Sustainability in practice

Real performance at Skelton Grange

Too many buildings are marketed as eco-friendly at the design stage and receive environmental accolades before their actual performance has been tested says Jonathan Lindh. Apparently a number of projects which have received awards seriously under-perform when it comes to user satisfaction and actual energy use.

Some hard evidence for this comes from a series of 'probe[1]' studies, carried out on a variety of buildings, which showed few met the targets the designers had originally set.

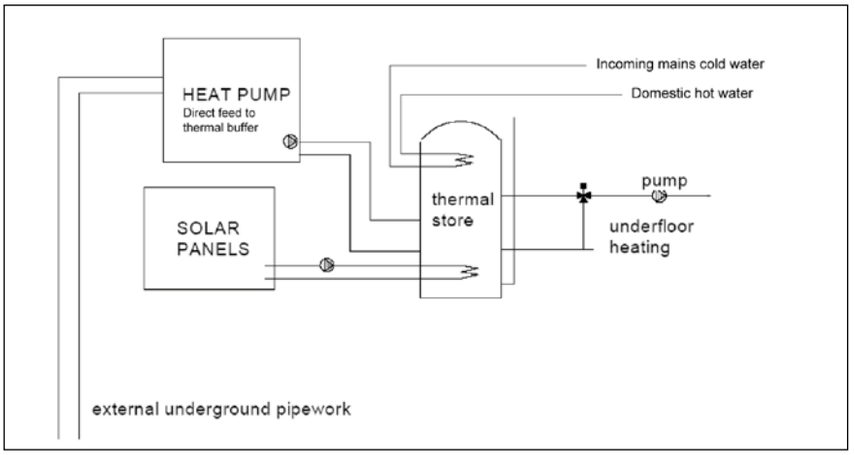
By way of setting a good example, my own company, LEDA, recently undertook a post-occupancy analysis of one of our own buildings, an environmental education centre for BTCV (British Trust for Conservation Volunteers) at Skelton Grange in Leeds. This centre, which won the Leeds Architecture Award for Sustainable Design last year, has been in operation for three years.

A showcase centre

BTCV wanted Skelton Grange to be a showcase of good sustainable design, and the challenge for LEDA was to create this on a budget that many architects would have considered tight for such a building. Their solution to this problem was to use our team of architects and environmental engineers to approach the design in a totally holistic way, a process known as 'integrated design' which we use for all their projects.

The centre was designed to maximise the benefits of solar energy in all its guises: providing good daylighting, warmth in winter from south-facing windows, heating water from solar panels and generating electricity from photovoltaic panels on the roof. A ground source heat pump was installed to provide the small amount of top up heating required for this highly insulated building, feeding into an underfloor heating system. Other sustainable features of the building include:

- a 2.5kW wind turbine linked to the centre's electrical system
- rainwater collection to supply low-flush (3.5 litre) toilets
- sewage disposal using a leach field for drainage, which also means that an area of land is kept moist and provides improved heat transfer for the heat-pump
- an insulation callec 'IsoGrass', made from dried grass cuttings used under the floor and in the roof
- use of a conservatory as a glazed buffer zone, to moderate the indoor environment and provide additional teaching and exhibition space
- windows containing argon-filled, double-glazing with a soft low-



The core of the heating and hot-water systems at Skelton is an insulated 300 litres thermal store. Heat from the solar panels feeds into a coil into the bottom of the store, whilst warm water (at 45°C), from the heat-pump, is fed directly into the middle of the store.

When heating is needed, water from this thermal store is pumped directly into underfloor heating pipework. At the top of the store is a highly efficient heat-exchange coil which supplies hot water. When a hot-water tap is turned on, cold water passes through this coil and leaves it at around 40°C.

emissivity coating

- design for deconstruction so the pre-engineered timber-framed building can be easily recycled at the end of its life.

Monitoring the building

BTCV have been recording the energy consumption at Skelton Grange over the last two years, along with the energy generated by the renewable energy systems. These records were analysed by Matthew Hill, one of LEDA's engineers, who helped design the centre. "One of the first lessons we learnt was that we should have installed more monitoring equipment on the energy systems", said Matthew, "but the problem for designers is who should pay for this. It's unfair to ask clients to foot the bill, and there is currently no government support for installing monitoring equipment."

The measurements BTCV recorded were daily output from the wind turbine and photovoltaic panels, hours run by the heat pump (recorded on the heat-pump's own display) , and electricity use recorded on the incoming supply meter. In retrospect an electricity 'export' meter and heat meters on the input and output of the heat-pump would have been useful additions, allowing a more accurate assessment of electrical use and a measurement of the efficiency ('coefficient of performance') of the heat pump.

The monitoring results were presented at a seminar in September, along with feedback from the building users on their experience of working in the centre. Client feedback was generally positive, expressing satisfaction with the way the building functions and their ability to control the internal climate. The original design process had included a variety of participation exercises to try and ensure the layout of the centre met BTCV's requirements, but it was also clear that the flexibility built into the design has allowed users to change their ideas about how spaces should be used.

Skelton Grange education and training manager, Helen Pearson, gave her personal view of the centre at the seminar: "We wanted a flagship building and we certainly got one. From three-year-olds coming to look for ladybirds to city councillors and officials from the RSPB, everyone has been impressed."

LEDA's analysis of the building's performance included an honest appraisal of their disappointments as well as their successes. There had been the all-too-common teething problems with some systems, which had been a struggle to iron out. In particular the settings on the heat-pump's controls had needed a number of minor adjustments to match it to the system at Skelton and the commissioning engineer (based in Cornwall) had been naturally reluctant to carry out this work.

The monitoring results also showed that the output from the wind turbine had been lower than expected. This has been partly put down to locating the turbine in a position where air turbulence can be created by the profile of the building in southerly winds, and partly from a failure to correctly optimise the electronics that link the turbine to the 'mains'. LEDA have asked the turbine installers to return and check this out.

It had also been necessary to carry out additional draught proofing as part of the building 'snagging' process, as contractors had not appreciated the importance of air-tightness in a well-insulated building.

LEDA's continued involvement with the centre, following the building's handover, was essential to its effective operation. Too often architects fail to return to their buildings once the publicity photos are taken for their portfolios.

Despite the problems, the energy figures showed that the building's performance, in comparison to published "Good Practice" figures[2], was respectable. The heat-pump was the largest user of electricity in the building, this being partly offset by the electricity generated, as the chart shows.

Over the year to July 2006, Fig. 1 shows that the wind turbine and photovoltaic panels generated approximately 25% of total consumption (2195kWh of 7881 kWh consumed), the majority of this coming from the photovoltaics. The comparison of monitored energy used in the centre with good practice figures for primary schools (considered the closest building type for comparison) are encouraging and can be seen more clearly in the Table 1 and Fig. 2.

These figures show that Skelton Grange is producing 75% less carbon emissions than one built to current best-practice standards. These may be figures to be proud of, but as my colleague, Matthew Hill, commented: "If the UK really does aim to achieve a 50% reduction in greenhouse gas emissions by 2050 all our new buildings need to be built to this standard – if not better!"

Refs

1. Published by CIBSE (Chartered Institute for Building Service Engineers)

2. Figures from the Carbon Trust's Energy Consumption Guide for primary schools were used for comparative figures

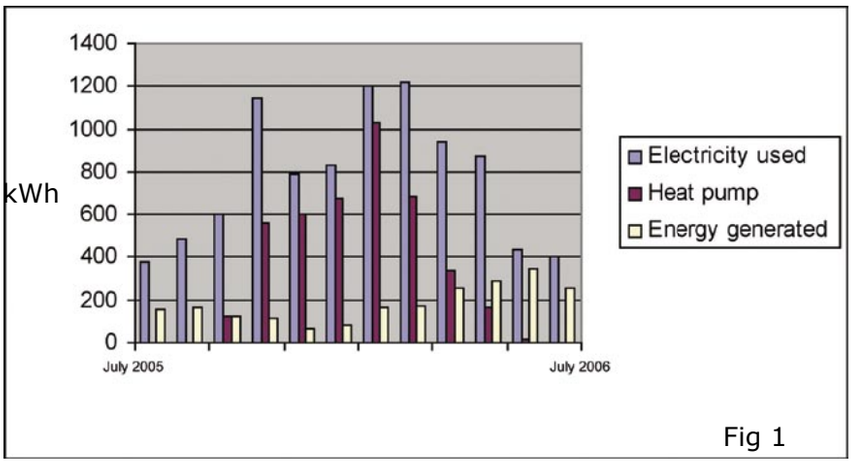


Fig 1

Table 1

	Typical	Good Practice	Skelton Grange
Electricity use kwh/ m^2/p.a.	28	20	17.8
Gas use kwh/m^2/p.a.	173	126	0
CO_2 emissions kg /m^2/p.a.	44.9	32.5	7.6

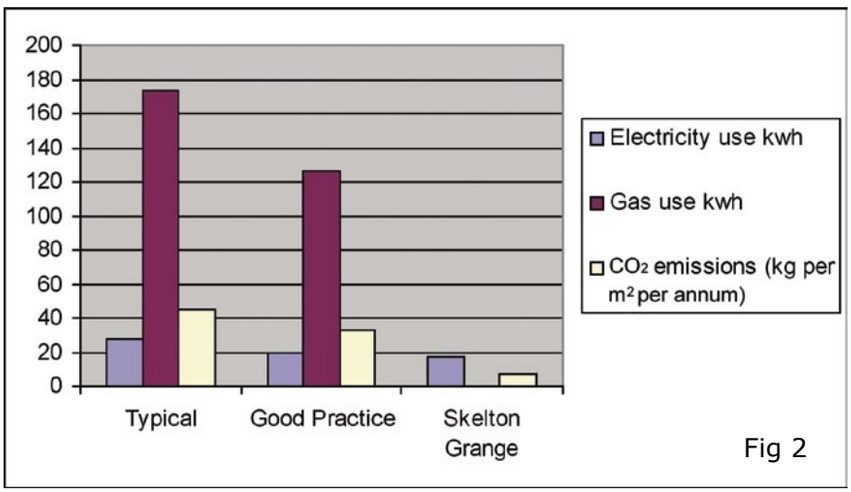


Fig 2