BRECSU

Energy Efficiency Office
Building Research Establishment

Energy efficiency in buildings

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BRECSU/Wimpey Homes low energy SUPERSPEC house

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Wimpey Homes Ltd have reassessed three of their standard 'pattern book' house designs to make them significantly more energy efficient. Wimpeys have now built the first show house to the new design, known as Superspec, on a site in Colchester.

Introduction

In a joint project with the Energy Efficiency Office and the Building Research Establishment, Wimpey Homes Ltd have reassessed three of their standard 'pattern book' house designs to make them significantly more energy efficient. Wimpeys have now built the first show house to the new design, known as Superspec, on a site in Colchester. The project is part-funded by the Energy Efficiency Office, through BRECSU (the Building Research Energy Conservation Support Unit).

The Superspec package

The Superspec package incorporates a number of energy-saving features which BRECSU has shown to be cost-effective in housing. These include high levels of insulation, including 100mm filled wall cavities, insulated floor slabs, double glazing, controllable and secure ventilation, and a smaller heating system.

The houses will be considerably more energy efficient than required even by the new 1990 Building Regulations. The designs use proven building techniques, and there are no compromises on internal layout or accommodation. The selling price is about 1.5% more than the same house built to the 1985 Building Regulation standards, but likely to be well below 1% compared to houses built to meet the 1990 Regulations.

Using BREDEM (BRE Domestic Energy Model) a computer prediction of the energy bill for the Superspec house has been compared with a similar house built to 1980s and 1930s standards

Market features

BRECSU and Wimpey Homes will use the show house to find out which features of the design are most attractive to potential purchasers. These could include: low cost space and water heating (typically 40% less than current designs); greater comfort; reduced emission of CO_2 to the environment; very little extra cost; smaller radiators; no plumbing in the loft; a mains-pressure shower.

The prototype Superspec house

For more information
on energy efficiency demonstration projects in buildings sponsored by the Energy Efficiency Office and managed by the Building Research Energy Conservation Support Unit (BRECSU)

please contact:
Enquiries Bureau
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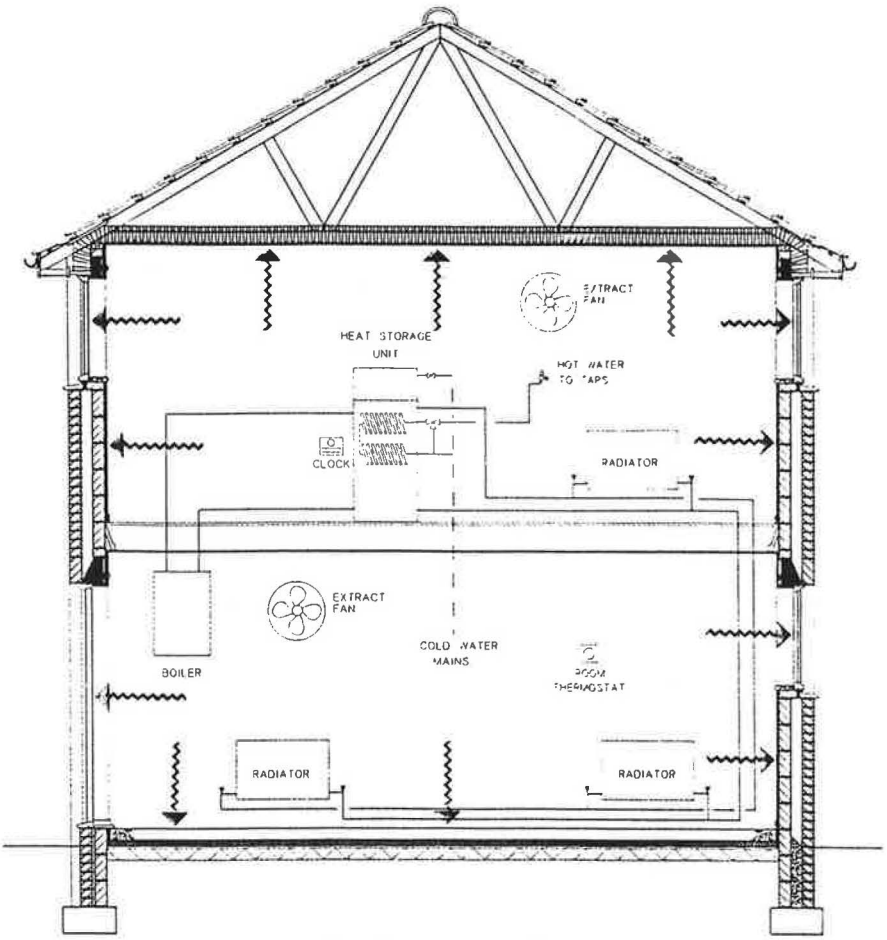
Future Plans

Wimpeys plan to apply the technical and marketing lessons from the show house to a full-scale development of three Superspec house designs on another site next year.

Through this initiative, the EEO and BRECSU hopes to encourage other builders to offer more houses in which quality includes improved energy performance, by showing that such houses are more marketable.



The Superspec package

SUPERSPEC TECHNICAL DETAILS

Construction

		U-values W/m^2K Wimpey Superspec	U-values W/m^2K 1990 Building Regulations
Ground Floor:	Concrete ground supported slab, insulated with 50mm expanded polystyrene below the slab and 25mm at edges.	0.30	0.45
External Walls:	Cavity wall construction, with 100mm wide cavity fully filled with expanded polystyrene beads and binder. Lightweight aggregate blockwork inner leaf finished with plasterboard.	0.29	0.45
Roof:	Standard trussed rafter construction insulated with 150mm mineral wool quilt.	0.21	0.25
Windows/External Doors:	Double glazed and weather stripped windows throughout.	2.8	5.7
	Doors formed with polyurethane foamed core.	0.50	–

Heating/Ventilation System

Heating System:	Gledhill 'Boilermate' thermal store. Heated by a Maxol 600 balanced flue boiler.
Ventilation:	Mechanical extract fans in bathroom and kitchen. Window mounted trickle vents.

Comparison of Performance

	1930s	1980s	Wimpey Superspec
Air change rates (pressurised)	Typically, average 11.5 ach up to a maximum of 25.0 ach		6.8 ach
Air change rates (normal)	1.5 ach	1.0 ach	0.5 ach
Design heat loss	7.0 kW	4.5 kW	3.5 kW
Annual heating costs (16 hours heating/day)	£459	£220	£100

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SEPTEMBER 1988

Energy Efficiency Demonstration Scheme
Project Profile 325

Pattern Book Design Studies and Field Trials of Low Energy Houses

Potential users
Private sector volume house builders.

Host organisation
Wimpey Homes Holdings Ltd.
Hammersmith Grove,
London W6 7EN.
Tel. No: 01-748 2000
Mr A C Squire.

Organisation activities
Private sector house builders.

Project summary
Design studies are being undertaken by Wimpey Homes to evalute three low energy designs based on current house types from the lower, mid and upper levels of their Pattern Book range. The basic designs will be optimised in terms of insulation, heating systems and ventilation, and evaluated to meet normal criteria for cost, performance, and buildability. The designs will aim to achieve significant savings in space heating energy, compared with houses designed to the standard of the Building Regulations.

One of the three house designs will then be constructed on a new Wimpey Homes site, as a prototype. During construction, buildability and actual building costs will be assessed, and once complete the house will be open to the public as a show house. Visitors will be interviewed and asked to complete questionnaires. Response to the house will be analysed in order to assess the market potential and sales appeal of the design. The house will then be sold, and if the design proves successful in meeting all the usual commerical critiera, further field trials will be carried out, involving the construction and marketing of a further 25 energy efficient houses.

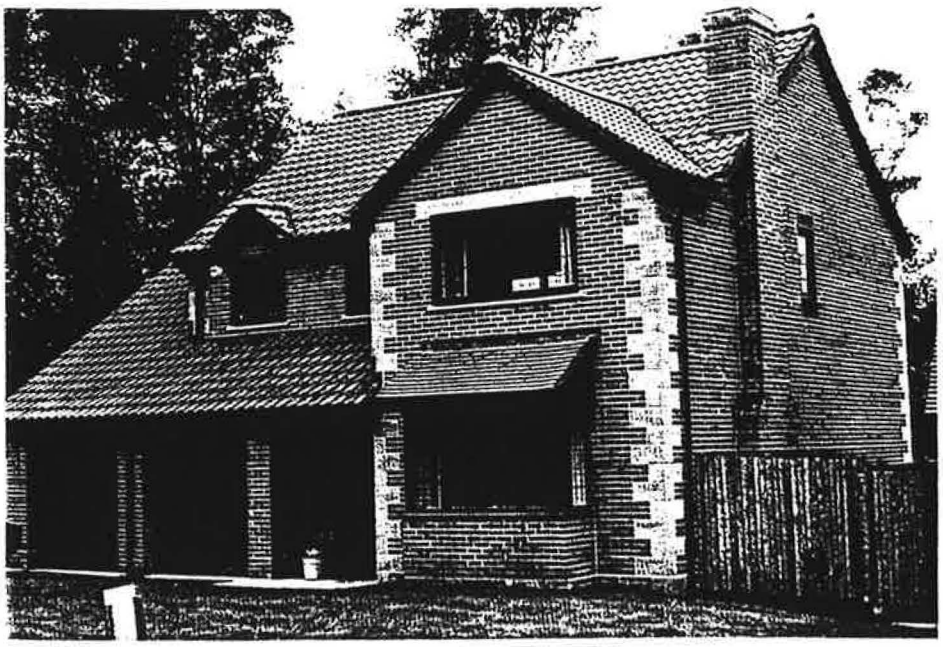
An appropriate mixture of the three new designs will be incorporated into a new development. Buildability and cost on a commercial scale will be assessed and the customer reaction to the houses will be monitored along with the rate of scale, and compared to the market performance of the rest of the development. Following scale and occupancy, owners of both standard and energy efficient houses will be approached in order to monitor the energy performance of the house, and in order to assess customer reaction post-sale.

The new designs, if successful, will be incorporated across the whole range of Wimpey Pattern Book house types. It is also planned to develop some system of energy labelling for the new designs, which could become a marketing feature. It is hoped that the example and market initiative of Wimpey Homes will encourage other volume house builders to adopt similar policies.

Expected completion date
March 1992.

Target energy savings by replicaion
After 10 years: 4.4 PJ or 165 ktce, worth £15 million, per year.

Monitoring organisation
Wimpey Laboratories Ltd.
Beaconsfield Road
Hayes, Middlesex.
Tel. No: 01-573 7744
Mr P D Johnson



House Builder Reference Series 9

HouseBuilder

DEC 1989/JAN 1990

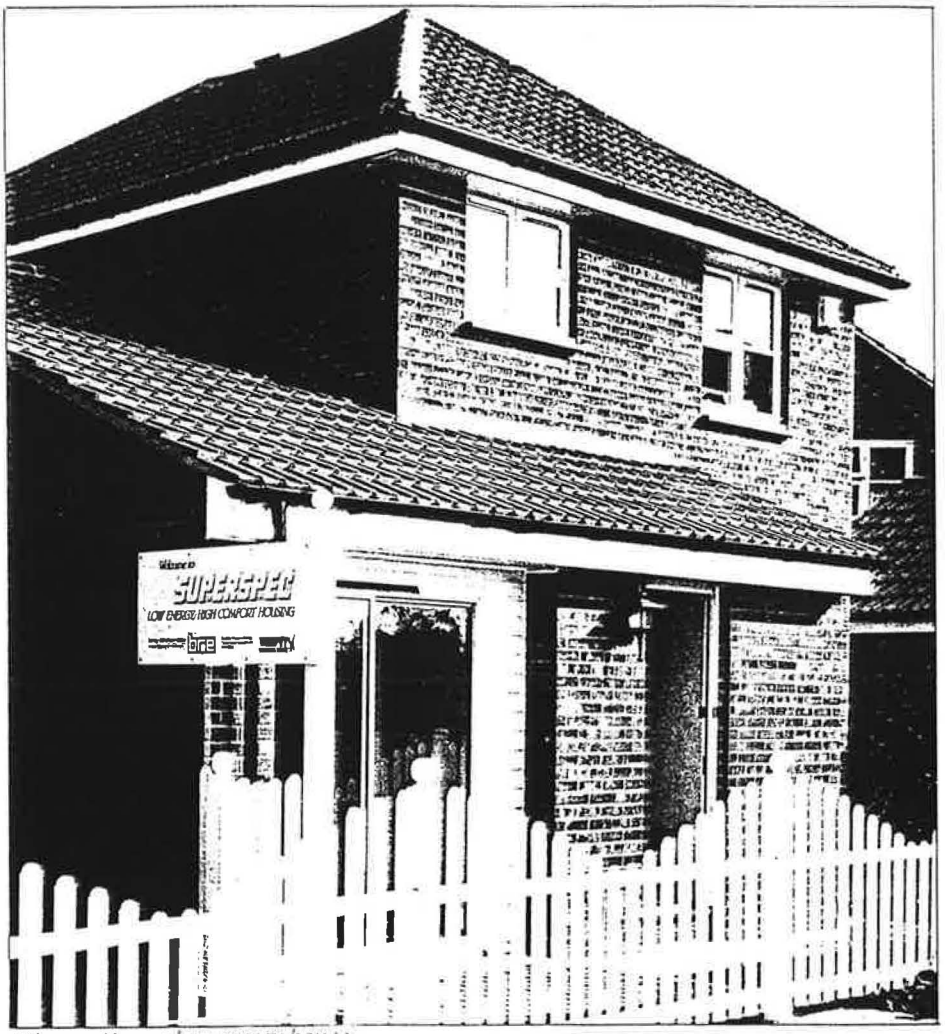
AN EXCLUSIVE SERIES OF TECHNOLOGY TRANSFER OF LOW ENERGY GOOD BUILDING DETAIL

Low Energy Housing

Phillip Johnson, Manager, Energy and Building Science Group
Wimpey Laboratories Limited

This issue is the last in the series of specially commissioned articles on low energy housing. These have covered the key aspects of building to increased insulation standards, reducing unwanted air infiltration, and providing efficient and controlled ventilation and heating systems. The aim of the series has been to provide helpful and practical advice, by housebuilders with experience of already using the building methods described.

The nine accompanying case studies prepared by NBA Tectonics have provided further evidence of successful implementation of the above techniques. Ranging from flats and sheltered housing through to 4 and 5 bedroomed houses, the case studies are examples of what is being achieved by the adoption of an integrated design approach to energy efficiency in private development housing. The houses featured in the case studies show annual savings in space heating of between 30% and 60%, compared even to the new insulation standards required in the 1990 Regulations. In monetary terms, the savings vary depending on the fuel type and the size of the property. In each case however, the developer uses the benefits of economy and comfort as part of his marketing approach.



Wimpey Homes low energy house.

Marketing

The marketing aspect is of course crucial to the success or otherwise of low energy housing. If low energy houses will not sell, or if the developer doesn't gain a competitive edge or an adequate return on the increased building costs, then insulation levels will rarely exceed standards set by the Building Regulations. However, the positive attitudes of the developers to the saleability of the case study houses, and reports from market research commissioned by BRECSU and others, indicates a real market for low energy housing.

This is not to suggest that the 'energy efficiency' tag on its own will sell houses. The wrong house, in the wrong location at the wrong price will be just as difficult to shift whether it costs £100 or £1 000 to heat. The expectation of purchasers will continue to centre on house size, layout, location and price etc and it is on this basis that the house will sell. However, it is strongly suggested that given a choice between two houses which both meet the principal requirements of the purchaser, the additional benefits afforded by the low energy house will tip the balance in its favour.

One of the important aspects to come out of this series of articles is that the energy performance is achieved largely by conventional building techniques applied to a standard range of house types. The house design and layout need not be compromised and the features which made it marketable in the first place can be retained in a low energy version. The question to be addressed by housebuilders is whether saleability will be increased by adopting the higher standards of insulation and constructional detailing highlighted in this series. An answer in the affirmative has already been suggested; however design and cost of the energy features are as important to their marketability as the design and cost of the basic house, and need careful consideration if the market potential of the low energy house is to be realised.

Design and Cost

The examples presented in the case studies have independently estimated building on-costs ranging between £700 and £4 000, representing between 1% and 4% of the selling price. The initial temptation is

to view these on-costs against the expected savings in energy, and judge the outcome on the grounds of simple pay-back. However, to do so would be to fail to recognise that house purchasers may actually be prepared to pay more for features with perceived 'added value' without necessarily expecting a favourable rate-of-return on the additional cost.

The low energy house may therefore have two types of benefits – those with perceived value and those with less obvious advantages. Since the house will probably not look any different to the prospective purchaser than a standard house, many of the constructional features and detailing will be largely hidden. Important as these are to the performance and buildability of the house, in themselves they may have little appeal or even meaning to the house buying public. The overall benefit is the resultant energy savings and improved comfort – aspects that will need to be explicitly conveyed to the purchasers as they are not self evident. The design of these hidden features should therefore be aimed at achieving a reasonable balance between on-cost and energy savings, subject to considerations of buildability and technical risk.

This balance is achieved by an integrated design approach which considers the combined effects of the energy saving features. This can most simply be done for instance by using one of the versions of the computer model BREDEM (BRE Domestic Energy Model). This enables the effects of higher insulation standards on energy costs to be evaluated. Cheaper insulation options may prove not to significantly reduce energy savings, and other areas where more insulation is justified may become appparent. Further guidance is contained in the BRECSU sponsored report 'Reduced cost low energy housing'.

Those features which purchasers perceive to be of real value will include double glazing and high performance windows, mechanical ventilation and heat recovery, extract fans, high efficiency heating and controls, storm porches and insulated external doors etc. These contribute to the energy performance, but also have added value which to the purchaser may exceed any extra installation cost. This cost may then be more than fully recoverable in the selling price, if the features are appropriate to the size and style of house and the sector of the market it is aimed at.

Selling the Benefits

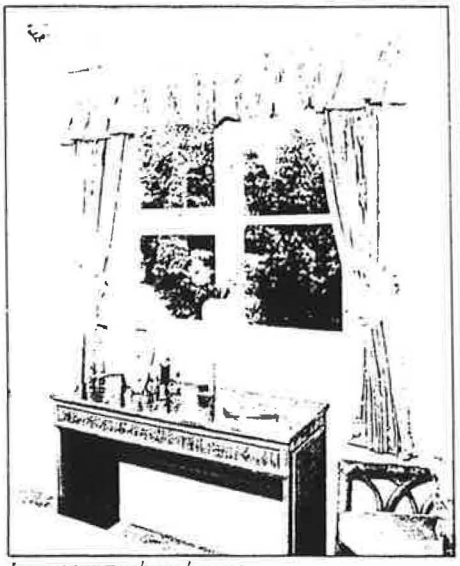
The sales approach adopted will no doubt complement the established image and marketing philosophy of the company. However, it is important to sell the benefits of the low energy house rather than the technology, no matter what particular aspect is highlighted. For instance, although great care may have been taken in design and construction to avoid cold bridging the benefit to the occupier (purchaser) of the absence of condensation will mean more than the specifics of insulation and building methods.

Other benefits include of course lower energy costs, and greater comfort, no cold draughts, greater quality of construction, improved indoor air quality etc, and the case studies have indicated how the developers have featured some of these aspects in their marketing. The environmental aspect of both the materials and construction (CFC free) and the energy performance (less CO_2 emission) may also become important marketing features.

These benefits may not be immediately obvious from a visit to the site and will need to be actively promoted by sales staff and agents, in brochures and advertising etc. Housebuilders may consider it advantageous to build to a recognised low energy specification, for example the electricity council's Medallion 2000 scheme, as a way of promoting the development.

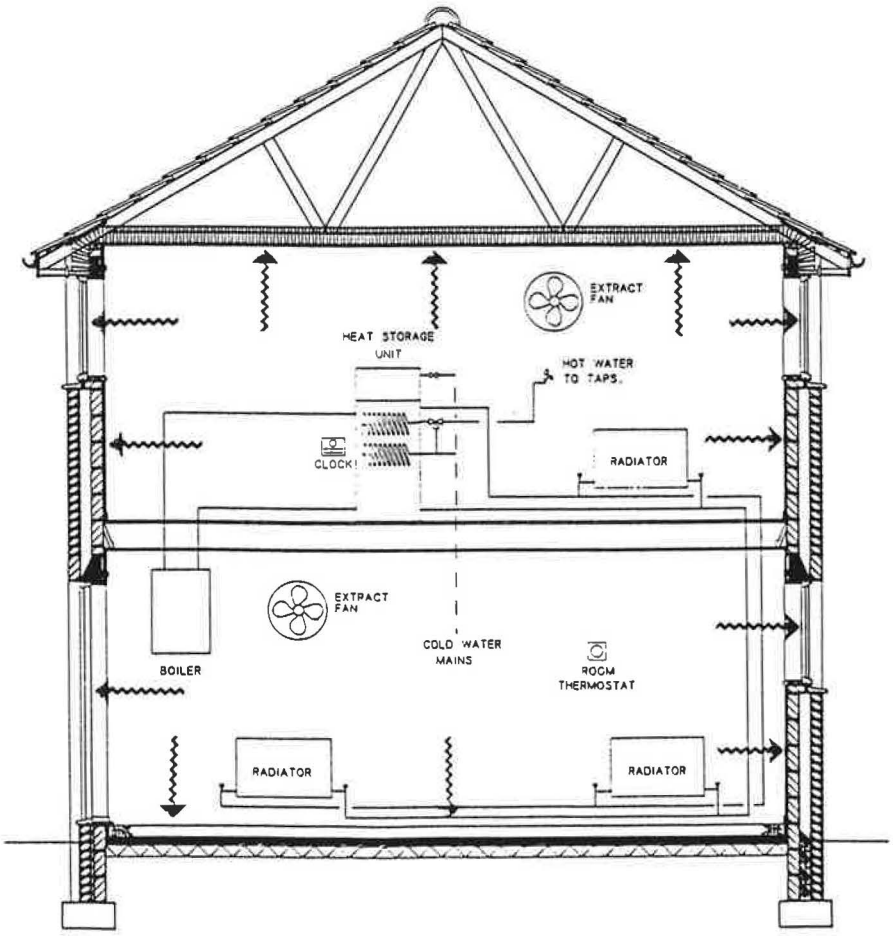
The National Energy Foundation are working on the formation of a national energy label – an independently assessed energy performance indicator – and this may also enable builders to readily highlight the superior performance of their low energy houses.

House selling is a competitive business, and market conditions going into the 1990's are probably as difficult as they have ever been. The low energy housing concept, with the added value and benefits offered to purchasers, could provide housebuilders with a much needed marketing edge.



Low energy show house.

The energy features and benefits should be simply explained.



This paper has been commissioned by the Department of the Environment's Building Research Energy Conservation Support Unit for the Energy Efficiency Office of the Department of Energy. The views expressed by the author(s) are not necessarily those of the Building Research Establishment or the Department of Energy.

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CASE STUDY No. 9

Badgers Green, Street, Somerset Alford Brothers Ltd.

Background

Alford Brothers celebrate their 50th Anniversary in 1989. Based in Taunton, they are the West Country arm of the Prowting Homes Group and build about 200 houses a year.

The company have built up a reputation based on traditional quality, and aim to combine this with a good standard of insulation. The company's commitment to quality is amply demonstrated by the winning of 5 NHBC "Pride in the Job" awards in 1989, including the regional winner. One of these awards was won by Christopher Crabb, the site supervisor for this Case Study site at Badgers Green in Street.

The Ash bungalow at Badgers Green.

Design and Construction

The site is a mixed development of 2, 3 and 4 bedroom detached houses and bungalows on the outskirts of the town. The Case Study concentrates on the 'Ash' bungalow.

Construction is of masonry cavity walls with an outer skin of facing brick or reconstituted stone, in-situ concrete ground floors and trussed rafter roofs. The properties in reconstituted stone have stone mullions, sills and lintels to reflect the stone building tradition of the area.

Heating is by means of a conventional wall hung gas boiler and radiators.

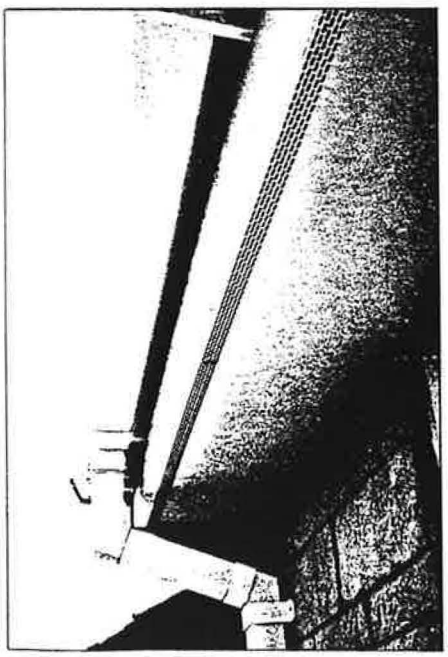
The energy efficiency package

- Walls have cavity construction with a 130mm thick inner leaf of low density aerated concrete blockwork (U value 0·57).
- Loft insulation is 100mm mineral wool (U value 0·34).
- Ground floors are finished with 40mm expanded polystyrene and chipboard.
- Windows are either aluminium or timber, fitted with double glazing and draughtstripping and have lockable 'night vent' casement fasteners.
- External door to kitchen is in aluminium, with thermal break, full height double glazing and draughstripping.

Although this design, with full double glazing and ground floor insulation, already exceeds the requirements of the 1990 Building Regulations via the 'trade off' approach, the company is actively looking at ways to improve the thermal performance of the external wall to 0·45 or better. However, because of the exposed nature of many West Country sites, they regard it as essential to maintain a clear cavity. For this reason, the company is evaluating several blocks, some with bonded insulation, others with insulated voids, which manufacturers have recently launched to meet the new 0·45U value requirement in the 1990 Building Regulations.

The decision to insulate the floor was taken largely to avoid the need for central heating pipework to be embedded in the floor screed. Central heating pipes are now run within the thickness of the 40mm polystyrene insulation and any gaps around the pipes filled with vermiculite. Access to the pipework is provided by means of removable sections of chipboard, screw fixed to timber battens – see Figure 1.

Where the property contains an integral garage, as with Ash bungalow, the wall between the living accommodation and the garage is 150mm thick low density aerated blockwork. This gives a U value of 0·6, which is in line with the 1990 revision to the Building Regulations.



The deep overhanging eaves with soffit ventilation to roofspace.

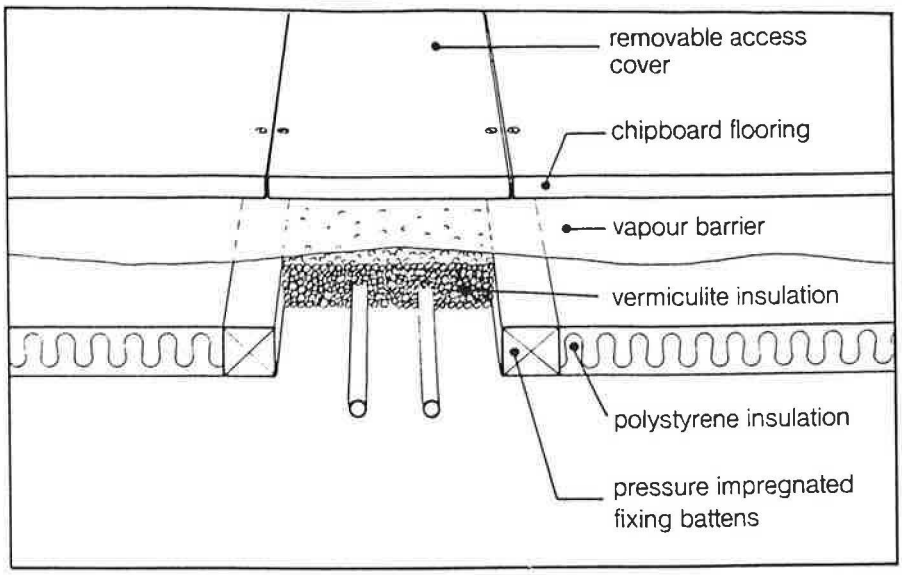


Figure 1 Detail of removable cover to underfloor pipework.

Energy and cost savings

The BRE Domestic Energy Model (BREDEM) was used to estimate the difference in energy use between the Ash detached bungalow and the same property assumed to be built to the 1982 Building Regulation thermal standards. The calculations showed that the energy saving package can produced annual savings in space heating of up to 39% compared to current standards and 16% compared to standards applicable from 1990. Compared to the 1982 thermal standards, the estimated saving would be in the order of £105 a year if the house was heated 16 hours a day; for 9 hour heating, the saving would be nearer £90.

If the loft insulation was increased to 160mm thickness and the wall U value reduced to 0·45, in line with the elemental requirements of the 1990 Regulations, the calculations showed that there would be a reduction in running costs of 47%, compared to the 1982 thermal standards, giving savings of up to £130 a year.

Building costs

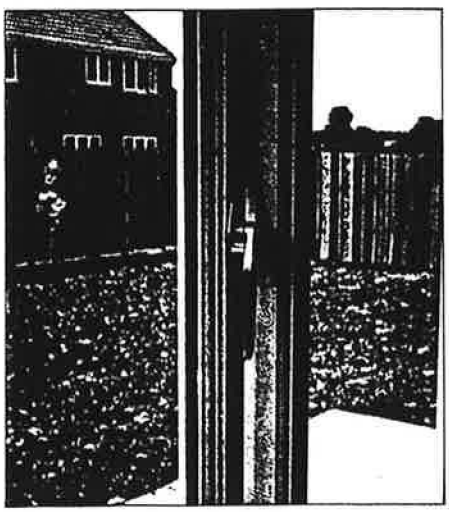
The extra cost of the energy efficiency package for the Ash bungalow was estimated by Davis, Langdon & Everest to be about £1 500 compared to the same property built to current regulations. The selling price in September 1989 was around £130 000, so the extra cost of the energy saving package would be a little over 1% of the selling price. Of the £1 500, about £550 is attributable to double glazing and is recoverable in the selling price.

To increase the loft insulation to 160mm and replace the aerated block inner leaf of the cavity wall with blocks designed to achieve a wall U value of 0·45 (such as the Leca 45 block) would increase the cost by around £125.

Buildability

The main departure from 'traditional' practice was the use of an insulated floating floor. To avoid a 'springy' floor, it is important to have a smooth level surface on which to lay the insulation. Mr Calvert, the Production Director at Alford Brothers, described a novel way that they had achieved this with an in-situ ground bearing slab. After the concrete had been finely tamped in the usual way, a length of 200mm wide dpc material was pulled tight across the slab and its trailing edge dragged across the concrete while it was still wet. This removed the ridges and undulations left by tamping and produced a smooth surface without drawing a film of laitance to the surface.

The insulated floor with removable panels to provide access to pipework.



The casement fastener locked in the night vent position.

Marketing

The company saw themselves as leading the market with their specification of double glazing for all their properties. The superior quality of the double glazed windows was used as a strong selling point and, along with the high standard of workmanship, was said to help sales.

As a policy, the company was continually on the look-out for products that enhanced the standard and appeal of their housing. For windows and external doors, a solid construction and well engineered ironmongery were key factors in giving a stamp of quality to the development. The fact that they use two point locking on the taller opening lights (to prevent warping and ensure proper compression of the draughstripping) illustrates the attention to detail inherent in the Alford Brothers approach.

The improved insulation standards were seen as part of the overall strategy of 'adding value' to their properties to match the ever increasing demands of the house-buyer.

ASSUMPTIONS

Estimates of annual fuel consumption for space heating using BREDEM
Annual average external temperature:

- Severn Valley = 10·02°C
- Midlands (UK average) = 9·54°C

Whole house demand temperature = 21°C
Efficiency of gas boiler = 67%

Estimates of costs and savings from energy efficiency measures

Estimates of extra capital costs are based on the Architects and Builders Price book, edited by DL&E, and published by E&FN Spon. Costs have been adjusted for Somerset (location factor from the Building Cost Information Service of the RICS). The insulated ground floor has been costed against a screeded floor with no floor finish applied.

Fuel cost savings are based on a gas price of 38·5p per therm.

Acknowledgements

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