

## Research Paper: Developing and planning for Passivhaus:

### Headlines

The government has signalled that carbon neutral development is high on its agenda<sup>1</sup> and Passivhaus is in the spotlight as an option for achieving significant levels of energy efficiency in the home. The recent RIBA Stirling Prize for Architecture (and the Neave Brown Award for affordable housing) for a residential scheme in Norwich, demonstrated that Passivhaus significantly reduces carbon emissions as well as delivering significant savings in energy costs for its residents.



The above images are all from the Stirling prize winning Goldsmith Street. Images courtesy of Enhabit

A research study undertaken jointly by Three Dragons and Dr Sarah Price of Enhabit Ltd, explored the implications of including Passivhaus in new development, as a requirement in a council's local plan. The study drew on a

wide range of research including developer, landlord and resident perspectives of Passivhaus alongside the views of council officers involved with a small pilot Passivhaus scheme. The study was supported by technical input from Dr Sarah Price and Three Dragons' specialist knowledge of the development process.

We concluded that Passivhaus delivers a broad range of benefits for occupiers and that Passivhaus performs well in comparison with other similar energy efficient homes. While its development will likely mean higher build costs, depending on the method of construction, it can attract a premium on values, so that the overall viability of Passivhaus may not be that different from other similar types of housing.

### Passivhaus defined

Passivhaus is an energy, comfort and quality standard that goes beyond Building Regulations, including the standard currently under consultation by government. It is a voluntary standard that is said to achieve a 75% reduction in space heating requirements, compared to standard UK new build<sup>2</sup> and to achieve significant reductions in carbon emissions. A true Passivhaus must be certified by a Passivhaus Certifier and verified by the Passivhaus Institute<sup>3</sup> in Germany, who own and developed the standard.

The five basic principles of Passivhaus are:

1. Ventilation that recovers heat
2. High levels of airtightness
3. Cold bridge free design
4. Passivhaus windows
5. High levels of thermal insulation

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/839605/Future Homes Standard Consultation Oct 2019.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/839605/Future_Homes_Standard_Consultation_Oct_2019.pdf)

<sup>2</sup> See the Passivhaus Trust website at [http://www.passivhaustrust.org.uk/what\\_is\\_passivhaus.php#2](http://www.passivhaustrust.org.uk/what_is_passivhaus.php#2)

<sup>3</sup> <http://www.passivehouse.com/>

## Benefits for residents

The temperature and humidity levels in a Passivhaus are steady throughout the year. This is achieved with a highly insulated and air tight building envelope providing long term thermal protection. The insulation is applied without any weak spots around the whole building which eliminates cold corners as well as excessive heat losses. Known as “thermal bridge free design”, this is an essential principle, along with triple glazing, assuring a high level of quality and comfort while preventing potential damage due to moisture build up.

A Passivhaus requires as little as 25% of the energy used by typical UK new dwellings. Passivhaus buildings also perform as they are designed to. So, a household living in a 100 sq m Passivhaus with gas heating could spend as little as £60 on space heating each year.

Passivhaus dwellings can be constructed using almost any construction technique and can use traditional or modern designs.



Lena Gardens – UK’s first Passivhaus Retrofit  
(Photo courtesy of Kingspan)



Agar Grove, Camden. (Image courtesy of Enhabit)



Hart Lea, Leicestershire. (Photo courtesy of Encraft)



Ringmer Passivhaus, (Photo courtesy of Enhabit)

## Certification

Certification is central to Passivhaus development and involves three organisations or individuals: the Passivhaus consultant, the Passivhaus certifier and the Passivhaus Institute.

The Passivhaus consultant (often the developer themselves) compiles the design drawings and details, the PHPP model (the Passivhaus Planning Package), site photos, product & materials delivery notes, commissioning certificates and the air tightness test for the Passivhaus certifier. In turn, the certifier reviews the evidence and submits it to the Passivhaus Institute, who issue the certificate.



Once all the evidence has been collected, certification can usually be achieved within a month. While certification may be raised as a potential disadvantage of Passivhaus

development, it has huge benefits in ensuring quality of design & construction, and experienced Passivhaus developers ensure it is built into overall project management and do not find it holds back development.

## Comparison of building standards

Passivhaus compares favourably with other sustainability standards currently in use. These include the AECB (Association for Environment Conscious Building)<sup>4</sup> Building Standard and Passivhaus Institute Low Energy Building. The Passivhaus Institute Low Energy Building lies between the AECB Building Standard and the Passivhaus standard.

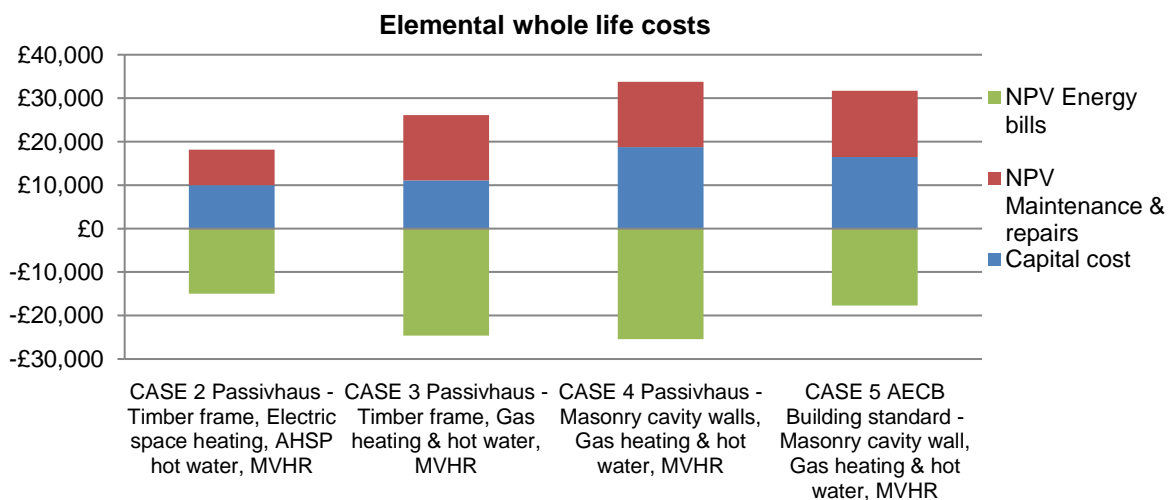
Whole life costs of a detached house, (its capital construction costs, energy bills and maintenance costs) for three different standards (2013 Building Regulations, AECB Building Standard and Passivhaus with alternative construction approaches) were modelled over 100 years and then compared, using 2013 Building Regulations as the baseline. The results of the exercise are illustrated below and highlight the different cost profiles for the different building standards that were compared.

- Capital costs are higher for the Passivhaus and AECB silver masonry buildings;
- Maintenance costs are all higher than the Building Regulations case mainly due to replacing filters in the mechanical ventilation systems;
- Energy bills are up to £25,000<sup>5</sup> lower over 100 years for Passivhaus buildings.

Sustainability standards such as the Code for Sustainable Homes level 6 (as was) or the Home Quality Mark 5\* both achieve goals in many areas of sustainability; however they do not guarantee the quality in workmanship, low energy bills and comfort afforded by Passivhaus developments.

## Benefits and disbenefits of Passivhaus as a home

From the perspectives of residents, developers and managers, the key benefit of Passivhaus development is the reduced energy costs for occupiers and positive impacts on fuel poverty. This largely explains why Passivhaus has been particularly popular in the affordable housing sector. Passivhaus also provides high levels of comfort and a lower risk of underheating and overheating. It is also said to provide



Whole life costs relative to the Building Regulations case (=£0) showing the breakdown of energy, maintenance and capital costs. NPV = Net present value.

<sup>4</sup> <https://www.aecb.net/>

<sup>5</sup>The discount rate has been modelled at an average of 3% over the 100 year period. Cost inflation has been modelled at 2%.

health benefits including reduction in allergies and asthma. While these reports are anecdotal, set alongside the other benefits of Passivhaus living, they help explain the view expressed by one interviewee for our research, “...the tenant feedback has been fantastic – they all love it.”

For occupiers, the one criticism of Passivhaus sometimes made, is that residents need guidance to make effective use of their home. But this probably reflects some historic use of complex instruction manuals which tended to confuse rather than inform. Simpler and clearer resident guidance, making use of social media, easily resolves the issue.

## Developers’ perspectives

The experience of the (market and social housing) developers interviewed highlighted that:

- Passivhaus can work for market sale and rent as well as for social housing;
- The importance of gaining certification of Passivhaus housing – compromising on this provides only short-term gains. It is important that architects, employer’s agents and the Passivhaus assessor work closely together to ensure that Passivhaus standards are met, without needing remedial action to gain the certification;
- Scaling-up Passivhaus development is feasible even if, initially, more time is needed working with contractors to ensure that Passivhaus requirements are understood and delivered;

## Costs, values and viability implications of Passivhaus

Passivhaus is generally assumed to involve additional construction costs but the research identified a broad range of views about the scale of the increase and an understanding that the level of any additional costs has been reducing with greater experience of this development type.

We concluded that an uplift in construction costs at 10% over Building Regulations is a reasonable assumption but that Passivhaus schemes can be delivered without any cost premium and that larger/longer term developments are likely to have a lower cost uplift than small, one-off schemes.

At the same time, the market value of Passivhaus sale housing can attract a price premium, although the evidence for this is limited. In addition to a synthesis of the views of developers we interviewed, we undertook detailed analysis of the sale prices of higher energy standard new homes and compared these with nearby homes of a similar age built to Building Regulations – on a per square metre basis. The analysis indicated an uplift in values achieved for Passivhaus housing over ‘standard’ developer homes of at least 5%-10% and possibly more in the right circumstances.

In terms of development viability, the higher values and higher costs broadly balance each other out and a scheme including market Passivhaus homes will have a similar viability profile than a scheme without. But the picture is different for affordable housing as social and Affordable Rent rental levels will not be affected by the introduction of Passivhaus but their build costs may be higher. So, as a general principle, as the percentage of affordable Passivhaus housing in a mixed tenure scheme increases, the viability of development can be put under more pressure.

For more information about the research generally please contact Three Dragons at [lin.cousins@three-dragons.co.uk](mailto:lin.cousins@three-dragons.co.uk) or [dominic.houston@three-dragons.co.uk](mailto:dominic.houston@three-dragons.co.uk) or for technical information about Passivhaus please contact Enhabit at [sarah@enhabit.uk.com](mailto:sarah@enhabit.uk.com).