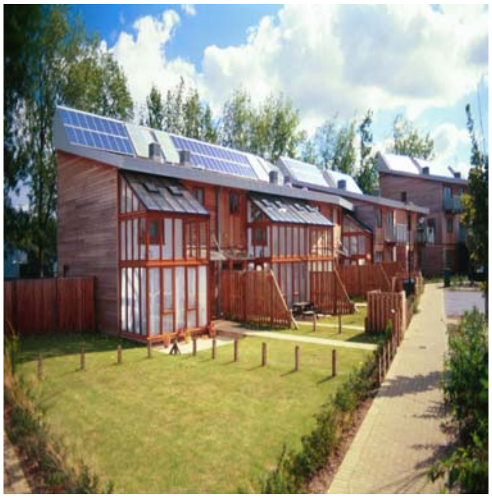
INTEGER Project, Maidenhead, UK

International Energy Agency

IEA – SCH Task 28 / ECBCS Annex 38:

Sustainable Solar Housing



	U-values (W/m2K)	Building Regulation requirements at time
Roof	0.2	0.25
Exposed external walls	0.2	0.45
Windows	2.16	3.0
Ground floor	0.35	0.45

The project

The project of 27 dwellings consists of six two-bed houses, two three-bed houses and 19 one-bed flats. Located on a brownfield site in the centre of Maidenhead, it was originally a car park with concrete garages that were mostly no longer in use. The site is ideally located for housing, being only five minutes walk from a railway station and ten minutes walk from the town centre.

The project was jointly funded by the Royal Borough of Windsor and Maidenhead and the Housing Corporation. Work on site began in 1999 and development was completed in September 2001.

Objectives

In 1998, housing association 'Housing Solutions' approached INTEGER with a scheme for a site in Maidenhead. The aim was to incorporate as many INTEGER elements of innovation in design, intelligence, environmental performance and construction process as possible in order to maximise the benefits to the future occupants. The design incorporated many innovative environmental features in which low energy use, and therefore low bills for tenants, was a central theme.

Building construction

Timber frame was the selected method of construction as it is sustainable and inherently thermally efficient. The timber frame was a 170mm engineered timber I-beam, which was filled with recycled cellulose insulation. I-beam construction offers additional thermal benefits as the beams prevent cold bridging.

All the ground floors were v313 chipboard on rigid insulation on a sand base. The upper floors were 30mm dry flooring, 22mm OSB (oriented strand board) on engineered timber joists with 100mm glass fibre quilt between joists for sound insulation. The ventilated roof spaces have 250mm recycled cellulose insulation fully covering the ceiling joists.

U-values of the houses and flats were well in excess of the Building Regulations at the time. These are shown in the table above.

For prefabrication of pods to be cost-effective, multiples of the same unit needed to be produced. In this scheme, plans for the 19 flats were amended at the design stage to enable repetition of the bathroom and part of the kitchen.

Building construction cont …

The kitchen was also altered so that all the mains services were located on the wall between the kitchen and the bathroom. This gave rise to a combined kitchen and bathroom open-ended pod with kitchen units already attached to one external pod end wall. A central service core was also included.

Although prefabricated pods were used for the flats, they were not considered cost effective for the houses because of the smaller number of units required. Using the pods saved an estimated £1,000 per flat.

The use of this type of pod system was reasonably successful, although the way in which the kitchen end of the pod was left open made it vulnerable to damage during storage, transportation and installation giving rise to issues of responsibility. It was also considered preferable to leave off the external linings in future pods, allowing a better finish to be achieved. The central service core was a success, although lessons were learnt about making clear the division between prefabrication plumbing and electrics and their on-site equivalents.

The dwellings were clad in Western Red Cedar. This is a low maintenance material requiring no preservative treatment. It contains natural oils and can be left without painting or varnishing for a natural look. It also changes colour to a more subtle silver shade; this should be considered when specifying, and explained to clients.

In this scheme the external cladding alternated between vertical and horizontal orientation to give each tenant in the flats a visible exterior boundary.

Cedar Cladding

This variation of orientation does mean high levels of wastage and it was recommended that this should only be carried out in future if there is an overriding rationale for doing so, rather than purely aesthetic reasons.

'Living' Green Roof

Another low maintenance sustainable feature was the 'green' roof. The roof is planted with chives, saxifrage and sedum, which are all tough flowering alpine plants with short roots. The roof is grown off site and is simply rolled out over a base. The sedum offers extra protection to the waterproofing layer and can extend the roof's lifetime by a factor of up to four. The plants are able to survive in periods of drought without extra attention.

The roof requires annual maintenance, and this is carried out by the supplier until it is established. The waterproofing system used is guaranteed for 20 years.

Passive stack ventilation extracts and light pipes were easily incorporated into the gently sloping green roof – whilst the steeper rear up-stand allowed for easy integration of the photovoltaic and solar water panels.

Technical Systems

Heating and Hot Water

A 3.3m² Solar Hot Water (SHW) panel was provided for each house. As there was insufficient space on the roofs of the flats for both photovoltaic and SHW panels, the PV potential was maximised instead.

The SHW panels have an efficiency rating of 80% and expected average output of 1.126 kW/h in the summer and 0.926 kW/h in the winter.

Each SWH panel is connected via a pressurised circuit into a copper double feed pre-insulated 160 litre storage cylinder with double primary coil for solar and boiler water heating. The life expectancy of these SWH panels is in excess of 25 years, with a five year guarantee.

Energy performance

The SAP ratings on this development ranged from 90-100 (this scheme was built prior to the raising of the maximum SAP rating from 100 to 120).

Gas provides all the heating and hot water needs; cooking is electric. The annual gas bill for the one-bed flats is currently £55 all-inclusive. This cost is less than for a typical one-bed flat partly due to the excellent energy performance of the buildings, but also due to the fact that Housing Solutions buy gas at a commercial rate through a bulk contract covering this the Greenfields project and another 20 sheltered schemes.

Dwelling Type	No. of dwellings	SAP rating	Annual predicted heating & hot water cost
One-bed flat	19	100	£97 (ground floor flat)
Two-bed house (mid terrace)	4	92	£184
Two-bed house (end terrace)	2	96	£181
Three-bed house (end terrace)	1	90	£209
Three-bed house mid terrace)	1	100	£197

Planning tools

An analysis was made of the site's relationship to the path of the sun and it was decided to place the buildings in a linear form close to the north-west boundary. This configuration enabled all of the homes to take advantage of the sunny aspect and of passive solar gain. There is a contrast in appearance between the sunny side of the buildings, south-west elevation, which is glazed and open and the north-east side, which has a denser exterior with fewer and smaller openings to minimise heat loss.

Costs and benefits

Total build costs of this project were approximately £2.4 million.

A further cost breakdown showing the cost of innovative features used in the project is shown below. To help meet some of these additional costs, Housing Solutions were able to secure DTI funding from the 100 Roofs PV Domestic Field Trial and the SMART Metering Programme.

Building Elements	**Inclusive Costs**
Kitchen / bathroom / airing cupboard / central service riser pods (15 flats)	£97,000
PV system (8 houses, 7 top floor flats)	£150,000
SHW system (8 houses)	£18,000
Passive stack ventilation vents (all 27 units)	£22,000
Grey Water System (all 27 units)	£46,000
Remote Monitoring (all 27 units)	£35,000

Marketing Strategy

INTEGER is the UK's leading action-research network promoting innovation in buildings using intelligent and green technologies. Since 1996, over 100 organisations have joined INTEGER as partners to find ways of delivering better performance and value in buildings. These organisations include designers, contractors and suppliers as well as housing providers, government agencies and research groups.

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