EnerPHit Project (Slovakia)

In this project an 'abandoned' family house located in Slovakia was renovated to meet the EnerPHit criteria for residential-use refurbished buildings. The house was in extremely poor condition at the outset and the aim of the project was to gain practical experience in an EnerPHit refurbishment and the use of ground-air heat exchanger techniques.

According to Royal Institute of British Architects in their Climate Change Toolkit (01 Climate Change Briefing, second edition, 2009) energy use in buildings accounts for almost half of all UK CO_2 emissions. Energy use in housing accounts for more than half of these emissions, i.e. 27% of total UK emissions. The replacement rate of the existing housing stock is estimated to be <1% per year, thus emissions from the existing stock account for almost all of the emissions – 99.7%. The briefing points out that at the existing rate of replacement 80% of existing dwellings will still exist in 2050, making it impossible for the UK to meet its carbon emissions reduction targets without an extensive programme of improvements to the energy efficiency of existing dwellings. Within the EU as a whole, the housing stock replacement rate is estimated to be between 1 – 1.5%

In the UK space heating accounts for 60% of domestic energy consumption (Energy consumption in the United Kingdom: 2012, DECC). In Slovakia (where this EnerPHit project is located) heating represents 80% of total final energy consumption in the residential sector (Energy Charter Secretariat, 2009).

"The use of Passive House components in refurbishments of existing buildings leads to extensive improvements with reference to thermal comfort" and "a reduction of the heating demand by 90% was achieved in a large number of projects." (Passive House Institute, website).

It is in this context that the EnerPHit standard for refurbishing existing buildings is of relevance.

The building is of solid block construction with a full height basement. An external wall insulation system comprising 25cm EPS was installed (30cm EPS to roof). The ground around the house was excavated to foundation level and 30cm of EPS installed around the basement. The opportunity was taken to install a ground-air heat exchanger since there was minimal additional cost involved. A 10cm layer of EPS was laid above the heat exchanger pipe to simulate additional depth (thermal shadow) as described by Walter Jeffries in his article on Earth Air Tubes (Sept 2008, http://sugarmtnfarm.com/2008/09/05/earth-air-tubes/).

Windows were replaced with high performance triple glazed UPVC units with insulated frames and a high efficiency (85%) MVHR unit was installed. The PHPP[1] was used to determine the optimum insulation and glazing combinations for meeting the maximum heat demand (25W/m^2/year). THERM[2] was used to model construction details and the effects of different insulation thicknesses.

The preliminary 'predicted' energy performance is less than the 25W/m^2/year necessary to meet EnerPHit standard. The Slovak building energy rating system (EPC) classes a family house with annual energy consumption of up to 54kWh/m^2/year as 'A' (Passive House). On the other hand the UK EPC rating system rates dwellings on the basis of energy cost – the SAP rating. The SAP rating is expressed as a number from 1 – 100 (divided into band A-G) and is based on the energy costs of space heating, water heating, ventilation and lighting minus cost savings from energy generation technologies. Although the EPC certificate includes an estimate of annual energy use per m^2 of floor area it is not comparable with the Slovak model.

Before:

After

Financials:

The additional cost, over and above what would have been spent, to retrofit to the Passive House enerPHit standard was € 34,000.

Annual Savings from Reduced Fuel Consumption estimated € 2,874 (PHPP).

Plus - What price *Health*? *Comfort*?

Conclusions:

Simple Payback (assuming 5% fuel inflation) is 9 years. Considering the expected lifetime of a house, typically taken to be 40 years, this is a good investment. The € 34,000 refurbishment costs include €1,600 for the ground-air heat exchanger, for which simple payback was calculated to be over 50 years – this can definitely be left out of future projects.

[1] PHPP – Passive House Planning Package is a software tool used to model and verify Passive House design and performance.

[2] THERM is a state-of-the-art computer program developed at Lawrence Berkeley National Laboratory. It is a two-dimensional (2-D) finite element program for calculating heat transfer in

Correct installation of the windows was the only major issue experienced. Although all parties involved in the buying process had nodded knowingly when the 'special' needs of the installation were discussed it was soon evident on site that the window fitters had little idea of how to install a window properly. It was therefore decided to go 'hands on' and take personal responsibility for installing the windows.

Whilst the companies involved on the project had heard of 'Passive House' they didn't have practical experience of working to the standards required to achieve the required air tightness. On the plus side the building team selected were very interested, researched the topic independently and made every effort to deliver on site. The window company selection was not so fortuitous –the quality of the actual windows was very good but the suppliers proved totally incapable of making a good installation. Whilst a satisfactory installation appears to have been effected (the proof will be in the air test – yet to be completed - and subsequent performance) this aspect could easily have gone very badly. In future projects it may be more prudent to procure the major items and their fitting through the main contractor who would then take responsibility for proper delivery and installation.

A further (surprise) discovery was the difficulty in finding tools for calculating the potential energy benefits for the ground-air heat exchanger together with a lack of published user experiences with this particular technology. The little evidence available (i.e. found) and calculations on energy yield suggested the ground-air heat exchanger was not an economic option for this project; however, as the ground around the building was to be excavated in any case, it was decided to install the option and to implement a monitoring programme to report on the performance over time. There is no conclusion to this question (or the project as a whole) at the time of writing.

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Quick biography:

Kim is a specialist in energy reduction and conservation and has an active interest in the environment and sustainable construction. He is a Certified Passive House Designer, Chartered Environmentalist (CEnv), Member of the Energy Institute (MEI) and a Passivhaus Trust (UK) member. He gained his MSc REBE (Renewable Energy and the Built Environment) at the Centre for Alternative Technology (CAT), Machynlleth, Wales.

Kim became involved in energy conservation with the deregulation of the electricity supply industry some 20 years ago, initially carrying out energy audits and site load profiling using portable energy loggers and electricity tariff analysis software. Kim was 'Carbon Reduction Manager' at North Yorkshire County Council (NYCC), the first such post in the U.K., where he developed the Carbon Management Strategy & Implementation Plan for the Council (2006). Kim moved from NYCC to White Young Green, a large and respected engineering and environmental consultancy in Leeds.