DORMONT ESTATE – DORMONT PARK PASSIVHAUS

DEVELOPER
Dormont Estate

ABOUT
Rural private estate with 12 traditional properties and 8 new-build houses for private rent

START DATE
November 2010

COMPLETION DATE
Construction: July 2011, Building Performance Evaluation (BPE): January 2015

OVERVIEW
Since our formation in 2008, the Zero Carbon Hub continues to work with Government and industry to identify risks, remove barriers to innovation and help demonstrate that energy efficient, healthy new homes can be delivered by the mainstream house building industry.

This series of building profiles gives examples of manufacturers, developers and clients who have embraced the challenge and are developing practical, commercially viable ways of delivering the next generation of homes in preparation from the nationwide introduction of Nearly Zero Energy Homes from 2020.

SUMMARY
Dormont Park is one of the first multi-unit Passivhaus developments in Scotland and comprises eight semi-detached houses designed for long term affordable rent. The project was part of Scottish Government’s Rural Homes for Rent pilot programme, which was aimed at encouraging private investment to deliver affordable housing in rural areas. Delivery of the Passivhaus design standards means occupants and the Estate can expect quality, comfortable housing, with low energy bills.

SPECIAL FEATURES
The houses were constructed to high levels of airtightness incorporating super-insulation with little to no thermal bridging, triple-glazed windows and Passivhaus certified MVHR units. The houses are not connected to the gas grid. Hot water is supplied all year round by solar thermal panels with wood burning stoves used as a backup system during the winter months. Construction was completed using offsite pre-fabricated timber frame panels. The performance of four units has been monitored for two years as part of the Building Performance Evaluation scheme.
PROJECT STRATEGY

DESIGN AND CONSTRUCTION / DELIVERY PROCESS

Dormont Park is situated in rural Annandale, a region that experiences high levels of fuel poverty as a result of a low wage economy and lack of mains gas grid. From the beginning of the planning stage, Dormont Park has been designed to the Passivhaus standards according to the Estate’s belief that it is the best way forward for delivering comfortable, energy efficient and low bill affordable housing. Another design aspiration of the Estate was to incorporate renewables and the use of local resources. An early scoping study established that the best fit was likely to be solar thermal panels with a timber frame construction. This remained the case and these elements were integrated in the final design.

In order to meet the Passivhaus requirements special attention was given during the design to:

- orientation of the properties
- size and type of windows used
- calculations of thermal bridges
- production of specific junction details designs
- airtightness strategy and
- procurement of Passivhaus certified products.

The Estate was aware that this development was a pioneering project for Scotland. As such there were no contractors in Scotland who had delivered a multi-unit PH scheme before. To find a contractor a prequalification questionnaire was sent to thirteen companies, with five companies selected for the next round of interviews. The final contract was awarded to CCG (Scotland) Ltd, who were appointed responsible for all aspects of the build process including coordination of onsite trades, while the Scottish Passive House Centre (SPHC) remained in an advisory role throughout the build process and in addition undertook all necessary testing and auditing required to ensure compliance with the Passivhaus standard.

KEY DEVELOPMENT CHALLENGES

The development received partial funding from the Scottish Government’s Rural Homes for Rent pilot programme. However, as additional funding was not made available to achieve the higher performance standards on site, both the technical and cost teams had to work closely together to deliver innovative and cost effective solutions within a normal commercial budget.

Bringing in a certified PH designer at the early stage of design process was not possible, as confirmation of the grant’s approval was still pending at the time the designs were made, and therefore such a decision would have exposed the project to potential financial risk. The design team therefore had to consider all the aspects of the Passivhaus approach and incorporate these to the initial design without the support of an expert. The design details were reviewed by the Scottish Passivhaus Centre (SPHC) once the funding was secured. Inputs from SPHC fine-tuned the design to comply with the Passivhaus Certification requirements but no significant alterations were deemed necessary.

Achieving a high level of airtightness is central to a successful PassivHaus design. Even though a robust system was put in place, achieving this airtightness requirement during construction proved to be challenging. Air leaks were noted from the air supply pipes into the rear of the wood stoves, around doors and service penetrations. An airtight, vapour control membrane layer was installed between the plasterboard and the rigid insulation. Additional tapes and seals were applied to help reduce air leakage from potential weak areas.

PRODUCTS AND SYSTEMS

FABRIC
- Engineered timber i-beam
- External wall with 260mm wide SpaceStud framing
- Additional 70mm rigid insulation layer internal to the main insulated layer
- Chipboard flooring with insulation on concrete slab, 200mm rigid insulation
- Clay slate roof finish on battens and a vapour control layer

BUILDING SERVICES
- No mains gas
- MVHR: 90% Efficiency (frost protection pre-heater and post heater fed with hot water from hot water tank)
- Wood stove: 82% Efficiency

CONTROLS
- MVHR Controls:
  - thermostat for the post-heater
  - summer bypass (for 3-bed units)
- Solar Thermal Control:
  - panel and tank temperature monitor
- Wood Stove:
  - light indicator (post-completion): green = heat input required, red = sufficient heat is stored
PROJECT SOLUTIONS

PART L 2010
Fabric Energy Efficiency

SPACE HEATING DEMAND
<15 Kw/m²/yr

BUILDING AIRTIGHTNESS
<0.6 ac/h @ 50Pa

PART L 2010
Carbon Emissions

ACHIEVED
4.81 kgCO₂/m²
2 bed
5.68 kgCO₂/m²
3 bed

SPACE AND DOMESTIC HOT WATER (DHW)
The system comprises of solar thermal panels, a wood stove and a Mechanical Heat Recovery Ventilation unit.

The installation of all systems followed the manufacturers’ instructions and guidelines while special attention was given to systems interfaces.

The heart of the heating and hot water system is a 300 litre thermal store, which receives hot water from the solar thermal panels and wood stove, while an electric immerser provides back-up heating.

Hot water is delivered to the post heater of the MVHR as the main residual heating system. Hot water is also provided to the domestic hot water system as normal.

AIRTIGHTNESS AND VENTILATION
The MVHR unit extracts warm and potentially moist air from the kitchen and bathrooms, and also supplies fresh air to the living room and bedrooms.

Without contamination, both air streams are routed via a heat exchanger in which heat is transferred to the fresh incoming air.

The 2-bedroom houses are equipped with a smaller MVHR unit without a summer bypass mode. While the 3 bedroom houses have a larger unit that incorporates a summer bypass mode which supplies fresh air without heat recovery in the warmer weather.

KEY LESSONS

CONSTRUCTION, TESTING AND COMMISSIONING

A number of performance diagnostic tools, including additional airtightness tests, in-situ U value measurements, thermographic surveys, and flow rate checks of the ventilation units, were used to evaluate the as built performance of the properties.

AIRTIGHTNESS TESTS
Airtightness tests upon completion were carried out by testers approved by the primary contractor. Testing carried out during the Building Performance Evaluation (BPE) study indicated much higher levels of air leakage than initially certified.

In-situ U value measurements: Deviation between designed and measured U-values was shown to be circa 28% for the wall and 34% for the roof. This drop in performance may be due to a number of factors such as local workmanship inadequacy or misleading theoretical data of the products used. The discrepancy is in keeping with the Zero Carbon Hub’s finding from similar projects regarding in-situ U value measurements. For more information on reasons and explanations behind the gap between designed and as-built performance, visit Zero Carbon Hub Website.
**THERMOGRAPHIC SURVEY**

The thermographic survey highlighted a number of common issues relating to air leakage associated with doors, windows and services penetrations, but overall confirmed a high level of thermal effectiveness and no significant risk of condensation and mould growth. An important discovery was the significant effect of the decision not to insulate the hot water pipes. Lack of technical knowledge of the high fabric performance of Passivhaus led the team to believe that heat lost to the building by not insulating pipework was beneficial to the building.

From the outset of the project it was clear that the complexity of the services was a concern. The plumbing and electrical works were contractor-design packages and have proved to be the most problematic post completion. The complexity has been exacerbated, and in part caused by, the lack of accurate or clear drawings or documentations of the installation. Future strategies must include greater specialist input at design stage or the engagement of experienced, specialist installers.

**POST OCCUPANCY EVALUATION**

A Building Performance Evaluation (BPE) was carried out from the end of 2012 to the end of 2014. With identically constructed and oriented homes, there was an opportunity to investigate the influence of occupant behaviour on energy consumption, buildings performance and users experience.

The Dormont Estate and CCG put in a concerted effort to impart sufficient information to the new occupants during the handover process. Documents including a handbook and manuals from the contractor and manufacturer were handed over to the occupants. Additionally, the plumbers and electricians undertook a walkthrough with the occupants and local service personnel who were to take over the maintenance duties for the Estate.

Occupancy Surveys were conducted to establish the basic data of the household occupancy numbers and patterns. Semi-structured interviews and a Building Use Study (BUS) survey with the occupants revealed the two main areas of concern, which were: the complexity of the installed services and the high temperatures during summer (overheating).

In general the occupants felt comfortable in their new properties which have been very well received.

Findings from the Energy Consumption monitoring showed that the occupants’ life style choices and behaviour had significant effect on the overall energy consumption. One unit in particular gives insight into the challenge of meeting user comfort when incorporating new technologies in the design. As a result of unfamiliarity with the technology and misleading information from one of the installers, the occupant initially preferred to use the electric immersion heater over the wood stove as a backup system for hot water production. Another reason behind the tenant’s preference was the falsely fitted thermostats on the towel rail intended as heat dump.

The estate team took action to remove the thermostats and install addition feedback lighting to help the occupant understand how to best run the system. However, the amount of time and labour to collect and store firewood means some tenants remained reluctant about the use of the wood stove. Therefore, the immerser was left on constantly, leading to very expensive electricity bills. However overtime, due largely to the high electricity bills, occupants began to see the benefit of using the stove rather than the immersion heater.