ENERGY EFFICIENCY OFFICE MAY 1989

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Energy Efficiency Demonstration Scheme
Expanded Project Profile 245

Low-Energy Local Authority Housing with Reduced Construction Costs

Potential users
All those in the public and private sector interested in providing low-energy housing.

Host & Monitoring Organisation
Manchester City Council
City Architect's Department
PO Box 488, Town Hall
Manchester M60 2JT Tel No: 061 234 4266

Main equipment supplier
Baxi Heating Ltd
Bamber Bridge
Preston PR5 6SN Tel No: 0772 36201

Installation contractor
Manchester City Council
Manchester Direct Works Department
Salisbury House, Granby Row
Manchester M1 7AG Tel No: 061 228 3488

Consultant to BRECSU
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Department of Building Engineering
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Manchester M60 1QD
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The aim of the project
The aim of the demonstration was to show that two storey, low-energy housing when combined with a simplified heating system can be constructed at a lower cost than housing equipped with conventional central heating, built to the minimum requirements of the current (1985) Building Regulations.

An earlier demonstration with Manchester City Council featured improved thermal performance of the building fabric of family housing. The scheme indicated that whole house central heating systems may not be essential for the maintenance of adequate comfort levels in two storey low-energy housing, providing warm air can freely circulate to all parts of the house.

Ten houses on a new low-energy development in Collyhurst, Manchester, were each fitted with a simplified gas-fired whole house heating system. The design allowed warm air generated by two heating appliances to migrate to all parts of the house, including the upstairs rooms which were not directly heated. A second group of houses, fitted with standard wet central heating systems, were used as a 'control' for comparison purposes.

Monitoring, including surveys of the occupants, confirmed that the simplified heating system operated satisfactorily with a small (13%) additional energy saving compared with the 'control' houses. But, of most importance, the overall construction costs were well below those of similar housing built to comply with the thermal efficiency requirements of the 1985 Building Regulations.

Collyhurst houses.

The benefits achieved by Manchester City Council

An earlier demonstration with Manchester City Council at Halliwell Lane concentrated on energy savings through the improved performance of the building fabric (Expanded Project Profile 89). Monitoring of the scheme (carried out between 1981 and 1983) showed that whole house heating systems may not be essential for the maintenance of adequate comfort levels. The results indicated that a suitably designed and properly rated ground floor heating system could provide satisfactory whole house heating in a two storey low-energy home. However, some of the Council's traditional housing stock includes partially heated homes which in the past have often caused complaints from tenants through inadequate heating and condensation problems. Understandably the City Council was unwilling to entertain 'partial' heating schemes in any new housing without a thorough and conclusive investigation.

To study the potential of simplified heating systems, Manchester City Council Architect's Department in 1984 designed 20 low-energy houses for construction on a re-development site at Collyhurst near the City centre. The houses were based on the original Halliwell Lane 3-bedroomed (nominally 5-person), low-energy design which had been adopted as the standard for new housing following the successful conclusion of the earlier demonstration.

The houses included most of the building fabric measures demonstrated at Halliwell Lane and were completed in 1984 by the City Council's Direct Works Department. Throughout the construction additional site supervision was applied to ensure the integrity of the workmanship.

The demonstration set out to compare the performance of the simplified heating system with that of a conventional wet central heating system. One group of 10 houses, the 'test' group, were heated using the Baxi 'heatsaver' appliance, the 'Brazilia 8000'. The second group, the 'control' group, were heated by a conventional whole house, wet central heating system.

The Baxi 'Brazilia' is a gas-fired wall mounted heating appliance with an output of about 0.8 to 2.5 kW. Two of these appliances were installed in each of the test houses; a model 8000S in the lounge and an 8000C in the hall. The 8000C model incorporates both a heat exchanger for space heating and in the same casing, but with independent controls, a circulator for domestic hot water generation. A single gas supply serves both elements, and the separate balanced flues are physically combined within the unit. The 8000C has a factory-set water temperature thermostat, and heats the domestic hot water by means of gravity fed primaries serving in this case, a 'Primatic' 110 litre hot water cylinder; see fig. 1.

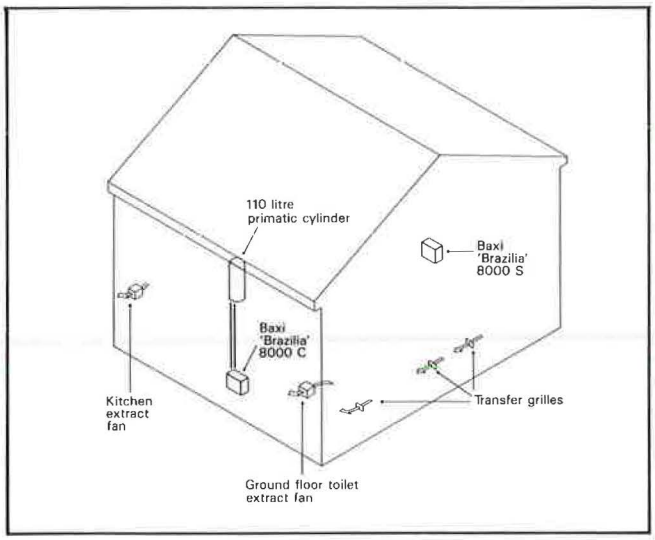

Figure 1 Wall heater schematic.

Air circulates freely around the unheated store room and w.c. on the ground floor through a series of grilles and specially designed fan-lights. A wall fan in the w.c., controlled by room lighting, assures a modest level of air movement from the lounge to the unheated spaces. First floor heating is through natural convection and the 'stack-effect' of the dwelling. To facilitate air movement, fanlights fitted in the first floor doors incorporte an air path between two glass panes. The heating controls are standard controls supplied with the Baxi 'Brazilia'.

The 'control' group of houses were heated by means of low-pressure, small bore, gas-fired centralised heating systems of conventional design. A Baxi WM30/3RS balanced flue boiler (rated output 4.4 – 8.8 kW) supplies both space heating (using steel panel radiators of standard size) and domestic hot water. The heating is controlled by means of a thermostat in the lounge, a cylinder thermostat for domestic hot water and a Randell 102 programmer; see fig. 2.

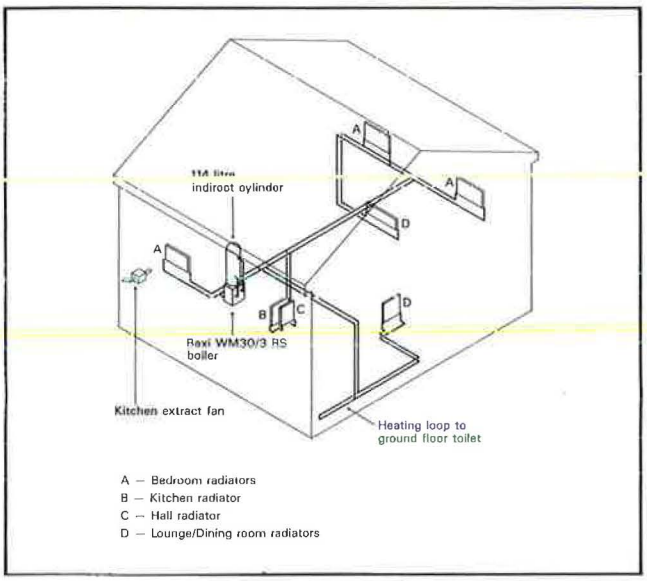

Figure 2 Conventional heating schematic.

The monitoring of the project was funded by the Energy Efficiency Office under the Demonstration Support Scheme. The City Architect's Department carried out the monitoring themselves. An independent consultant was appointed to represent the interests of BRECSU, who managed the demonstration on behalf of the Energy Efficiency Office.

The physical monitoring of the project involved the comparison of energy use and an assessment of the comfort conditions attained in the two groups of houses. Tenant surveys were undertaken in support of the physical monitoring to obtain demographic data and to ascertain the tenants' views on their homes and the heating provided. The air change rates in most of the houses were measured and a detailed investigation of air movement in a single house undertaken. Air movement is an essential element in the design of these houses and in the performance of the heating systems. The tenant surveys and ventilation measurements were undertaken by the Department of Building Engineering, University of Manchester Institute of Science and Technology. The monitoring programme also examined the cost-effectiveness of the design.

Monitoring over two winters showed that a modest energy saving was achieved in the Baxi 'Brazilia' houses. The target temperatures and comfort levels in the two groups were broadly similar. The bedroom temperatures in the 'test' group were slightly lower than in the 'control' group, although perfectly acceptable to the tenants, even in severe winter weather. Humidity measurements and regular inspection confirmed that condensation did not occur (except on windows) and there was no evidence of mould growth in either group of houses.

In general the heating controls in the 'test' houses were well liked by the tenants because of their simplicity and ease of operation. By contrast the heating controls in the conventionally heated houses were more complex and, although not the subject of complaint by the occupants, were not used to their best advantage.

Energy & construction cost savings

The main benefit of the Collyhurst scheme is a substantial reduction in overall construction costs. The over-cost of the Manchester low-energy house design, demonstrated at Halliwell Lane, is about £80 per dwelling compared with a house of similar size built to the 1985 Building Regulation requirements. The Collyhurst houses with their simplified heating systems were about £990 per house cheaper to construct than the houses with a whole house heating system, and £910 cheaper than houses built to Building Regulation standards; see fig. 3. The saving is due to the reduction in material and installation costs, and takes into account the additional site supervision and detailing of drawings required to ensure the integrity of the measures employed. As there is an overall saving on construction costs the benefit of the measures is immediate and there is no payback period.

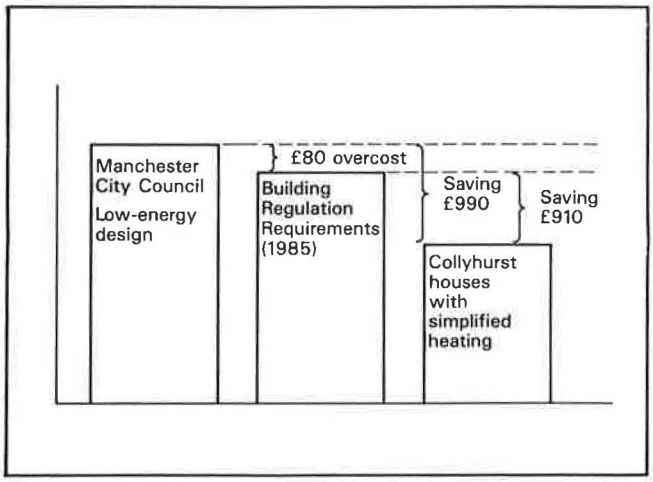

Figure 3 Capital Cost Savings.

But there are also benefits to the tenant. The demonstration showed that the Collyhurst houses with their simplified heating system and scheme for internal air movement can achieve comfort levels and design temperatures that are normally associated with whole house heating systems. A modest energy saving on space and hot water heating of about 13% (6.4 GJ) was achieved in the test houses compared with the conventionally heated houses. At the gas price of £3.6 per GJ this saving is worth nearly £22 per annum; see fig. 4.

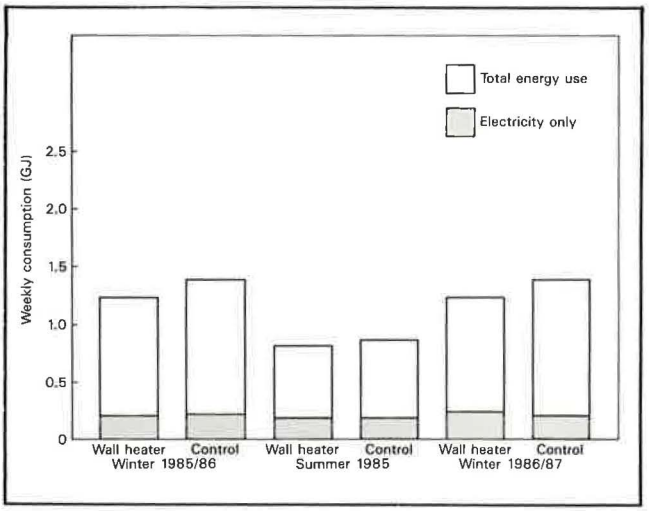

Figure 4 Mean weekly fuel consumption.

In other situations the saving on construction costs will depend on the actual package of measures employed and other factors such as the use of direct labour, local costs etc. Research has shown, however, that future replicators should achieve a saving of at least £450 per house through the use of a simplified heating system which off-sets the higher costs of the extra insulation measures applied to the building fabric.

Replication potential

The measures demonstrated at Collyhurst are directly replicable to new family housing with high levels of insulation and draught stripping. In the private sector the measures are particularly relevant to the low-cost end of the market, including 'starter' homes. But in principle there is no reason why the approach should not be applicable to higher priced two storey developments. In the tenanted sector cash constraints on housing associations and other developers make these results even more attractive.

The demonstration showed that there is no reduction in the occupant's standard of comfort. Very large dwellings, in which the ratio of perimeter wall to floor area is higher than normal, may need special attention.

Providing the design and supervision is properly executed, it is also applicable to existing housing undergoing major refurbishment which is an important area for many local authorities.

Manchester City Council

Manchester City Council has responsibility for a housing stock of the order of 96,000 dwellings. The Council has been active in improving the efficiency of its existing housing and has undertaken many energy initiatives. In recent years the Council has adopted a policy of low-energy design for the fabric of new build housing, and has a continuing programme of heating and insulation improvements to its existing housing stock.

Manchester City Council's experience

Between 1981 and 1983 Manchester City Council hosted a demonstration of fifteen low-energy houses at Halliwell Lane, Manchester. The substantial energy savings demonstrated were achieved in houses with conventional central heating systems and the major emphasis of the project was on the building fabric rather than the heating systems. That project led to a complete re-design of the City's range of 'newbuild' house designs, all to thermal standards well in excess of the requirements of the Building Regulations (1985). Since then the Council has been looking at other cost-effective options for reducing energy consumption in housing. The costs of heating can still be a major worry to householders, even though the costs of fuel are rising more slowly than a few years ago.

The Collyhurst low-energy housing scheme was designed to investigate the use of heating systems with a very low capital cost. As all the City's 'new-build' housing is already built to low-energy standards it was possible to carry out a detailed comparison of the low cost heating system as against standard gas-fired central heating.

The project raised issues of freedom of choice. The results (and especially the social surveys carried out by UMIST) strongly suggest that ease of control of a heating system may be more important to the occupant than sophisticated automatic controls which can be harder to understand and operate. It may be that the Architects and Engineers have underestimated the ability of householders to choose heating standards which suit their taste and their budget.

The important point which the project demonstrates is that heating standards are not compromised by this type of heating system. The heating system provides whole house heating to a good standard; both the householder and the City Council will receive better value for less money.

The City will be taking the results of this project very seriously indeed; it has clear and significant implications for both new housing and the modernisation and improvements programme.

I G Brewerton
Formerly of the City Architect's Department
Manchester City Council

Best Practice programme

The work described here was carried out under the Energy Efficiency Demonstration Scheme. The Energy Efficiency Office has replaced the Demonstration Scheme by the Best Practice programme which is aimed at advancing and disseminating impartial information to help improve energy efficiency. Results from the Demonstration Scheme will continue to be promoted: however, new projects can only be considered for support under the Best Practice programme.

For copies of reports and further information on this or other projects, please contact the Energy Efficiency Enquiries Bureau at the

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Information on participation in the Best Practice programme and on energy efficiency generally is also available from your Regional Energy Efficiency Office.

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