

Welsh Passivhaus social housing trials

In 2009 Bere Architects won a competition to design low cost houses for Wales which would showcase the Passivhaus concept and feature innovative measures for energy efficiency and eco excellence. The houses are now complete and open for visitors at Ebbw Vale (by appointment).

Larch House and Lime House are the first Welsh Passivhaus social housing prototypes to be erected in Wales; both house types are certified with the Passivhaus Institute by BRE Wales. Larch House has been designed to achieve Code 6, 'zero carbon' of the Code for Sustainable Homes. It is a 3 bed Passivhaus designed to minimize annual heat demand (below 15kW/m²/yr) using extreme peak load climate data prepared by the BRE for this Heads of Valley site.

Much of the winter warmth in Passivhaus designs is derived from solar gains, but Ebbw Vale is 1000ft up in the top of a valley, with cold and misty winters. The BRE's weather data for the site showed it was twice as demanding as both Manchester and Innsbruck, Austria. To keep winter heat inside, the insulation levels are very high (walls 0.095 W/m²K; floors 0.076 W/m²K; roof 0.074 W/m²K), and because of the relative lack of winter sun, compared to a lowland site, the windows are unusually large to maximize the solar gains from a bright overcast winter sky (55% of south elevation). This is the traditional design strategy for a Passivhaus, resulting in great comfort, tiny energy bills, and bright and airy interior spaces. However, for social housing, we needed to find a way to overcome the costs associated with large windows and retractable blinds, so we made subtle but crucial changes to the way we designed the second Passivhaus.

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Cost analysis

A cost comparison was done against the RICS /BCIS database¹ for one-off detached houses on normal lowland sites (nearest comparison available):

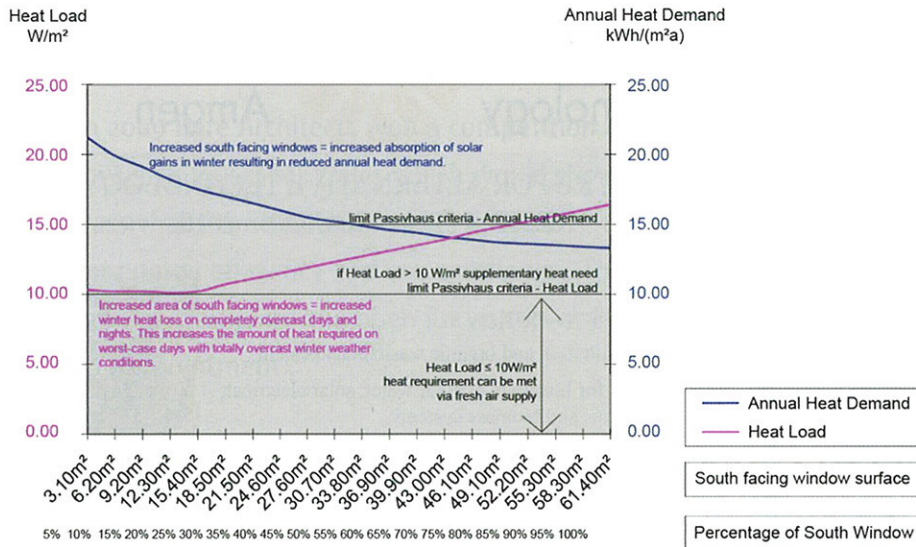
- Cost of Larch House, Passivhaus built to Code level 6: cost of the one-off, 100m², three bed house, with normal UK weather data (7-10% less than cost using Ebbw Vale weather data), and including £ 12,000 towards the cost of PV, a sprinkler system, large windows and external sunshade blinds = £ 1700/m².
- Cost of the Lime House (low cost) Passivhaus: 76m², two bed Passivhaus: After adjusting our Passivhaus for lowland weather data (saving 7% costs) we found a Passivhaus built to the 2 bed Lime House spec costs £ 1364/m² (excluding PV) which is just 14% more than exact comparisons with RICS data for average ordinary one-off houses built over the last 10 years averaging a cost of £ 1171/m², both excluding prelims and PV.

According to RICS figures, once we build in quantities, ordinary estate housing, over the last 10 years, cost an average of £ 760/m², excluding prelims and based on RICS data of the average price difference between one-off and estate housing. We think it should be possible for a large volume housebuilder to build Passivhaus estate housing of our (low cost) type, using the Lime House design techniques for £ 886/m². That means that for a 2 bed house of 76m², the cost premium for a Passivhaus is £ 9,500. (We are looking for housebuilding partners with which to put this theory into practice.)

The return on that investment is 14-17 years, based on assumptions of 5-10% annual fuel price increases, and the cost savings of the house over 50 years are likely to be more than £ 60,000, even with only 5% annual energy increases and without income from the feed-in tariff associated with photovoltaics. For 10% price increases the figure would be £ 360,000

The Larch House, (left) and Lime House (right) still under construction.





Lime House achieves Passivhaus certification using a different method, based on keeping the heat load below 10W/m² at any time. 10W/m² is the maximum amount of heat that can be transported by a low energy heat recovery ventilation unit, and unlike Larch House, Lime House has no towel radiator backup heating. It results in a building that focuses on minimizing heat demand during the worst periods of misty, Welsh hilltop, winter weather with short, dark days and cold nights. In these conditions, solar gains are of little importance, and internal heat gains are more important. So south facing windows are reduced in size and the better insulation of walls dominates, with no more than 20% south facing glazing. A weather optimization graph determined that any more than 20% glazing would increase the peak heat load above 10W/m².

Payback

If fuel costs go up 5% per annum, our Code 6, zero carbon Passivhaus, social housing prototype will be significantly cheaper after 50 years than when it was built (due to its negligible demand for fuel and the feed-in tariff), whereas a standard building regs house will have more than doubled in cost, due to fuel costs. Even with 2.5kWp photovoltaic panels, a Code 5 Passivhaus will have cost only £10,000 more after 50 years than when it was built. At today's fuel prices our Code 6 Passivhaus is calculated to earn the occupant £1,333 per annum.

Conclusions

Now, we have some UK based cost data that shows how Passivhaus houses can be built to a low cost, with really attractive payback periods that make it look short-sighted not to spend a little extra to achieve a certified Passivhaus, compared to a basic speculative builder house. These Passivhaus buildings will also future-proof occupants and owners from high running costs and fuel poverty. So why isn't everyone building to the Passivhaus standard, or at least why aren't they building highly insulated building

fabric that is free of cold bridging and saves huge amounts of energy? Why do architectural magazines in 2010 boast details with basic levels of insulation and cold-bridges galore? The answer again is our housebuilding system which rewards speculators (private householders and commercial developers) for greed, regardless of the financial and environmental cost to future generations and the timidity of successive government ministers to go further than skin-deep into the portfolios they hold, to understand and then to explain and legislate for the greater good.

Justin Bere

Ref: 1. www.bcis.co.uk/ordb

Justin Bere is an architect and principal of Bere Architects, a practice of twelve people, based in its own 'towards Passivhaus' 27kW low energy offices in Islington, London. The practice began designing to Passivhaus principles in 2001 and has been using the Passivhaus Planning Package (PHPP) and thermal modelling software since 2007. Currently the office workload includes seven Passivhaus projects in progress, at all stages from planning to work on site. JUSTIN.BERE@BERE.CO.UK



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