

PASSIVE HOUSE - BASIC PRINCIPLES AND STANDARDS

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Abstract: Nowadays the need of energy efficiency and sustainable solutions in the industry is more prominent than ever. People are in a constant search of new ways to switch from fossil fuels to other sources of energy which are more reliable and have a smaller ecological impact. Taking into consideration that buildings and, especially, houses in the modern world are everywhere around us, the following idea was developed. In this work, we will discuss what is a passive house building, how it appeared and what problems it solves. We will also analyze the basic principles and things which are taken into consideration when constructing such a building.

Key words: passive house, energy efficiency, sustainability, building standard, principles, heat.

The term "Passive House" refers to a design and construction standard that aims to drastically reduce heating requirements in homes so that oversized conventional heating systems are no longer necessary. The homes maintain constant temperatures and do not rely on wasteful amounts of fossil fuels to continually heat and cool, therefore passive.

The strategy of a Passive House is to reuse "free" heat to heat the home. "Free" heat is generated from all electrical and gas appliances such as ovens, refrigerators, computers and light bulbs.

So, the passive house works in the following way:

- A mechanical ventilation system, with an air to air heat recovery component, is installed to simultaneously bring in fresh air and remove the same amount of stale air.
- The stale air leaving the house is carrying the "free" heat. It goes through the heat recovery ventilator, and transfers the heat, to the incoming fresh air, before it leaves the building.
- The cool, exterior fresh air comes into the heat recovery ventilator, picks up the "free" heat and goes into the home warm.

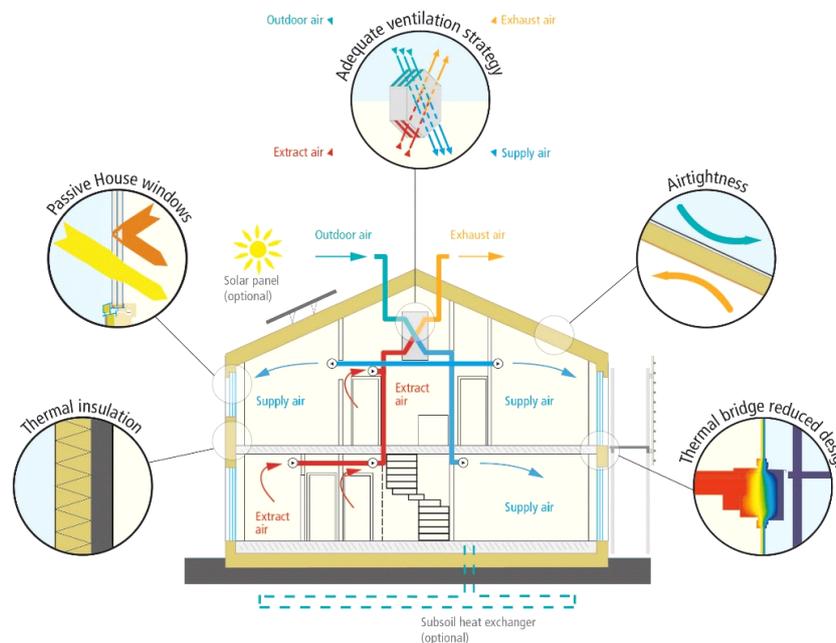


Figure 1. The 5 Passive House principles.

The building envelope of a Passive House must be extremely well insulated and air-tight so that this "free" heat cannot unintentionally escape out of the building. This means that there is no air leakage throughout any walls in the whole house. Special attention is drawn towards eliminating thermal bridges which are areas or components of objects which have higher thermal conductivity than the surrounding materials, creating a

path of least resistance for heat transfer. These are usually, areas at the crossing of two concrete blocks or surfaces. Here it is necessary to mention the importance of the U-value. The U-value is a measure of the flow of heat through an insulating or building material: the lower the U-value, the better the insulating ability. The insulating materials should have U-values typically in the 0.10 to 0.15 W/(m²·K) range.

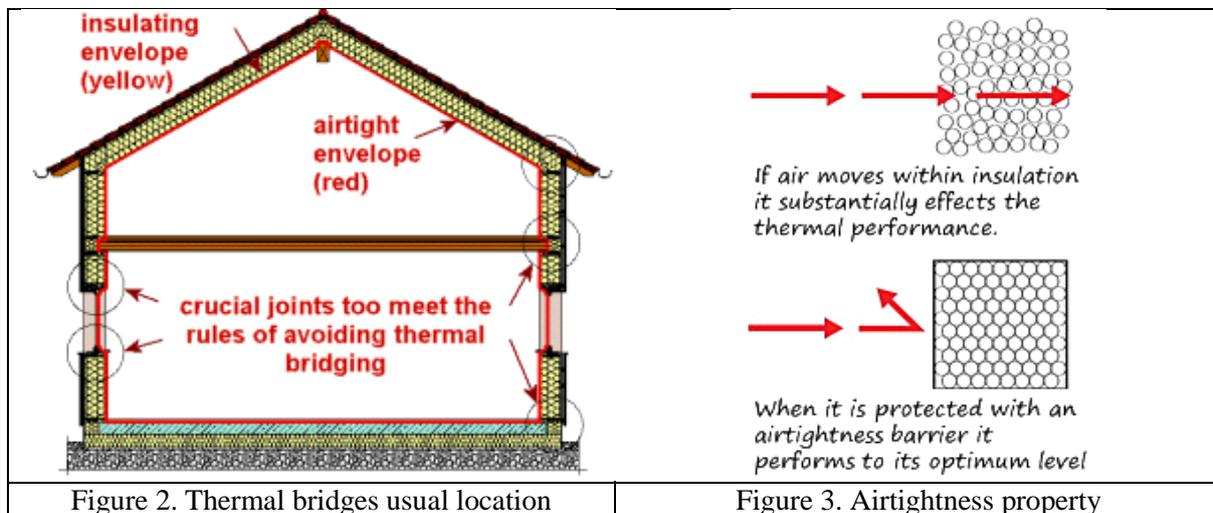


Figure 2. Thermal bridges usual location

Figure 3. Airtightness property

In passive construction the building is made airtight in order to prevent the unwanted movement of air. This has many benefits, some of which include:

- Reduced heat loss.
- Reduced energy costs (Space Heating).
- Improved thermal performance of the structure.
- Improved thermal comfort. (A steady temperature is maintained throughout the building).

The windows must meet the standard of heat loss. The ideal situation for quality windows is when, for example, solar heat can enter the building, but none can exit. The most efficient windows are considered those with triple-pane glass. Passive house windows have low U-values, typically 0.85 to 0.70 W/(m²·K) for the entire window including the frame.

One of the most important things when building a passive house is to maximize the amount of heat that we can recover. By doing this, the energy consumption efficiency compared with a conventional house is going to rise with about 75%. Heat recovery can also be improved by adding subsoil heat exchangers, which tend to be very useful throughout the whole year, because the temperature at just 15 meters into the ground remains always at a constant level, at 10°C. Depending on latitude and depth, ground temperatures range from 7°C to 21°C. In addition, installing solar panels is always a good solution which tends to reduce energy consumption.

Bibliography

1. Passipedia, *Energy efficiency of the Passive House Standard: Expectations confirmed by measurements in practice*, 2019.
2. Barbara Eldredge, *Passive house construction: Everything you need to know*, 2016.
3. Wikipedia, *Passive House*, 2019.
4. CadOn, *Temperatura solului în funcție de locație, adâncime și anotimp*, 2017.
5. Passive House Institute, *Passive House requirements*, 2015.
6. Katrin Krämer, Passive House Institute, *25 Years Passive House – Interview with Dr. Wolfgang Feist*, 2015.