

# The Passive House Standard: An Introduction

To live in the most environmentally friendly way, a Passive House is perhaps the way forward. Certified Passive House Designer, Steff Bell Bsc (Hons) ACIAT explains how they work in the first instalment of his introduction to the Passive House Standard.

The term 'Passive House' has become more commonly used in the UK in recent years, largely as a result of increased media coverage on radio and television programmes, such as Channel 4's *Grand Designs*. With the mounting pressure to reduce our CO<sub>2</sub> emissions, whilst also becoming more sustainable and energy efficient in line with Government objectives, could this rigorous German energy standard help us to reach our ambitious targets for 2016 and beyond?

## The Passive House Concept

A Passive House is a building that is designed and constructed to a strict set of criteria to ensure maximum comfort with minimum overall energy consumption. The building fabric is detailed in such a way that heat loss is reduced to an absolute minimum, whilst internal heat gains are maximised. As a result, conventional heating systems can be removed and space heating can sufficiently be supplied through passive sources such as body heat and the

sun. This saves up to 90% of the building's overall energy consumption when compared to a standard house constructed to current Building Regulations.

## The Passive House Institute

The Passive House approach is tried and tested and is widespread in both Germany and Austria. The first Passive House project was built in Germany in 1990 and there are now an estimated 20,000 Passive Houses across Europe.



Right: Passive House example from Steingaden, Germany (South elevation)

**It is possible to build a Passive House to the same price as a house built to current Building Standards in the UK**



Below: Passive House example from Steingaden, Germany (South elevation)

The Passive House Institute (PHI) was founded in 1996 by the concept's co-creator Professor Wolfgang Feist. Based in Darmstadt, Germany, the institute have developed the Passive House Standard through extensive research and monitoring of thousands of Passive House projects. The success of the Passive House Standard in Europe has been, in part, due to the expert guidance and certification schemes lead by the PHI, and also thanks to the backing of the EU and respected professional institutions that have embraced the Standard. European projects such as CEPHEUS (Cost Efficient Passive Houses as European Standards) and PEP (Promotion of European Passive Houses) have been launched to assess the potential of the Passive House Standard with regard to providing affordable, low energy homes as standard across Europe. These projects have been very successful and have played a large role in the development and progression of the Passive House Standard.

## Passive House Design

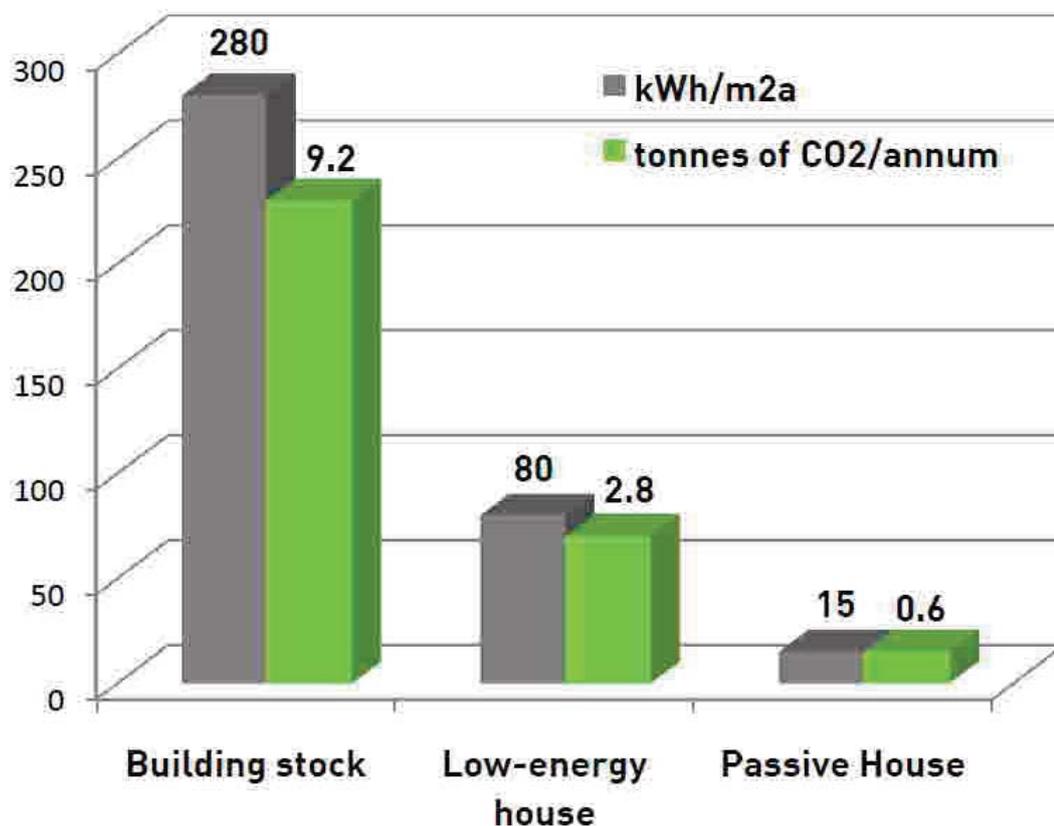
A building designed to Passive House Standards will provide a number of benefits for its owners and tenants. Such benefits will include excellent indoor air quality with reduced internal pollutants and a constant supply of fresh air, a reduction in maintenance and running costs as well as a drastic reduction in energy consumption and CO<sub>2</sub> emissions.

## Passive House Criteria and the Passive House Planning Package (PHPP)

The basic principles upon which the Passive House Standard has been developed centre around a set of strict criteria that every Passive House project must adhere to in order to become a certified Passive House. The main criteria are as follows:

- Space heating demand  $\leq 15 \text{ kWh}/(\text{m}^2\text{a})$
- Building heating load  $\leq 10 \text{ W}/\text{m}^2$
- Useful cooling demand  $\leq 15 \text{ kWh}/(\text{m}^2\text{a})$
- Primary energy demand  $\leq 120 \text{ kWh}/(\text{m}^2\text{a})$
- Building air-tightness  $\leq 0.6 \text{ ac}/\text{h}^{-1}$
- Excess temperature frequency  $\leq 10\%$

Compliance with these criteria is verified using the Passive House Planning Package (PHPP) throughout the design and construction process. The PHPP is a sophisticated design tool specifically developed by the PHI for the accurate planning and calculation of Passive House buildings. The PHPP is similar to SAP, however PHPP is considerably more advanced with the ability to provide accurate results that have been proven through extensive monitoring of existing Passive House buildings across Europe. In addition to the PHPP calculations, there are a number of sub-criteria and design considerations to be taken into account when planning a Passive House Project that



Left: Comparative values for CO2 and energy use per year for different types of houses.

are intended to make certification easier and more achievable. These are shown briefly in the Passive House diagram and will be discussed in more detail in part two of this article, Passive House: Technical Overview.

## Certification

It is important to note from the outset that 'Passive House' (and/or 'Passivhaus' as it is in German) is not a legally protected concept, meaning that anyone can claim their building is a Passive House. However, the true proof of a building being a Passive House is certification by the PHI or an independently recognised representative of the PHI. Anything else is merely built 'towards' Passive House Standard, using Passive House products, or simply taking advantage of the Passive House reputation for quality and comfort.

The intention to build a Passive House and seek certification must be established and agreed upon at the outset of a project. The process of planning and detailing a building to Passive House Standard demands consideration of the Passive House requirements at every stage of the design. Achieving a certified Passive House building after a project has been designed or after construction has begun can be extremely difficult, and in many cases impossible. It is therefore imperative that

the decision to 'go passive' is clear from the beginning.

## Construction and Energy Costs

Through the use of rigorous planning and precise execution of construction and site management, it is possible to build a Passive House to the same price as a house built to current building standards in the UK.

### Universities and local government are interested in Passive House design, with local councils investigating the potential benefits

Generally though, it is observed that a Passive House can cost from 8-15% more than a conventional house. The additional costs come through the upgraded building envelope and the mechanical ventilation system. However, over the life cycle of the Passive House this increase in capital costs is eclipsed by the dramatic savings made due to reduced energy consumption and the almost non-existent heating bills.

Improved thermal comfort levels are another of the major benefits to building a Passive House, together with the reduced

energy costs and CO2 emissions. The reduction in the energy consumption of a Passive House leads to a situation where renewable technologies become a better and more economical option for a project. This is because they can now provide sufficient energy for the building's needs, in many cases create more energy than required, which can result in the house owner selling this energy back to the grid, for a profit.

## Passive Houses in the UK so far

Passive House development is beginning to take shape in the UK with interest and knowledge increasing at a fast pace in recent years. The first UK Passive House projects were built in Wales in the form of a community centre and a detached family house (Certification by the BRE). In November 2009, Scotland had its first certified Passive House project confirmed. The affordable housing project Tigh-Na-Cladach in Bethania, Dunoon was certified by the Scottish Passive House Centre having met the relevant criteria. Channel 4's programme *Grand Designs* has been filming the development of England's first certified Passive House project. Although the programme will be aired in September of

**The Passive House Standard is founded on a set of well established planning and construction methods**



Right: An example of a Passive House certificate

this year, the detached family house situated in the Warwickshire countryside was certified in January (again by the Scottish Passive House Centre). There is also a project of 14 Passive Houses under construction in Essex for Hastoe housing association by Parsons and Whittleby (with certification by in-built) as well as a Passive House call centre awaiting certification in Dover (Certification by the BRE).

Further Passive House developments, including Das Passivhaus, will feature in Inverness as part of the Highland Housing Fair 2010, August 1 – 31, designed by HLM Architects with consulting and certification from the Scottish Passive House Centre.

## Passive House recognition and development

Universities and local government are interested in Passive House design, with a number of local councils investigating the potential benefits that Passive House buildings could offer. Kingdom Housing Association, based in Fife, is planning a pilot Passive House project due for construction in the spring of 2010.

The University of Strathclyde, Glasgow have also recognised the potential importance of Passive House as they are

running the certified Passive House Designer course (in partnership with the Scottish Passive House Centre) that trains professionals such as Architectural Technologists, architects and engineers to competently design and certify Passive House projects.

## Conclusion

Clearly, interest levels in Passive House are high. The Passive House Standard's potential to provide the UK with a solution to the problem of excessive energy consumption and high carbon dioxide emissions is now being recognised. The Passive House Standard is founded on a set of simple and well established planning and construction methods, none of which are difficult to understand or implement. However, the key to correct implementation will be in the training and knowledge available to the professionals and tradesmen employed to apply the Standard. Unlike normal building projects it is imperative that when building a Passive House each person involved understands the impact mistakes can have on the overall goal the team is striving to reach.

We are now in the fortunate position of being able to learn from the lessons and mistakes experienced in Germany and Austria during their 20 year development of

the Passive House Standard. These experiences should be used to assist and guide us towards a Passive House model ideally suited to the British climate that will provide us with a benchmark to work from, in the struggle towards a greener and more sustainable, low energy future. In doing so, Passive House design could not only help us reach our ambitious targets for 2016 and beyond, but it could in fact be responsible for us achieving those targets.

In the next part of this article, 'Passive House: Technical Overview', I will look closer at the individual components of a passive house and the values that must be achieved in order to comply with the Passive House Standard. This will focus on the task of maximising heat gains and minimising heat losses including information regarding, Mechanical ventilation with heat recovery (MVHR), Passive House windows, air-tightness and individual component u-values.