Steel Farm

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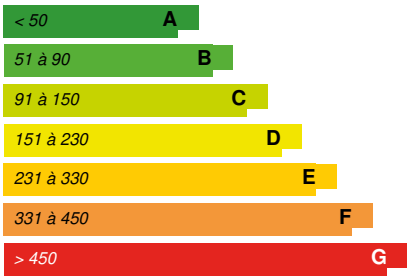


Building Type : Isolated or semi-detached house
Construction Year : 2013
Delivery year : 2013
Address 1 - street : NE47 8JP WHITFIELD, United Kingdom
Climate zone : [Cfb] Marine Mild Winter, warm summer, no dry season.

Net Floor Area : 151 m^2 Other
Construction/refurbishment cost : 1 567 €
Number of Dwelling : 1 Dwelling
Cost/m2 : 10.38 €/m^2

General information

Steel Farm is located near Hexham in the North Pennine Area of Outstanding Natural Beauty (ANOB). Built using traditional construction technology it is the first Certified Passivhaus in Northumberland.

As organic farmers they owned a plot of land where they dreamt of building a comfortable, low energy home that could accommodate them in their old age and minimise their impact upon the environment. They longed to build their own sustainable low energy home so that family could come and stay. (In the winter of 2011 Trevor and Judith Gospel were renting a small, gloomy bothy. That bitterly cold winter they found that the inside of their fridge was warmer than the living room.)

The remote rural location, limited access to utility mains, and onerous planning restrictions incurred significant costs and strongly influenced design. A number of conditions imposed by the local planning department increased costs and nearly prevented the Gospel's from building their dream home. The house features a solar thermal system for domestic hot water and a reed bed system for the treatment of foul waste water. AECB Water Standards informed the design also.

Delicate negotiations were undertaken to demonstrate the value that the project had to offer the local and regional economy, and the environment. They also saw the removal of a requirement to provide tabling and two chimneys. Ultimately all of these criteria were fulfilled without compromising the client's desire to achieve the Passivhaus standards of performance.

Planning permission was received in September 2011. Construction commenced in June 2012 and was completed in February 2013.

Trevor and Judith now live in their spacious new, home. The walls are washed with natural daylight and the windows frame views of the rolling

hills (allowing surveillance of the livestock). The lights are rarely used.

A three part documentary series about the project is available at www.PassivhausSecrets.co.uk

See more details about this project

http://www.PassivhausSecrets.co.uk

Stakeholders

Stakeholders

Function : Designer
LEAP

Mark Siddall

http://www.leap4.it
Architect and Passivhaus Designer

Contracting method

General Contractor

Type of market

Realization

If you had to do it again?

Definitely train the site trades before starting on site. We did and risk was reduced significantly.

Building users opinion

Trevor Gospel "The construction of our new home has been a real adventure; challenging at times but, all in all, well worth the wait. Both Mark and Joe have met and exceeded our expectations. We had a limited budget and stuck to it. I don't think that we could have been in safer hands."

Judith Gospel “In our old accommodation, a winter or two ago, 2011 I think, we measured the temperature of the fridge and the living room. At one point it was warmer in the fridge! More than the savings in the energy bills and the reduced environmental impact, we are enjoying the comfort of our new home."

Energy

Energy consumption

Primary energy need : 85,00 kWhpe/m^2.year
Primary energy need for standard building : 220,00 kWhpe/m^2.year
Calculation method : Other
CEEB : 0.0862
Breakdown for energy consumption : Space Heating Demand 14 kWh/m2.yr
DHW 35 kWh/m2.yr

Envelope performance

Envelope U-Value : 0,10 $W.m^{-2}.K^{-1}$
More information :
Wall0.1 W/m2K
Roof0.08 W/m2K
Floor0.11 W/m2K
Windows (uninstalled)0.76
Window g-value0.5

Building Compactness Coefficient : 3,20
Indicator : EN 13829 - n50 » (en 1/h-1)
Air Tightness Value : 0,32
Users' control system opinion : A digital programmable room stat is used. Radiators are fitted with thermostatic valves.

In practice the digital programmable room stat has proven to be more complex that was desirable.
As the dwelling is a Passivhaus, and space heating demand is already minimised, controlled can be simplified even further. In future a simple seasonal On-Off switch will be used (On from September, Off from March).

More information

The precise amount of electrical energy used by the house can not be determined because the electric meter is used for the whole farm.

Real final energy consumption

Real final energy consumption/m2 : 24,00 kWhfe/m^2.year
Real final energy consumption/functional unit : 3 649,00 kWhfe/m^2.year
Year of the real energy consumption : 2 014

Renewables & systems

Systems

Heating system :
- Condensing gas boiler

Hot water system :
- Condensing gas boiler
- Solar Thermal

Cooling system :
- No cooling system

Ventilation system :
- Double flow heat exchanger

Renewable systems :
- Solar Thermal

Renewable energy production : 40,00 %

Solutions enhancing nature free gains :
Solar gains optimised and balanced against overheating risks. Internal gains minimised.

Smart Building

BMS :
Complexity avoided. Simple controls used where possible.

Environment

Urban environment

Rural location. As an opperational farm house the dwelling is accessed by car. Public transport is not available. The site is located near Hexham, Northumberland. North East England.
Land plot area : 1 250,00 m^2
Built-up area : 15,00 %

Products

Product

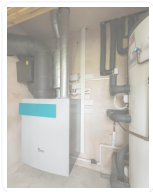
Paul Novus MVHR (supplied by Green Building Store)

PAUL

Green Building Store

http://greenbuildingstore.co.uk/
Product category : HVAC, électricité / ventilation, cooling
mechanical ventilation with heat recovery

Passivhaus Certified



Costs

Construction and exploitation costs

Total cost of the building :307 350 €

Energy bill

Forecasted energy bill/year :367,00 €
Real energy cost/m2 : 2.43
Real energy cost/Dwelling : 367

Health and comfort

Water management

Rainwater butts used externally.

AECB Water Efficiency Standards were adopted as the basis for minimising mains water, domestic hot water demand and overheating risks.

Low flow fittings, a compact services plan, a microbore plumbing system was utilised so as to minimise the volume of dead legs (< 1.0 litres), and the storage cylinder was superinsulated (100mm compared to standard 50mm.)

Indoor Air quality

Hygienic ventilation (0.3 - 0.4 air changes per hour).
30 m3.h/person

Comfort

Health & comfort : Measured Performance:

Average temperature over the Year 20.3C

Winter:
oAverage Whole House Internal Temperature 18.5C
oAverage External Temperature 5C

Summer:
oAverage Maximum Internal Temperature 23C, Average Maximum External Temperature 15C,
oAverage Maximum Internal Temperature 24.7C, Average Maximum External Temperature 23C

Calculated indoor CO2 concentration :
Calculated household average <1000ppm

Calculated thermal comfort :20C during winter. 0% >25C during summer.
Measured thermal comfort :Refer to Health & Comfort above.
Acoustic comfort : Noise levels from MVHR designed to be < 25 dB(A) in habitable rooms and < 35 dB(A) in non-habitable rooms

Carbon

GHG emissions

GHG in use :15,70 $KgCO_2/m^2$/year
Methodology used :
PHPP calculations used to estimate energy use and carbon emissions

Building lifetime : 100,00 year(s)

Contest

Reasons for participating in the competition(s)

Energy Consumption Data:

- **6 cylinders of LPG were used in the 12 months between March 2013 and February 2014 (08.03.13-07.03.14). There was 3649 kWh/yr (24 kWh/m2/yr) of energy used.**

- The average North East space heating and hot water demand, for a house similar in size to Steel Farm, is estimated to be about 25,345 kWh/yr. In practice Steel Farm demonstrates an 85% reduction in energy demand.

NOTE: There is no sub-metering to differentiate between space heating, DHW and cooking. Dates of purchase for the 47kg cylinders have been used to approximate the energy demand as the use of unmetered LPG cylinders prohibits absolute accuracy of measurement.
Heating:

- The house run on LPG using 47kg cylinders fed to a condensing boiler that has been converted to LPG.
- Predicted energy demand PHPP 39.6 kWh/m2.yr (based upon 4.3 occupants), 26.2 kWh/m2.yr (based upon 2 occupants and adjusted to 19C as monitored.
- The cost of LPG is £65 per 47kg cylinder (10.68p/kWh)
- 6 cylinders of LPG were used over 12 months (08.03.13-07.03.14). Approximate energy usage 3649 kWh/yr (24 kWh/m2/yr).
- The cost of heating the home using LPG was £395/year.
- Comparison to mains gas: A standing charge for mains gas is 19.55p/day (£71.36/year). 3649 kWh/yr at 0.03569 £/kWh = £130.25/yr. Mains gas supply would cost £202/yr. So if mains gas was available the heating bill could be reduced by 80%, a saving of £768/yr.

Conclusion: The house appears to perform in reasonable alignment with the PHPP calculations.

Primary Energy:

As an active farm the electricity meter issued to measure both the supply of the farm equipment and lighting as well as the household. The client determined that the cost of sub-metering was determined to be an extra, unwarranted expense.

Internal Environment Data:

Trevor and Judith have stated that the home is very comfortable. Temperature sensors have been installed in the home in order to gain greater insight into Trevor and Judith's response to living in the home.

- Average Temp Over the Year 20.3C

Winter:

- Average Whole House Internal Temperature 18.5C
- Average External Temperature 5C
- RH Average 51%

Summer:

- Average Maximum Internal Temperature 23C, Average Maximum External Temperature 15C,
- Average Maximum Internal Temperature 24.7C, Average Maximum External Temperature 23C
- RH Average 55%

Vital Stats: Overheating Risk Assessment

- The Peak daily temperature was less than 25C for 95% of the year
- When the Peak Internal Temperature of 31C occurred the Peak External Temperature was 28C (considered to be due to high solar gains)
- When the Peak External Temperature reached 35C the Peak Internal Temperature was 29C.

Statement of Design Intent

Aesthetics

As farmers Trevor and Judith Gospel recognise that they are custodians of the land.

The rolling landscape of Northumberland is a jewel in the crown of the North East. Just as a precious stone compliments the band of a ring they wanted their home to compliment an Area of Outstanding Natural Beauty.

They wanted the patina of time to enrich their home and the character of the house to develop over decades. Its purpose being to respond to, enrich and evoke a sense of place.

Yet they did not want a traditional house. Nor did they want a home that was alien to its setting. They wanted a characterful home that is harmonious yet distinctive, memorable, unique and meaningful.

Steel Farm comes from the earth. The sun kissed walls are natural stone drawn from the quarry nearest to the site. The roof is Cumbrian slate. Details beguilingly appear to echo traditional design, yet in practice radically reinterpret the past.

Inside the house daylight washes the interior as the windows are positioned, sized and proportioned to carefully frame views across the land and toward the fields where sheep roam freely beneath dramatic skies.

Watch the full documentary about the design and performance of Steel Farm at www.PassivhausSecrets.co.uk

Building candidate in the category

Energy & Temperate Climates

Users' Choice Award

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