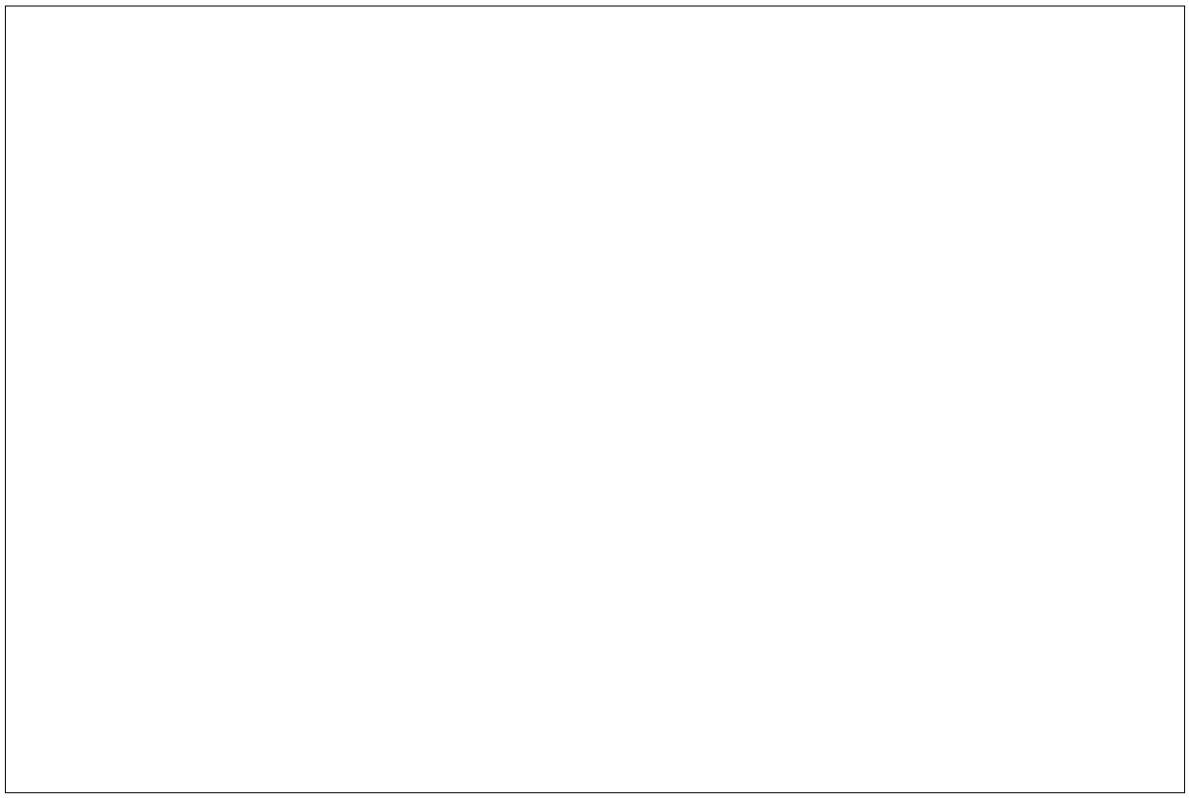
The Zero-Heating House, Peterculter, Aberdeen, Scotland

International Energy Agency

IEA – SHC Task 28 / ECBCS Annex 38:

Sustainable Solar Housing



The project

In Aberdeen, Scotland, a private development was built in 2000. On a small semi-urban site surrounding by conventional homes, the client desired a home which would meet the needs of the environment and there family in the future.

The design team were set a low budget for the design of a four bedroom family house but were keen for the building to compliment sustainable targets. In the UK there have been a plethora of showcase environmental housing yet this building aimed to achieve an affordable yet environmentally friendly home.

The building is an evolution of a design used previously by the design team and this gives it a key advantage. The building holds a specific grid layout and has a habitable roof space to reduce costs and reduce site waste. The building has an open plan main area encompassing living, dining and kitchen with an open landing area to circulate passive heat gains vertically.

Sustainable Objectives for the design

The sustainable targets set by the design team will be met by:

• Ensuring that environmental gain is not created through additional expense. This is mostly achieved by a compact design and passive means of heating.

• The typical dedicated central heating system is not included in the design. The money saved from the omission of this feature is given over to the additional cost of environmental features. This includes:

a) Elimination of dedicated heating system

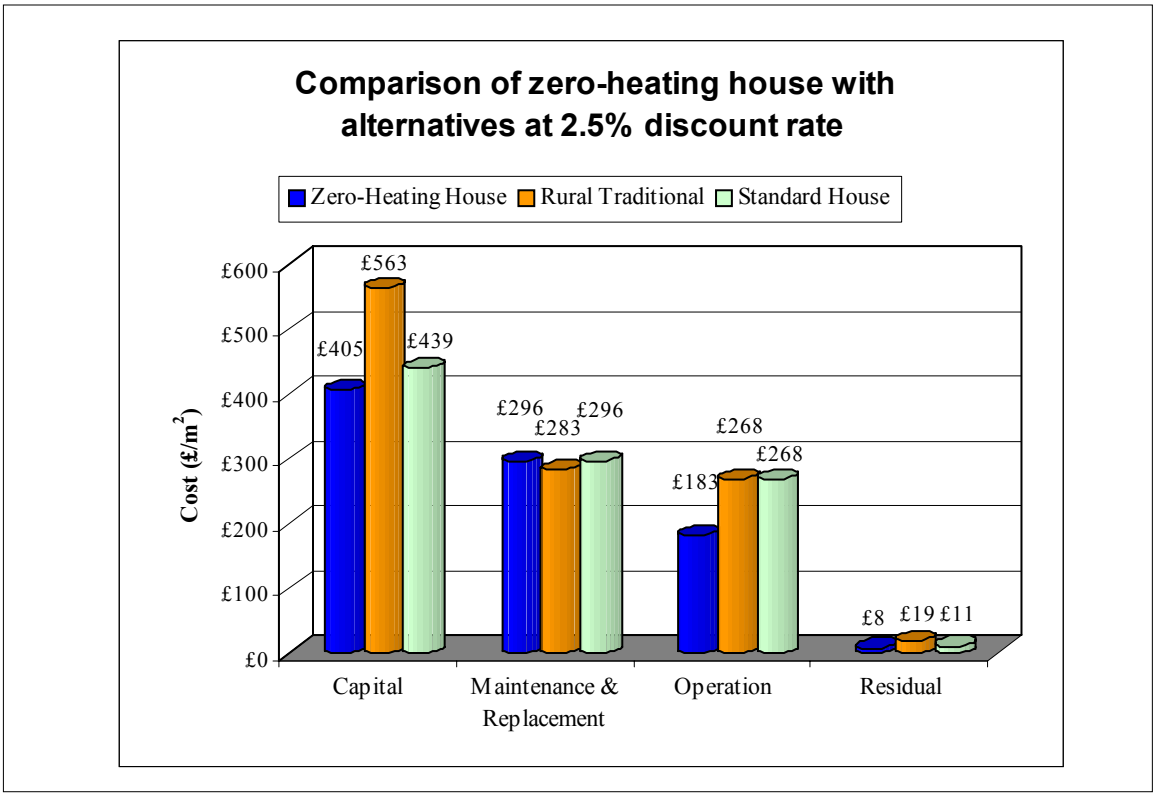
b) Heat recovery ventilation units at points of pollution.

c) Super-insulation in the depth of timber “I” beams using vacuum packed recycled insulation. (U value: 0.10 W/m2K)

d) Passive solar design with thermal mass on the floor.

e) Low E triple glazing on all windows. (U value: 1.1 W/m2K)

f) Sustainable materials, locally sourced and from renewable sources as far as possible.



•Make best use of the available technology and design to reduce energy use, waste and embodied energy in buildings to a minimum during construction and during occupation.

• Use local resources (human and materials) to support the development as far as possible.

• Finally, create an acceptable and successful design aesthetic and innovation.

Building Construction

Much of the design is not a new concept yet there is not much residential housing in the UK which achieves sustainable concepts affordably. The main thrust of the idea for this building was the need for a dedicated heating plant to be eliminated offset by the use of between 300-400 mm insulation.

The '*zero heating*' family home is built using timber "I" beams that simultaneously quick to install, allow a large depth for the insulation and are less expensive than traditional construction. Glue has also eliminated from the construction. The external wall has a U-value of 0.12 W/m²·K and the roof has a 0.10 W/m²·K.

Externally, the building is clad in locally purchased larch cladding with clay pantiles, chosen through an environmental life cycle analysis.

The glazing is mostly south facing, with most of the north, east and west glazing eliminated. This will allow daylight to enter on the south facade while reducing the risk of heat loss on the remaining facades. The glazing is also triple glazed, krypton fill with low E and the roof-lights are double glazed low E. The triple glazing has a U-value of 1.1 W/m²·K and the roof-lights have a U-value of 1.4 W/m²·K

The interior floor is exposed concrete 250mm thick, insulated by 100mm of polystyrene insulation so as to act as thermal mass. The floor has a U-value of 0.14 W/m²·K

The interior of the building is far more open than would be expected, so as to allow the heat to circulate, but the real innovation is in almost eliminating dedicated circulation space by allowing all rooms to run of the central living space and balcony. As a consequence most of the interior space is two story, which allows light to flood in for vast periods of the day.

In addition to the added insulation, passive solar design, thermal mass, mechanical heat recovery fans and triple glazing a solar panel was also installed to aid the water heating of the house. A wood stove is also included in the central living space as a back up during winter, though preliminary calculations suggest that internal temperatures inside the house over the year should not fall below 14ºC.

Analysis

The project was completed in 2000. The three phases of research included:

1) Life Cycle Cost Analysis of the whole building, giving priority assessment to the energy efficient features of the design.

2) Environmental monitoring and assessment of the interior with emphasis on heating and ventilation.

3) Post Occupancy Evaluation, for assessing the environmental comfort of the building.

Results from the three phases has been used for adapting later projects for the greater use of simple energy efficient design.

In its primary aim of reducing heating costs the '*zero heating*' house succeeds in reducing annual heating costs. This equates to an 80% saving over current 'standard' housing designed in accordance with modern building regulations, before discounting.

Total energy costs for the '*zero heating*' family home, including all the energy efficient features, succeeds in reducing combined annual energy and maintenance bills by £300 per year (at 2.5% discount rate). This represents a 21% saving over current 'standard' housing designed in accordance with modern building regulations.

The additional fabric insulation, triple glazing, heat recovery ventilation units and solar powered water heating allow for a 80% reduction in the heating CO_2 emissions between the alternatives. The use of a wood fire also complements this environmentally as the fuel is from a sustainable source, termed as biomass energy.

With all the energy saving features combined, savings of up to 21% at a discount rate of 2.5% may be obtainable on the operational costs only, and have a quicker overall payback period of 19-21 years.

Technical systems

Mechanical Heat recovery on points of pollution, all other systems are passive.

As a back-up system a wood fired fireplace in located in the main living space. During analysis this system was only used during the coldest winter nights.

Project team

Client

Architect

QS

Engineer

Contractor

Contact person

Gokay Deveci, Chartered Architect
The Scott Sutherland School, Faculty of Design,
The Robert Gordon University,
Garthdee Road,
Aberdeen,
AB10 7QB
g.deveci@rgu.ac.uk