniences. An airtight construction avoids infiltration.

- Prevention of structural damages: A high air humidity results in the creation of condense, which causes humid areas in the wall because of lower temperatures – and with it structural damages in the building envelope.

To assure an air tight building envelope, moisture brakes or even moisture barriers are attached in order to prevent humidity to get into the construction and the thermal insulation. It is very important, that these foils are fixed very accurately, because otherwise they do not have any effect. The following table shows values for air change pr. hour (ac/h):

Air change pr. hour (ac/h)	
International standard	0,5
Ordinary buildings	0,25-0,4
Low energy houses	0,05-0,1
Passiv houses	0,03 (0,6 at 50 Pa)
Note: the given values are for 0 pa. When testing air tightness with a blowerdoor each value has to be multiplied with a factor 20.	

Table. Air change pr. hour for different kinds of buildings.

To guarantee a construction without any leaks it is recommended to develop a leak tightness concept and to locate weak points in the envelop by a so-called Blower-Door-Test. In this test a ventilator creates a constant pressure of +/- 50 Pascal (Pa). Depending on the tightness of the building the ventilator has to work more or less strong to obtain a specific pressure in the building. Thus, the measure of untightness can be deduced with the help of artificial smoke and the untight points can be located.

The verification of an airtight construction can be done by the above mentioned Blower-Door-Test. The n_{50}-value indicates how often the complete air in a room is changed within one hour monitored at +/- 50 Pa. In case of a ventilation system applied, this value has to be smaller than in the case of window ventilation.

Fig. Blower Door test in an apartment.

Fig. Example of registration of white smoke movement to trace cracks and crevices in combination with the blower door test.

<u>Air tight constructions – Practical implementation</u>

The air-tightness should be ensured on the inside of external constructions by help of a vapour barrier of e.g. aluminium foil or plastic film.

On the outside wind-tightness should be ensured to protect the building construction against bad weather conditions. The first thing one should do when ensuring the air-tightness of a building is to check the joints between the different parts of the external constructions, e.g. the windows/doors and walls. By sealing up joints between the different external constructions a good result can be achieved with low costs.

According to the German Passiv Haus Institut the most important rule for achieving good air-tightness is to seal the whole building with an air-tight layer (see Fig. below).

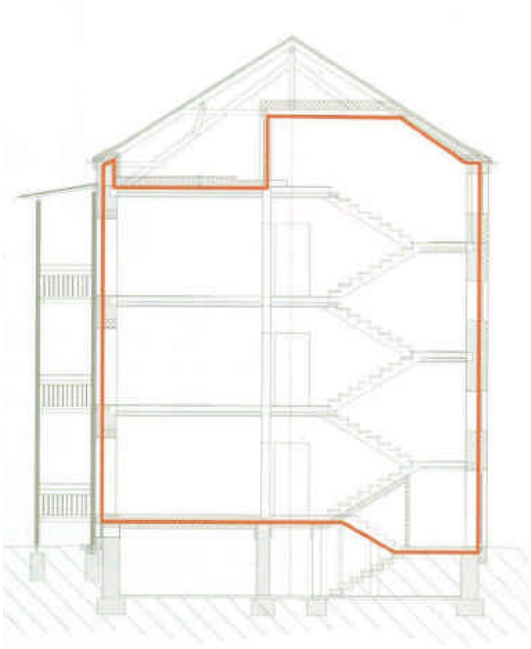

Fig. Air tight layer (in red) wrapping the whole building.

Technology	Relevant Indicators	Performance Requirements	Check Systems and standards

		2006 (Present situation)	Goal for next EPBD in 2011	BAT (Best Available Technology)	
Air Tight Constructions	n_{50}-value [1/h]: (Air change per hour, monitored at +/- 50 Pa) Infiltration [1/h]: Permeability ($m^3/h/m^2$), Naturally ventilated dwelling: Dwelling with balanced whole house ventilation: Leakage factor, Air permeability of windows (three different classes) [m^3/hm^2Pa] A3: 0,35 A2: 1,00 A1: 2,50 Without classification: 5,00	≤ 2,5 ≤ 1,3 (in case of ventilation systems applied) 0,14 5 3 Class A3	≤ 2,2 ≤ 1,2 (in case of ventilation systems applied) 0,12 5 3 Class A3	≤ 0,6 0,04 10 5 Class A3	Blower door test DIN EN 13829:2001-02 DIN EN 832 Applied Pressure difference test of 50 Pascal (Pa) Building Regulations UNI 7979 UNI 10344