Energy efficient house design in practice

by P.J. Davidson BRECSU

The article in last month's issue of "Energy Management" gave a brief overview of the Energy Efficiency Office's programme of demonstrations in the housing sector, as managed by BRE the Building Research Establishment. In the case of new housing, these are showing the benefits of integrating packages of energy efficiency measures into the designs of range of dwelling types. Monitoring by independent consultants, briefed by BRE, is providing the answers to such questions as cost and ease of construction, actual energy savings, the effect on average internal temperatures, the incidence of condensation and occupant's reactions.

In Milton Keynes, for example, one demonstration involved 36 dwellings for young, single people, designed by the ECD Partnership for the Society for Cooperative Dwellings Limited. These were completed in 1984 and became the home of the Giffard Park Housing Cooperative (Figure 1). The accommodation consists of one and two-person flats and four-person shared houses, arranged in four parallel terraces. Energy efficiency was one of the fundamental issues in the architects' original thinking and the resulting package of measures was integrated into the design from the beginning. It comprises three elements: a) measures designed to maximise the use of available solar energy, b) measures which reduce heat loss through the fabric and by air movement, and c) a heating system which capitalises on the consequent reduced demand for heat.

The axis of each terrace runs East-West and living rooms and bedrooms are located on the south side, together with the majority of the glazing. Insulation levels are significantly better than those required by Building Regulations, with 25mm polystyrene under the floor slab, fibreglass batts filling the 75mm wall cavity and 140mm quilt in the loft. All windows have either sealed double-glazing units or a patent sliding dual glazing system. Draught-proofing is fitted at all openings, though extra ventilation is provided in the loft. Considerable attention has been paid to detailing at wall openings, etc, to avoid cold bridging.

Because of the low design heat loss, the architects were able to select a simple heating system and opted for individual gas room heaters instead of full central heating. These were located in living rooms and bedrooms, with domestic hot water supplied by multipoint heaters in the small flats and cylinders heated by gas circulators in the 4-person houses. The saving of installation costs partly offsett the extra costs of the insulation and passive solar design measures.

Monitoring of this development, by the Open University Energy Research Group under contract to BRE, showed first of all that the energy saving measures were included in the construction process without any significant problems and to a high standard of workmanship. Regular meter readings and temperature measurements have shown that annual fuel costs are low: £300 for 4-person houses and under £200 for the smaller flats (see Figure 1). The design thermal performance has been achieved in practice, with heat losses reduced by 38% and useful solar input increased by 55% compared with BREDEM (2) computer predictions for similar dwellings built to 1985 Building Regulations. The annual gas consumption for space heating has been reduced by 60%, worth on average £58 per dwelling per year in 1986. This recovers the net additional cost of £500 per dwelling in just over eight years.

On the whole the tenants were very pleased with their homes. They appreciated the low fuel bills and found the sunny south-facing rooms very pleasant. However, there was some incidence of condensation and mould growth during the first winter, particularly in the bathrooms. Further investigation revealed that the construction was much more airtight than anticipated and background air change rates were down to 0.2 air changes/hour, about one-quarter of the norm. This was compounded by the life style of the tenants, who used the heating very intermittently. For the second heat-

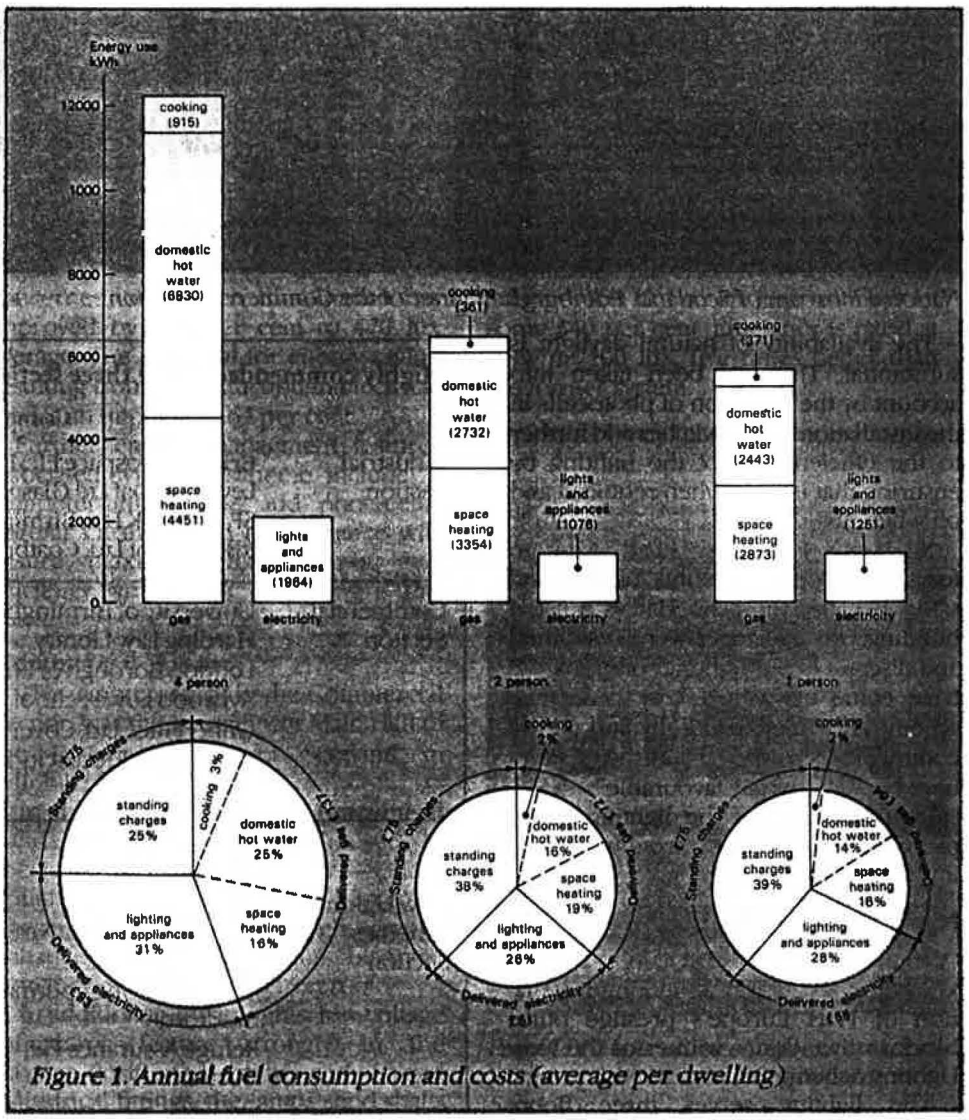


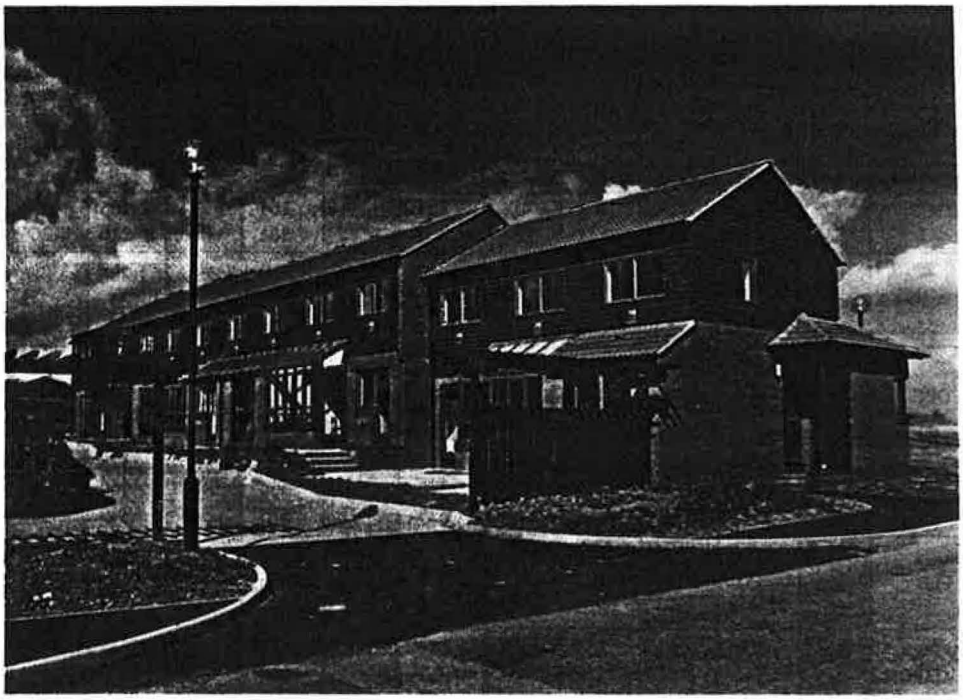
Figure 1. Annual fuel consumption and costs (average per dwelling)

ing season, humidistic-controlled extract fans were installed in the bathrooms, together with trickle ventilators in the heads of some windows. These simple measures resulted in the virtual elimination of the condensation problem; they have therefore been added to the original design package and included in the cost analysis.

Taking these points into account, the project has successfully demonstrated the effectiveness of the energy efficient design. Space heating costs are now very similar to those for hot water (Figure 1), and form less than 20% of the total fuel bill. A full report is available ([3]).

More recent projects are currently demonstrating design solutions for new housing which, by virtue of energy efficiency and the resulting saving on costs for heating plant, achieve lower fuel bills and increased comfort without any attendant increase in overall construction costs.

Further details of Giffard Park and of other EEO/BRE projects can be obtained from the Enquiries Bureau, BRECSU, Building Research Establishment, Garston, telephone 0923 894040.



Low-energy houses at Giffard Park, Milton Keynes, have the majority of the glazing on the south side.

References

1. *P J Davidson; Demonstrating energy efficiency in housing. Energy Management April 1988.*
2. *B R Anderson, A J Clark, R Baldwin, N O Milbank; BREDEM – The BRE Domestic Energy Model – background, philosophy and description. BRE Report 1985.*
3. *An integrated design for energy efficient cooperative housing. EEDS Report ED/107/170/ 1986.*

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(43)

SEMINARS & COURSES ETC.

Seminar on Recovery of Engineering from Municipal and Industrial Waste through Combustion
21-24 June, Church College, Cambridge. Details: Dr. G.L. Ferrero, Commission of IG European Communities, Directorate-General for Energy, Rue de la Loi 200, B-1049, Brussels. Tel: (32 2) 235 1111.

Modern Applications of Thermal Analysis.
28 June, Gatwick Penta Hotel. Details: Stanton Redcroft Ltd, Customer Liaison Dept. Tel: (01) 946 7731.

Harnessing Daylight Seminar, Recent Developments in Natural Lighting
19-20 July, Cumberbirch Conference Centre, Hull. Details: Hull School of Architecture, Humberside College of Higher Education. Tel: (0482) 25938.

International Symposium on Engineering and Economic Aspects of Energy Saving in Protected Cultivation
4-8 September, Cambridge. Details: Dr. B.J. Bailey, Institute of Engineering Research, Wrest Park, Silsoe, Bedford MK45 4HS. Tel: (44 525) 6000.

Energy Management, Short Course
19-23 September, Portsmouth Polytechnic. Details: Dr. M.R.I. Purvis, Dept. of Mechanical Engineering, Anglesea Road, Portsmouth, Hants PO1 3DJ. Tel: (0705) 827681 Ext. 227/130.

Combustion Fundamentals Course — Post Experience Lectures
26-30 September, Imperial College. Details: Professor Weinberg, Dept. of Chemical Engineering & Chemical Technology. Tel: (01) 589 5111 Ext 4360.

(36)