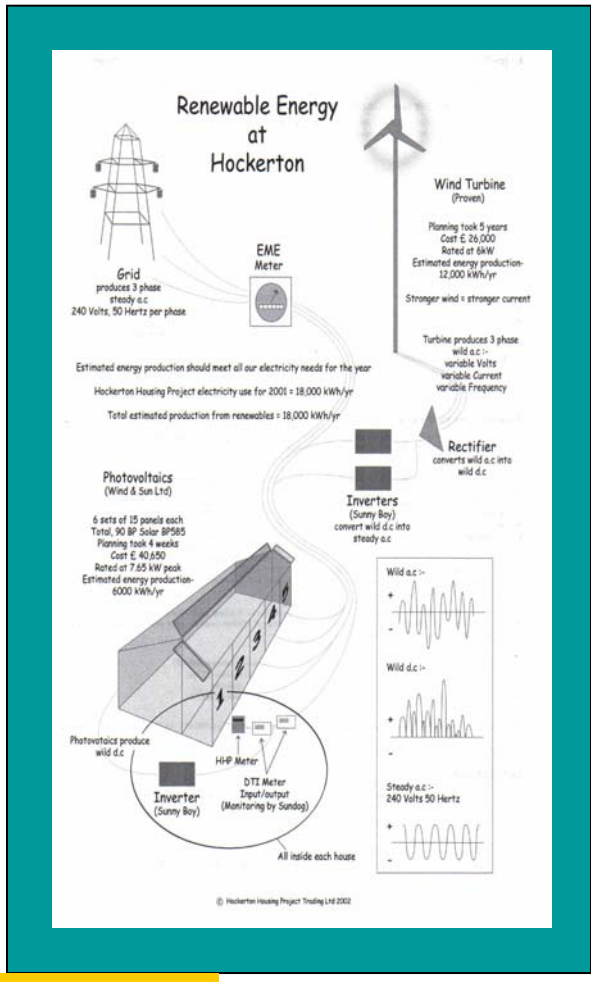

Hockerton Housing Project, UK

International Energy Agency

IEA – SCH Task 28 / ECBCS Annex 38:

Sustainable Solar Housing

The project

The Hockerton Housing Project (HHP) is an innovative residential sustainable development in the village of Hockerton near Nottingham, UK.

Completed in 1998 after three years of planning and 18 months of construction, it has been designed as one of the first zero energy residential systems in the UK, reducing life cycle energy to a minimum. Maximum use of benign, organic and recycled materials has been made in the construction and the development is designed to be, to a large extent, self-sufficient. The houses are earth covered and have passive solar heating without a space heating system. A wind turbine and photovoltaic system provide all of the energy required to run the homes. The water and sewage system is self-contained.

It is the UK's first earth-sheltered, self-sufficient ecological housing development. Project members live a holistic way of life in harmony with the environment, in which all ecological impacts have been considered and accounted for. The houses are amongst the most energy efficient, purpose built dwellings in Europe.

The Project consists of a terrace of five single storey dwellings which are earth-sheltered at the rear (North), such that the ground surface slopes and blends smoothly into the field at the back. Each house is 6 m deep with a 19 m south-facing conservatory running the full width of each dwelling. A repeated modular bay system of 3.2m in width was used for ease of construction. Most internal rooms have 3 m high French windows so they are not so dependent on natural light.

The development is located on a 10ha site that has a slight slope just to the south west. Previous use of the land was essentially agricultural. The large area has allowed incorporation of features that enable the occupants to live in a sustainable and self-sufficient way. This includes crop cultivation and the rearing of small animals. It has also allowed for large water catchment for the homes and waste disposal via a reed-bed system.

Objectives

There were several key design objectives regarding energy performance and sustainability:

- To reduce space heating requirement by artificial means to zero
- To reduce CO_2 emissions incurred by the existence of the development, to zero
- To be as autonomous as possible in terms of provision of utilities, including water
- To use renewable energy sources to meet the energy requirements of the development
- To use easily transferable construction techniques and ready available, environmentally responsible materials
- To provide competitive costing to conventional housing (in the short term) with demonstrable savings (in the medium-long term)
- To provide occupier control of infrastructure and services with minimal maintenance
- To increase biodiversity and enhanced landscape associated with the project
- To offset all energy requirements (including those embodied within materials) and CO_2 emissions incurred during construction work
- To achieve all of the above with no loss of comfort or modern amenities.

Building Construction
The development is of high thermal mass construction with 200mm concrete block internal cross walls on a 300mm concrete slab, a concrete beam-and-block roof and 500 mm thick external walls of two skins of concrete blockwork used as formwork to contain mass concrete.

The adoption of a single sub-slab 200mm in thickness, simplified the construction of the superstructure as there are no movement joints. A polyethylene waterproof geomembrane was laid on the upper blinding slab.

Walls, slab and roof are super-insulated with 300 mm of expanded polystyrene (cfc free) with the mass on the inside of the insulation. The roof is covered with 400 mm of topsoil and the north side and terrace ends are buried in the ground.

The building envelope is clay brick for exposed exterior walls, using bricks fired from waste methane gas. All of the internal walls are wet plastered. There are no holes through the main slab for soil pipes or services so the insulation and membranes are not perforated.

The main doors and windows opening into the conservatory are triple glazed with low-e glass and argon filling, whilst the conservatory has double low-e glazing.

The solar space heating is completely passive; heat transfer from the conservatory to the house can be facilitated by opening windows if required.

The roof, walls and floor have a U-value of 0.11 W/m^2K and the triple glazed units 1.1.

Technical Systems
Ventilation is provided by opening windows in the external wall and glazed doors between the house and the conservatory. In addition, each house has a mechanical ventilation heat recovery (mvhr) system that supplies fresh air to living/bed rooms and extracts from the kitchen and bathroom.

Water is heated using an air-to-water heat pump and is stored in a heavily insulated 1,500 litre plastic tank in the utility room. The system is maximised by drawing air from the top of the conservatory to gain the benefit of solar heating and uses less than a third of energy required for a conventional system.

Other energy conservation measures include predominant use of low energy light bulbs, laptop computers and purchase of appliances that are highly energy-efficient. Appliances are not left on standby and clothes dried on conservatory racks rather than tumble-dryers.

Space heating relies totally on heat from solar gain and incidental gains from occupation. The heat is stored in the mass of the buildings (e.g. concrete/ blockwork) and released when the air temperature drops below that of the building fabric.

The elevation design makes good use of low winter sun penetrating to the back of the dwellings and provides good internal daylighting as well as maximising on passive solar gain through the conservatories. The trees on the southern boundary are all deciduous so do not block sunlight once they lose their leaves in autumn. During the summer, shading is created within the homes due to the high angle of the sun - this reduces thermal gain and brightness inside, when it is least wanted.

A 5kW wind turbine and a 7.65kW array of photovoltaics generate almost as much energy as used by the homes. The HHP wind turbine is one of very few examples in the UK of a community owned wind turbine, whereby the owners are supplied directly with the 'clean' renewable energy produced.

Energy performance

The Government sponsored monitoring programme [New Practice Profile 119] was conducted over the 1st year of occupation only (1998/1999), as part of the Energy Efficiency Best Practice Programme. The total energy consumption of the 5 homes during the monitoring period was 20,500 kWh. This represents just over 4000 kWh per house and around 11kWh per house per day. This compares to an energy use of about 25% of conventional new UK housing, and only about 10% of current UK building stock.

Some of the internal monitoring has continued by HHP occupants themselves.

Max/ min temps [in one house] for porch, conservatory, main house and main house ground slab have been recorded together with an 'ambient' internal air temp [taken approx. 8am each morning] in order to give a realistic picture of the dynamics of temperature fluctuations in the houses. These are cross- referenced with temperature readings in the other houses. The energy consumption of each of the five houses is monitored on a quarterly basis. Note the lower usages compared to the monitored data.

	House				
	1	2	3	4	5
Occupation profile					
Adults	2	2	1	2	1
Teens	0	0	1	2	0
Children	3	3	0	0	0
Key variability of facilities between homes					
TV[s]	0	1	1	2	0
Heat pump [water]	Yes	Yes	No	Yes	Yes
Home working	Yes	Yes	No	Yes	No
Energy use (average over period – 1998 -2002)					
kWhr/year	**3002**	**3625**	**3482**	**4027**	**2743**
kWhr/day	8.22	9.93	9.54	11.03	7.51
[a]kWhr/m [2]/year	17.65	21.3	17.5	23.68	16.25
[b]kWhr/m [2]/year (internal)	23.69	28.6	23.55	31.78	21.65

Marketing Strategy

The homes were self-built by the occupants. Since 1998, only one house has changed ownership. In 2002, one of the homes was sold within months of becoming available. Due to the unusual nature of the project, estate agent services were conducted by the project itself who contacted people that had expressed an interest in joining HHP. The house sold within weeks and the new occupants have happily settled in. It is unlikely that any other homes will be sold in the foreseeable future.

More recently the builder associated with HHP has gone on to build a pair of similar earth-sheltered dwellings on land adjacent to the site. These were commissioned by the landowners. HHP continues to be contacted weekly by individuals wanting to live in similar properties.

Contact person

Nick White, Hockerton Housing Project Trading Ltd.,
The Watershed,
Gables Drive,
Hockerton,
Southwell,
Notts NG25 OQU

Tel: 01636 816902
Email: hhp@hockerton.demon.co.uk
Website: www.hockerton.demon.co.uk

Information (Publications:)

Hockerton Housing Project Information Pack – includes project details and its history, principles, design, construction methodology, services and also sections on autonomous housing and earth-sheltering to set the project in context.

Background Document - enshrines the foundation of the project, laying out its aims and objectives at the earliest stage.

Land Management Plan - an operational document, describing current usage and status (including records of biodiversity) of the land. It defines how the land must be developed in a sustainable way.

HHP Project Brochure - details of key aspects of project and suppliers.

The Sustainable Community – A Practical Guide (Hockerton Housing Project). Based on the experience of the Hockerton Housing Project (HHP), this 52-page guide aims to help others plan and set up their own sustainable projects.

Sustainable Housing Schemes in the UK – A guide with details of access (Hockerton Housing Project)- Profiles over 30 schemes as key case studies with details of access arrangements and further information.