Playing house

Monitoring of two public housing projects shows that 50% savings over conventional designs are possible using simple low energy and solar techniques. So why are the results not replicated more often? *Stephen Ashley* reports.

Many houses have proved that we are profligate in the use of energy in house design and that even the new *Building Regulations* fall short of what could quite sensibly be achieved. However the real world dictates that minimal capital cost rules the private sector, while the public sector seems to have been forced out of the housing market.

Of the many houses throughout Europe that have been monitored, we have chosen two schemes of public housing in the UK for this article. The reasons for this are: cheap estate housing is where the greatest benefits can be achieved from use of low energy design; such buildings are much more cost conscious than individual "dream" homes; and because the different approaches are more comparable.

Both of the projects described made over 50% savings in heating fuel costs; the first for a satisfactory payback period.

Giffard Park

This project of 36 houses and flats in Milton Keynes is based on the principle of wrapping up and facing south. Some gravity-fed solar collectors were installed as an experiment. The money available for low energy measures was £500 per house.

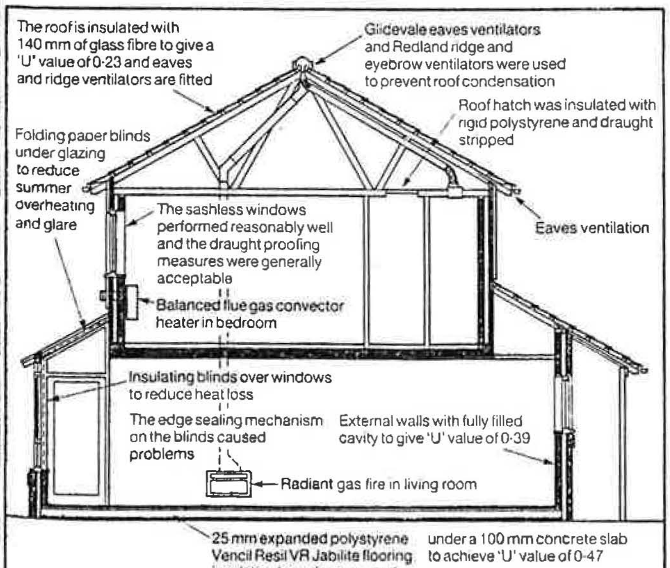
The site is pleasant and the designers had the opportunity to place the dwellings in four terraces with a north-south orientation. Habitable rooms were placed on the south side where glazing was increased considerably. The larger houses have a small sunspace added. Solar contribution to the heat load is about 25% instead of the normal 10%, and insulation levels are high.

Construction is fairly conventional with concrete strip foundations and brick/block walls. At first-floor level the outer brick skin is replaced with a block/weather-boarding skin for cost and aesthetic reasons. The 75 mm cavities are filled with glass fibre bats.

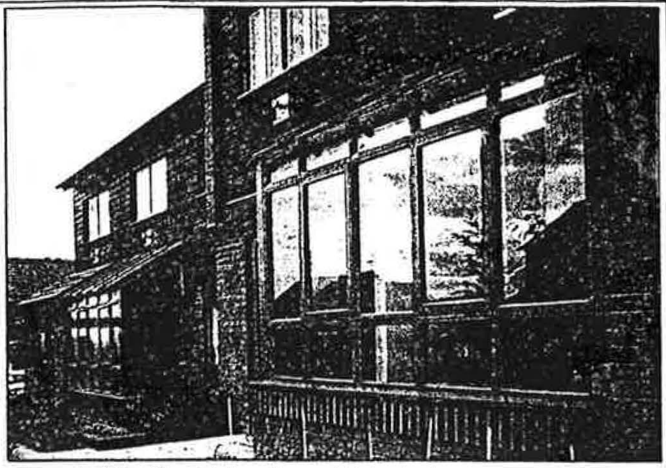
Internal walls are of concrete blocks and the floor between ground and first floor is of 150 mm precast concrete. This was to increase thermal mass, sound insulation and fire protection between flats. The ground floor is 100 mm cast concrete on 25 mm expanded polystyrene slabs between the concrete and the dpm.

The roof is conventional but with 140 mm of glassfibre insulation; the ceilings below incorporate a vapour barrier.

Double glazed sashes were used and all doors and windows were draughtproofed using a silicon sealant.



Above: A cross-section of the housing design at Gostwick.



Above: At Giffard Park in Milton Keynes, high levels of insulation and passive solar design features have reduced space heating requirements by 61%.

Much of the passive solar design came from the desire to add on single storey porches on the north side and single storey glazed extensions on the south side. This led to the stepped design and allowed for some 20% more glazing than if constructed to the then current *Building Regulations*.

The sloping roof alongside the glazed extension was used on the four-person houses to carry an experimental gravity-fed solar heated water system. This consisted of nine pre-glazed and pre-insulated stainless steel panels measuring 1 x 0·5 m and each acting as a collector and intermediate storage unit between the cold water feed in the loft and the hot water cylinder. It thus acts as a simple preheater.

Insulating blinds were installed to all south-facing windows. These were of novel design using a metallic film to reflect infra-red. They didn't work very well and were not liked by most tenants.

All solar controls are passive. In winter the blinds are folded back, and the system is drained to avoid freezing.

Money was saved by not putting in a full central heating system which was unnecessary bearing in mind the degree of solar heating and insulation. Balanced flue gas convectors were used in the bedrooms and bedsitting rooms, and radiant gas fires in the living rooms. Gas multi-point water heaters were installed in the smaller flats and small gas-fired circulators and storage cylinders were installed in the four person houses. The savings on capital cost went some way to paying for the extra insulation etc.

Controls are limited to thermostatic controls on the convector heaters in the bedrooms, and a humidistat control on the extract fan in the kitchens and bathrooms.

Monitoring carried out between 1983 and 1986 was quite thorough, and yet again, special software and computer heroics were needed to make sense of the mass of data recorded. The results were most encouraging.

Market research interviews showed that the solar features, the method of heating and the houses themselves were popular. Dissatisfaction was aimed at the lack of privacy through the large south facing windows, difficulty in using the blinds, condensation and mould in the bathrooms before extract fans were fitted, and a lack of heating in the bathrooms.

The energy required for space heating was reduced to 39% of that required for a standard *Building Regulations* house. Solar gains contributed 25% to the total space heating requirements, incidental gains another 31% and the auxiliary heating only 44%.

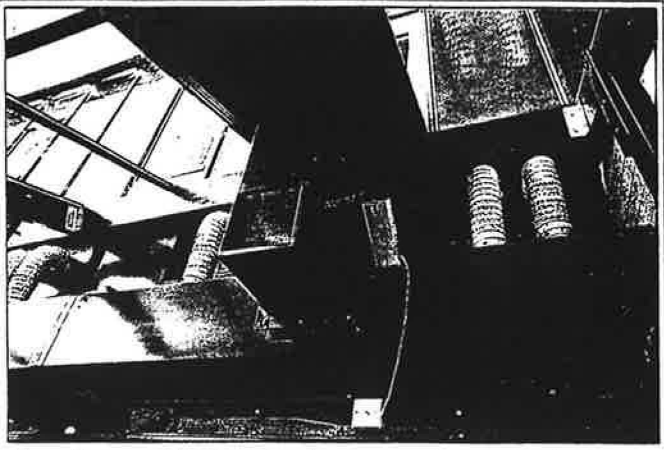
The building was airtight with tests inferring an infiltration rate of 0·2 ac/h under typical winter conditions.

Average total annual fuel bills and space heating costs were very low with standing charges being 40% of the total on the two and one person flats.

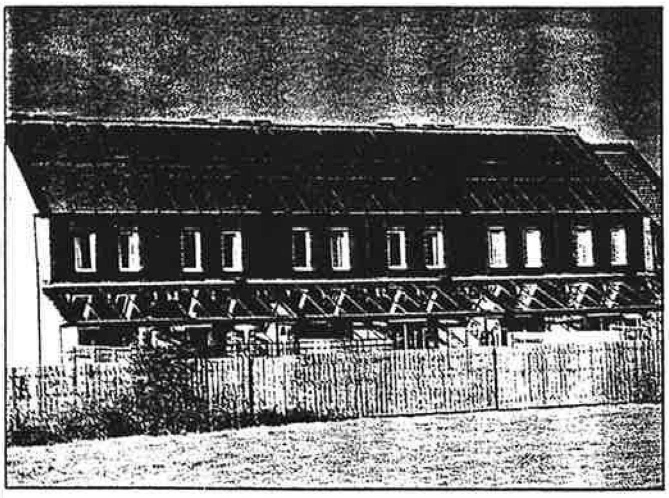
Not so encouraging were the hot water circulator based systems that proved to be relatively inefficient for reasons that have not yet been made clear. The solar panels provide only 12% of the hot water requirement and thus provided an unnacceptable payback. In fact the payback period is estimated to greatly exceed the lifetime of the panels themselves!

If one charitably excludes the costs of the solar heating and the blinds then the extra cost of £497 per dwelling averaged out over all the dwellings represents a simple payback period of 8·5 years. This was considered cost effective.

domestic hws before the warm air is ducted to the house or the heat store depending on demand. The brick store is a 4-tonne stack of 1800 perforated bricks. A microprocessor controls the heating and is based on a series of priorities, subject to demand from the timeswitch and the room thermostat.



Above: The warm air heating and ventilations system draws warm air from the sunspace.



Above: The most noticeable solar features are the conservatory-type extension to the main living space in the four person houses.

Gostwick

This terrace of three houses was built as an experiment by Peterborough Development Corporation. The key features are a sunspace running the width of the house and total coverage of the south-facing roof and wall with air-heating solar collectors.

Construction is of timber frame with a clear cavity and outer brick skin. 80 mm of glassfibre was compressed into the 75 mm deep studs. There is 50 mm of polystyrene below the concrete floorslab and above the ceiling is 100 mm of glassfibre. The single glazed sunspace and the solar collectors both use the same aluminium patent glazing. 58% of the glazing is on the south side.

The floor of the sunspace has concrete slabs as storage. No blinds are used, overheating being controlled with louvre vents. Ducts take hot air from the sunspace into the solar collectors above. These ducts can be opened or shut in order to utilise the stack effect. There is a wall and glazed double doors between the sunspace and the living room.

The active solar system uses 32 m² of single glazed, black rear-ducted steel absorbers fitted directly to the timber frame. An in-duct heat exchanger extracts heat for the domestic hws...

Auxiliary heating for space and water is provided by an 8 kW balanced flue boiler taking hot water to a heat exchanger in the air stream of the warm air heating system or to the hot water cylinder as the microprocessor dictates.

Monitoring was caried out for one year until January 1985 with one of the houses quite extensively monitored.

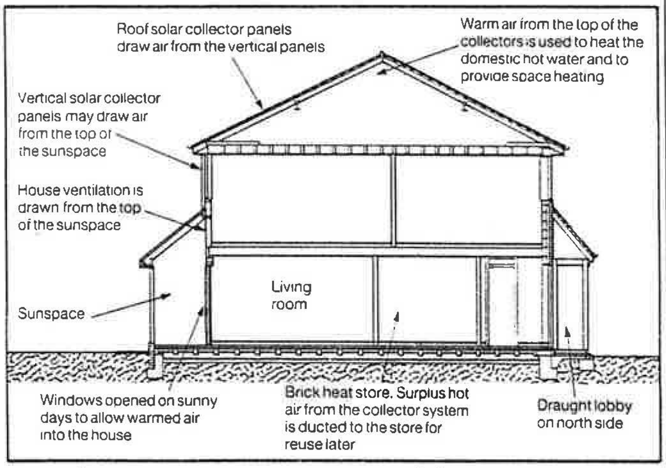
It was found that occupiers like the houses, but overheating did occur in the sunspaces when the external doors were closed (the problem was security).

The energy needed for space heating was reduced to 47% of that for a standard *Building Regulations* house. Solar gains contributed 34·9% to the gross annual space heating requirement, 14% from the passive measures and 20·9% from the active system.

Air infiltration was down to 0·4 ac/h. Two distinct modes were discovered for air movement between the sunspace and the house. When sunspace temperatures were not high, the net air flow is from the sunspace to the house, even with the bathroom and kitchen extractor fans off. In the summer, when the sunspace is very hot, air flow is from the house to the sunspace, due to the stack effect.

Cost effectiveness calculations cannot be made as the houses were built to achieve a standard rather than to cost limits. In a more cost conscious example, prefabricated components, for example, would have been used.

This article has been taken, with permission, from the *Project Monitor* series of reports. The work for the reports was carried out by the ECD Partnership and sponsored by the Commission of the European Communities. Copies of the reports and further information can be obtained from J Owen Lewis, School of Architecture, University College Dublin, Richview, Clonskeagh, Dublin 14, Eire.



Above: Cross-section of the passive solar design at Giffard Park.

Project data

Giffard Park, Milton Keynes, Bucks.

Building details (four person house, mid-terrace)
Volume: 209 m³
Floor area: 87 m²
Roof area, glazed: 4·2 m²
External wall area: 78 m²
Window area
☐ total: 23 m²
☐ south: 15·5 m²
☐ north: 5·7 m²

Thermal characteristics
Roof: 0·23 W/m²K
Floor: 0·36 W/m²K
External walls: 0·39 W/m²K
Windows: 2·6 W/m²K
Global heat-loss cop: 846 W/K
Infiltration rate: 0·5 ac/hr
External design temp: 0°C
Internal design temp: 20°C
Net heat load: 33 kWh/m²

Site
Altitude: 85 m
Latitude: 51°N
Average ambient temperature:
January: 4·2°C
July: 17·5°C
Degree days: (base 15·5°C) 2308
Global irridation on the horizon: 945 kWk/m²
Sunshine: 1460 h/y

Gostwick, Peterborough.

Building details
Volume: 485 m³
Floor area: 97 m²
Roof area: 48·6 m²
External wall area: 60 m²
Window area: total 9·38 m²

Thermal characteristics
Roof: 0·3 W/m²K
Floor: 0·7 W/m²K
External walls: 0·5 W/m²K
Global heat loss coefficient: 147 W/K
Infiltration rate: 0·4 ac/h
Net heat load: 44·4 kWh/m²

Site
Altitude: Sea level
Latitude: 52° 30'N
Average ambient temperature:
January: 3·5°C
July: 16·1°C
Degree days: (base 18°C) 2956
Global irridation on the horizon: 968 kWk/m²
Sunshine: 1460 h/y