140 Balfour Road , Brighton BN1 6NE

OVERVIEW

- Age of house: 1920s
- Type: Semi-detached
- No of years in residence: 1 year
- No of residents (children & adults): 3
- No of bedrooms: 3
- No of other rooms: 6
- No of floors: 3
- Wall type: Cavity
- Loft conversion: Yes
- Extension: Yes

FEATURES

- \+ Airtight construction
- \+ Cavity wall insulation
- \+ Flue gas heat recovery
- \+ Green roof (planned)
- \+ Heating controls and optimiser
- \+ High performance glazing
- \+ Low water use goods
- \+ Mechanical Ventilation with Heat Recovery(MVHR)
- \+ Passivhaus standard
- \+ Solid wall insulation (external)
- \+ Underfloor heating

Introduction

Tim and his family bought this 1920s semi- detached three bedroom house in 2012 and have spent over a year completely renovating it and adding a loft conversion. Their motivation has been to make the house warm and comfortable, cheap to run in the long term, but also helping to mitigate climate change.

The approach has closely followed the German Passivhaus standard. It focuses on: high levels of insulation on the walls, ground floor and roof, airtight construction (to reduce draughts) and the introduction of a mechanical ventilation system. Low water use goods, such as low flow shower heads, spray taps and a low flush toilet are also included.

All energy efficiency measures have been carefully modelled using the Passivhaus Planning Package, a software based tool for calculating the amount of energy a building uses. Renewable energy systems such as solar panels were considered, but the roof is overshadowed by neighbouring houses.

Energy and CO_2 performance

At present this property does not have sufficient usage figures for a comparison to be made against typical housing. However, at this standard of specification, consumption and CO_2 emissions should eventually be around 60 – 70% below an average UK house.

Beyond the high house efficiency, ultimate performance is largely limited by the lack of space for renewables.

Thermal improvements

Walls For the lower two stories, all cavities were filled with blown 'whitewool' synthetic insulation by the previous owner.

The side and rear wall will be externally insulated with 120mm of graphite-enhanced expanded polystyrene insulation, rising to 200mm on the rear extension, later in 2013. This will be finished with a synthetic render applied directly.

The front wall was insulated by dismantling the internal cavity leaf and rebuilding using 100mm PIR cavity fill and finishing internally with lightweight blocks, finished with plaster.

Roof The 'hybrid-warm' roof is insulated with 100mm of PIR foam board on the warm OSB deck, beneath the tiles. A further 125mm of PIR and phenolic foam board was fitted between the rafter 'bays'. The flat roof of the dormer is of a similar construction, but with an average insulation depth of approx 300mm, and is topped with an 1.6mm single sheet of EPDM (synthetic rubber).

A similar construction is planned for the single-storey rear extension (still under construction), but with the addition of a green roof above.

Ground floor Underfloor heating is being installed. At the front of the house, this forms part of a 'floating' floor, topped with oak flooring. To the rear, it is embedded directly in a 110mm concrete slab. The slab has been constructed using 70% less conventional 'Portland' cement than is commonly used in Brighton – instead, a blend of 30% Portland cement, and 70% GGBS (a waste product of steel manufacture) was used. A combination of polystyrene, and PIR insulation is installed underneath with additional insulation around the perimeter (both above and below) to reduce thermal bridging.

Windows All new windows are triple glazed (Fakro rooflights, and Rehau Geneo PVCu casement windows).

Some, or all of the double-glazed PVCu windows which were already installed in the house will be upgraded to triple-glazed.

Airtightness The building has been sealed to a high level using membranes tapes and OSB boards glued together at the edges, as well as externally using a conventional 'render'. The airtightness of individual components has been checked at various points during the construction, with the use of a

self-constructed 'blower door' to pressurize the house.

Thermal bridging Care has been taken to eliminate or mitigate 'thermal bridges' which occur when cold objects (e.g. the bases of walls, structural steelwork etc.) pass through the layers of insulation – allowing heat to sneak around the insulation.

Heating systems

Gas boiler The boiler is a condensing Vaillant combi, recently installed by the previous owner. To this will be added a flue gas heat recovery unit, which uses waste heat to preheat hot water. The boiler has been configured to give a low return temperature, thereby maximizing condensing efficiency. Tim will also use an omptimiser to tailor heating to outside conditions and is developing software to minimize cycling and ensure that the boiler runs as efficiently as possible. Intelligent heating controls are planned (based on the 'DIY Zoning' software system).

Ventilation system A 'Viking House Breathing Window' heat recovery ventilation system is planned, to pre-heat incoming fresh air with the heat from the outgoing air. This minimises the heat required to warm up fresh which is drawn into the house.

Use of materials

Most insulation is in the form of high performance synthetic materials, such as PIR board, polystyrene and 'whitewool'. However, the majority of the PIR board was recycled (obtained as factory waste from a SIP manufacturer). Existing timber (e.g. from the old roof) is being reused when-ever possible, and bricks reclaimed for re-use.

Materials such as wall-blocks have been selected which have both a high 'thermal mass' (to reduce swings in temperature within the building), and also a high recycled content where possible (e.g. blocks which are made from 50% recycled materials). A 'lean' design has been adopted which has minimised the use of raw materials.

Most of the concrete has been produced using a high percentage of waste products (blast furnace slag instead of portland cement).

Construction waste has been re-used and recycled when possible (e.g. insulation off-cuts, fire wood, hard-core etc.)

Water efficiency

Low water use goods Showers will have low flow heads (6 litre per minute 'Pulse Eco shower'), spray taps will be fitted, and toilets are low flush. New plumbing is being installed to leave the option open for a future rainwater harvesting system.

Further improvements planned

The house has no renewable technologies at present, but this is under consideration. Overshadowing from neighbours limits the potential for solar technologies. Rainwater harvesting is also being considered.

Lessons learnt

Tim's decision to go for Passivhaus standard, particularly in relation to airtightness and thermal bridging, was made following his experience ecorenovating his former flat, which did not have these measures and suffered from cold spots and compromised comfort.

Semi detached Insulating to Passivhaus standard whilst being attached to an ordinary building presented problems achieving airtightness and insulation, at the boundary particularly with a shared cavity wall.

Software Improvements were designed using PassivHaus software and particular attention was paid to preventing thermal bridging, which was modelled using 'Therm' (freely available).

Links

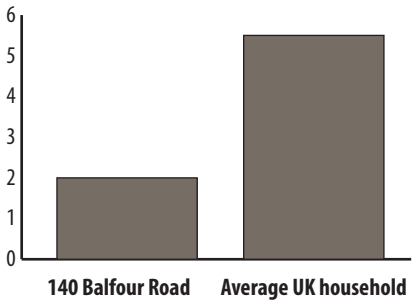
Windows: Rehau Geneo 'PHZ' triple-glazed windows to Passivhaus standard from www.solentglass.co.uk

Fakro FTT U5: www.ecomerchant.co.uk

Ventilation system: www.viking-house.co.uk/fine-wire-hrv.html

CO_2 performance (estimated)

CO_2 performance Tonnes CO_2



CO_2 emissions (tonnes)[1]	
140 Balfour	Average UK household[2]
2.0	5.5

63% below average

[1] CO_2 fuel emissions factors from SAP 2009

[2] Average fuel emissions 0.233kg CO_2/kWh (from EHS 2009 fuel split)

Eco Open Houses is an annual collaborative project between Low Carbon Trust, Brighton Permaculture Trust and Brighton & Hove City Council. This year the event is run as part of the Ecobee Project and has been selected within the scope of the INTERREG IV A France (Channel): England cross-border European cooperation programme and is financed by the ERDF. For more information on the Ecobee Project see: www.ecobeeproject.eu

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