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The perfect match

technical file

The BRE has developed experimental techniques for accurately measuring energy savings in dwellings. *Robert Rayment* describes the findings of the latest research carried out using matched pair test houses.

The BRE's new experimental technique for measuring energy savings in dwellings centres on the use of matched pairs of houses. One of each pair of houses is used as a control while energy saving measures are installed in the other.

Comparisons are then made over a set period of time using computer controlled simulated occupancy. This gives a direct measure of the energy savings.

This technique has considerable advantages over other measurement methods. For example, in an occupied house the savings can be very dependent on user behaviour and, in a 'before and after' experiment in one house, the corrections which have to be made for the weather can introduce a large amount of scatter.

Both of these problems are avoided with the BRE test houses, while realistic operating conditions are still maintained.

Since the last article on measuring home energy savings appeared in *Building Services*[1], the BRE has extended its test facilities to include two pairs of semi-detached houses and a row of four terraced houses.

They have a total floor area of 84 m^2, an open plan lounge-diner, kitchen and hall downstairs and three bedrooms, bathroom, wc and airing cupboard upstairs. The houses are set up as matched-pairs with simulated occupancy.

Programmable schedules are available for measuring internal heat gains from people and appliances, hot water run-offs at bath, basin and kitchen sink activities, curtain drawing, moisture input and window and door opening.

Continuous measurements of electricity and gas consumption, comfort temperature and relative humidity are also made in all rooms. Heating system temperatures and heat flows, as well as the external temperature, humidity, wind speed and direction and incident solar radiation on the vertical walls of the houses are all measured.

Test investigations

The houses have been used for a variety of investigations. On the building envelope these have included double and low-emissivity glazing[2], loft insulation[3], floor insulation, cavity-fill and internal insulation.

Weather compensator control[3], flow-switch control with thermostatic radiator valves[3], hot-water controls[3], the effect of heating strategies and zone control have also been examined.

Ultimately, the findings are used to provide advice on fuel saving methods and internal environmental performance, and to improve our understanding of the interactions between occupants and their dwellings and heating systems.

Zone control

As an example, some results on zone control experiments are presented here.

A pair of semi-detached houses, as described above, were used for this investigation. The heating was by gas-fired boiler and radiators. Both houses had cavity-filled walls, secondary glazing and 150 mm of loft insulation.

The respective U-values were 0·6, 2·8 and 0·3 W/m^2K. The floor U-value was about 0·6 W/m^2K. Thus the test house conditions closely matched the current UK *Building Regulations*.

In the reference condition both houses were run with just the downstairs room thermostat set to about 21°C, and operating on the circulating pump and boiler. Thus the upstairs heating was in phase with that downstairs and, whenever heat was called for downstairs, the upstairs was heated as well.

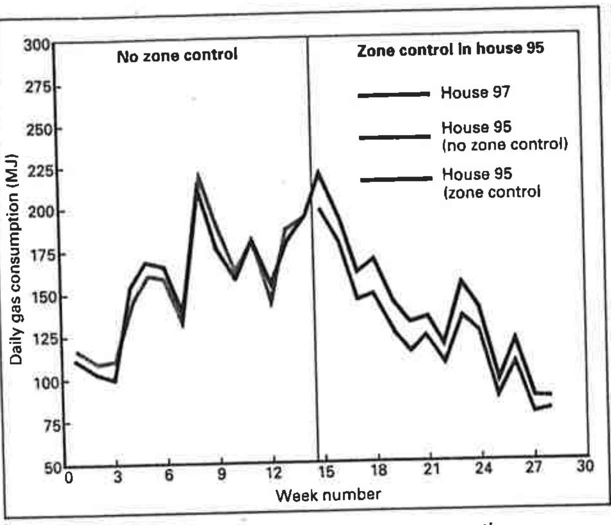

Figure 1: The effects of zone control on gas consumption.

Domestic hot water was on a separately controlled and pumped circuit. Under test conditions one of the houses, House 95, had an upstairs zone thermostat operating a motorised valve in the upstairs circuit set to about 16°C.

Measurements were taken throughout the 1991/92 heating season. The effects of zone control on gas consumption is shown in figure 1.

A complete regression analysis shows that the mean winter-day consumption without any zone control was 154 MJ/day and with zone control 139 MJ/day, ie a saving of about 10% under these conditions.

Control of upstairs temperatures can be carried out in the way described, or by fitting thermostatic radiator valves to the upstairs radiators. In general, both will prove to be cost-effective.

Future experiments

For the future, the BRE has replaced its current test houses with a set of four new houses. These are small, detached constructions with a floor area of 84 m^2. Two of them are timber-frame and built to Swedish standards; the other two are of brick-block construction and are built to just beyond the current UK *Building Regulations*.

The houses are equipped in the same way as the previous test houses. The brick-block variety have wall, floor and roof U-values of about 0·27, 0·30 and 0·29 W/m^2K, whereas the timber-frame houses have U-values of 0·21, 0·21 and 0·16 W/m^2K respectively.

In addition, triple glazing is used in the timber-frame houses and removeable secondary glazing in the others. Gas and electric heating systems are installed in all the houses.

The primary use of the facility is to examine the implications of very low energy houses in the UK climate, and first results will appear after the 1992/93 heating season.

Robert Rayment is head of the Heating Systems and Controls Section of the BRE.

References

[1] Rayment R, "Comparing home energy savings", *Building Services*, April 1984.
[2] Rayment R, "Energy savings from sealed double and heat reflecting glazing units", *Building Services Engineering Research and Technology*, Vol 10(3), 1989.
[3] Rayment R, "Investigations of the performance of domestic central heating systems and of reductions in building fabric losses", EEC Contract Final Report *EUR 10433 EN*, published by the Commission of the European Communities, 1986.