

PASSIVHAUS INFOSHEET

Principles

P1 What is a Passivhaus?

A Passivhaus (AKA Passive House) is a house (or any building) that is designed, constructed, and certified according to the Passivhaus Building Standard, the gold standard for ultra-low energy buildings.

P2 The Basic Principle

The basic principle of a Passivhaus is to keep heat in the building so that you don't need to use a lot of energy to keep it warm. In fact, the goal is to reduce heat losses to such an extent that the building's space heating demand can be met mostly by 'Passive' heat sources such as the sun, people and appliances.

P3 Fabric First

The term 'Building Fabric' refers to the elements of a building (i.e. walls, floors, roof, windows and doors) that enclose the interior of a building and separate the internal from the external. Passivhaus is a 'Fabric First' approach meaning that the priority is the creation of a super energy-efficient building fabric, rather than on the use of renewable technologies. In other words, the focus is on reducing the need for energy in the first place, rather than on energy generation.

P4 Form Factor

'Form Factor' is the ratio between a building's external thermal area (i.e. the surface area that can lose heat) and the treated floor area (i.e. the floor area to be heated). When designing Passivhaus buildings, form factor is a key consideration as the more compact the building is, the easier it will be to retain heat. In practice, an inefficient form will mean that more insulation will be required for the building to be energy efficient.

P5 Glazing Orientation

The orientation and size of windows is another key design consideration. On the one hand solar gain (i.e. heat entering the building from the sun) is desirable as an important means of heating for a Passivhaus. On the other hand, too much solar gain can lead to overheating. Solar shading can therefore be an effective tool to block sunlight when the sun is high in the sky and at its hottest, while letting in low level sunlight.

Features

F1 Continuous Insulation

In order to retain heat, the main strategy is to wrap the building (including the roof, walls, and floor) in an appropriately thick layer of high-performance insulation (a bit like a tea cosy), and to ensure that this insulation layer is continuous, that is, installed without any gaps to avoid thermal bypass [i.e. heat escaping around the insulation layer) and any resulting performance gap [i.e. the building performing to a worse level than intended.

F2 Thermal Bridge Free

The term "Thermal Bridge" refers to a situation where a part of the building fabric is more conductive than other materials around it, and therefore forms a 'bridge' through which heat can escape more easily. This typically occurs where there is either a break in the insulation, less insulation, or the insulation layer is penetrated by an element of structure. The best practice is to eliminate thermal bridges completely by "designing them out" during the design stage.

F3 Triple Glazed Windows

High-performance triple glazed windows and doors are a must for Passivhaus buildings both to minimise heat losses through window openings and keep the inside surface temperature of the glass at a comfortable level [$> 17^{\circ}\text{C}$ at all times].

F4 Airtightness

Another way that heat can escape through building fabric is through air leakage. Passivhaus buildings are therefore required to meet a very high level of airtightness [≤ 0.6 air changes/ hr @ 50Pa], about 10 times higher than a standard new build.

F5 MVHR

In a Passivhaus, a Mechanical Ventilation system with heat recovery (MVHR) is required to extract stale moist air from wet rooms, supply fresh tempered air to living areas [30m³ fresh air / person / hour], and using a heat exchanger, recover some of the heat from the outgoing air in order to reduce heat loss through ventilation, whilst providing excellent indoor air quality.

Advantages

A1 Reduced heating demand

The most significant advantage resulting from the features of a Passivhaus, is a significantly reduced space heating demand [≤ 15 kWh/m². yr], around 75% lower than a new build house built to UK Building Regulations.

A2 No Performance Gap

The term "Performance Gap" refers to a disparity between the anticipated and actual performance of something, and research has highlighted that the energy-efficiency of standard new build homes is on average 60% worse than anticipated during the design stage. Conversely, due to the robust quality assurance process that certified Passivhaus buildings are required to undergo, they consistently perform very close to their design targets, effectively eliminating any performance gap.

A3 Less Overheating

All homes including Passivhaus homes can overheat, however Passivhaus provides powerful tools to design for good summer comfort, and one of the criteria to meet the Passivhaus Building Standard, is that the indoor temperature does not exceed $> 25^{\circ}\text{C}$ for more than 10% of the year.

A4 No condensation or mould

Condensation, damp, mould in buildings are symptoms of poor building performance and their presence, while fairly common, has a qualitative impact on the enjoyment of our homes. In contrast, the thermal bridge free design, airtight construction, and the use of triple glazed windows in Passivhaus buildings makes condensation build up and resultant damp and mould growth far less likely, and their absence are notable indications of their superior building performance.

A5 Excellent Indoor Air Quality

With a mechanical ventilation system running 24/7 excellent indoor air quality is all but guaranteed in Passivhaus buildings, with lower levels of particulate matter, volatile organic compounds (VOCs), nitrous oxide, carbon monoxide, CO₂, and other pollutants.

Benefits

B1 Sustainable

In 2019, the UK Government committed to a Net Zero Target as recommended by the Climate Change Committee. With buildings accounting for more than a quarter of all UK carbon emissions, it is important to find low carbon approaches to building. Passivhaus buildings result in ultra-low "Operational Carbon" emissions, meaning less emissions arising from the use of energy during their operation.

B2 Affordable

Passivhaus homes typically attract much lower energy bills, and with more resilience to increases in energy prices, their occupants have greater energy security. While there is an initial cost uplift in the region of 8% to build a Passivhaus, this is offset by the lower energy costs for the entire lifespan of the building.

B3 Comfortable

Passivhaus homes are warm and comfortable all year round, with no cold spots, no drafts, even surface temperatures, steady and controlled temperature and humidity levels, and reduced likelihood of overheating. Passivhaus homes are also quiet, as the high-performance building fabric and windows dramatically reduce sound transmission from outside.

B4 Healthy

Passivhaus homes are sanctuaries which promote good health and mental wellbeing. With cold, dampness, and mould banished, and a ventilation system which ensures excellent indoor air quality, not only are negative health effects associated with poor air quality eliminated, but improved indoor air quality has also been shown to have positive effects, such as improving productivity.

B5 Valuable

Passivhaus homes are a fantastic investment, offering both higher exchange-values in the short term, and higher use-values for the long-term. Yes, you can expect to sell a Passivhaus for a premium, but what price do you put on greater comfort and better health and wellbeing for you and your family.

Sources