

House for the Future, Macclesfield

Background

In the energy crisis in the 1970s energy prices increased dramatically, for example the price of electricity doubled in 12 months, and one of the Government responses was to improve the thermal insulation requirements for new houses via the Building Regulations. However, there was uncertainty about how to improve existing buildings and so in 1974 Brian Trueman, a TV Producer for Granada Television, proposed a Television Series which would look at basic techniques for improving energy conservation as well as considering how this might be dealt with in the future by looking in addition at renewable energy sources. The working title for the series was 'Eco-House' and the original proposal was to build a new house which would be on a site large enough to provide much of a family's food requirements.

The series was eventually given the title 'A House for the Future' and early discussions led to the decision that the programme might be more useful for viewers if an existing house were to be upgraded rather than to go for newbuild. It should be stressed at the outset, and Brian Trueman himself would readily admit to this, that it was to be first and foremost a Television Series which must therefore hold the interest of the viewer. It would not necessarily come up with solutions to all the problems but it would at least educate people as to what might be the right and wrong way to go about things.

Granada then had to come up with two essential elements for the programme, firstly, a house to work on and secondly, a family to live in it. Brian Trueman wanted to look at use of solar energy and wind energy, which made it essential that there would be no obstruction from adjacent buildings and so a rural site was favoured over an urban site. While a site was being chosen, Granada were interviewing prospective residents from the 250 families who applied to be considered. The family chosen were Geoff and Lynn Grant and their two young daughters and, since an important part of the programme was to be looking at the Do-It-Yourself aspects of many of the techniques, their choice may have had a lot to do with the fact that they were both teachers of practical subjects. Geoff taught Woodwork and Lynn taught Domestic Science.

The Building

After much searching a suitable building was finally chosen near Macclesfield. It was the former coach house and stables belonging to Upton Hall in Prestbury Road. The building was in a fairly derelict state and although the (solid) walls appeared to be sound they bowed out noticeably towards the top. The walls were 340mm thick at the lower floor and 225mm thick at the upper floor, there was no damp-proof course. The building was approximately 12m by 6m in plan and 5m to the eaves with a pitched roof. There was a partial upper storey which formed a hayloft over the stables and the ground floor was mainly formed of large stone paving slabs which would be retained and reused. The main existing openings were on the south-west elevation in the form of large double doors for the carriage house and two stable doors.



The Coach House in its derelict state

Granada TV appointed Donald Wilson as architect and enlisted the help of members of the Environmental Research Unit at the Electricity Council Research Centre at Capenhurst near Chester. These were, Tony Mould, Jack Siviour and Frank Stephen, also Cleland McVeigh of Brighton Polytechnic was to monitor the performance of the building and its various pieces of equipment once the project was completed.

The completed house was to be designed around four basic principles:

1. The main living spaces and bedrooms were to be on the south side and the kitchen, bathroom and circulation were to be on the north side (in fact the long elevations face North-East and South-West).
2. The external envelope and floor were to be highly insulated.
3. The building was to be made as airtight as possible with a mechanical ventilation system and external doors would be sheltered and, preferably, have lobbies.
4. As much use as possible was to be made of natural energy sources.

In addition to the above, it was still considered important that there should be provision for the growing of produce and so a kitchen garden and conservatory/greenhouse would be provided.

The Solution

It was logical to apply the wall insulation externally to make use of the thermal mass afforded by all of the brickwork, this would also prevent further erosion of the existing walls. The existing roof was not very sound and would need to be replaced but there would need to be considerable modification to the roof in order to incorporate the levels of insulation that had been decided on. In addition, the intention was to have some form of solar collector on, or forming part of, the roof. A major consideration in the choice of insulation material, method of fixing and type of external cladding was the ability for amateurs to install it since this was to be part of an instructional television programme.

Ease of handling and fixing led the team to decide on semi-rigid slabs of mineral wool or glass fibre for the wall insulation and this was to be protected externally by redwood weatherboarding. 100mm of insulation gave a calculated U value of $0.36 \text{ W/m}^2\text{K}$ which was much better than the Building Regulations requirement at the time. The insulation was fixed in two layers of 50mm by applying 50mm battens and 50mm counter-battens to the walls. This collaboration between the scientists at Capenhurst and the Development Team at Pilkingtons led directly to the manufacture of rigid glass-fibre batts.

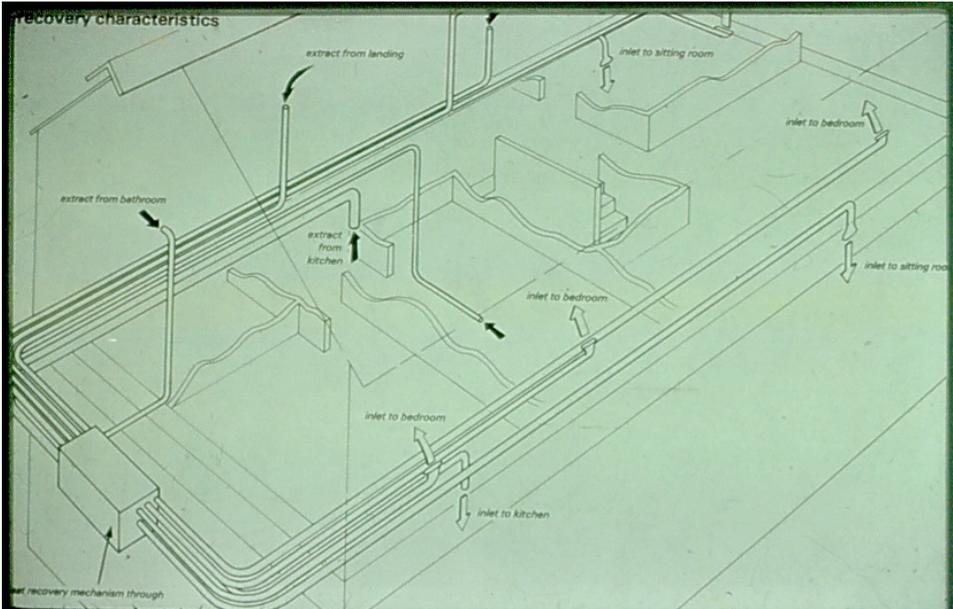
The roof was to have 150mm of insulation incorporated in it, giving a U value of $0.22 \text{ W/m}^2\text{K}$, and the ground floor was formed by lifting the existing slabs and then re-laying them on top of 50mm of extruded expanded polystyrene, giving a U value of $0.36 \text{ W/m}^2\text{K}$. It was more than 20 years later before the Building Regulations required that ground floors were insulated in new houses. In addition to this insulation of the external envelope there was to be 50mm of

insulation laid between the first floor joists because the house was to be zoned for heating purposes with the first floor design temperature being lower than the ground floor design temperature. Also, there was to be an unheated workshop next to the kitchen which would have external access and so this space was thermally separated from the rest of the house with 100mm of insulation.



Insulating shutter folded at glass door reveal

Standard timber-framed double-glazing was used for all of the windows but the windows had insulated shutters on the inside which could be closed on cold winter nights.



Schematic of Whole-House Ventilation

Whole-house mechanical ventilation with heat recovery was integrated into the construction by means of ducting made from 100mm plastic rainwater pipes with simple push-fittings. The air supply to each room was arranged such that the air discharged where possible upwards from the floor into the gap between the two panels of double-panel radiators to reduce the possibility of draughts. There were to be only two extract points in the house, one in the kitchen over the cooker and one in the bathroom. There was a manual boost at the cooker hood. The ventilation unit was sighted at high level in a lean-to outhouse.

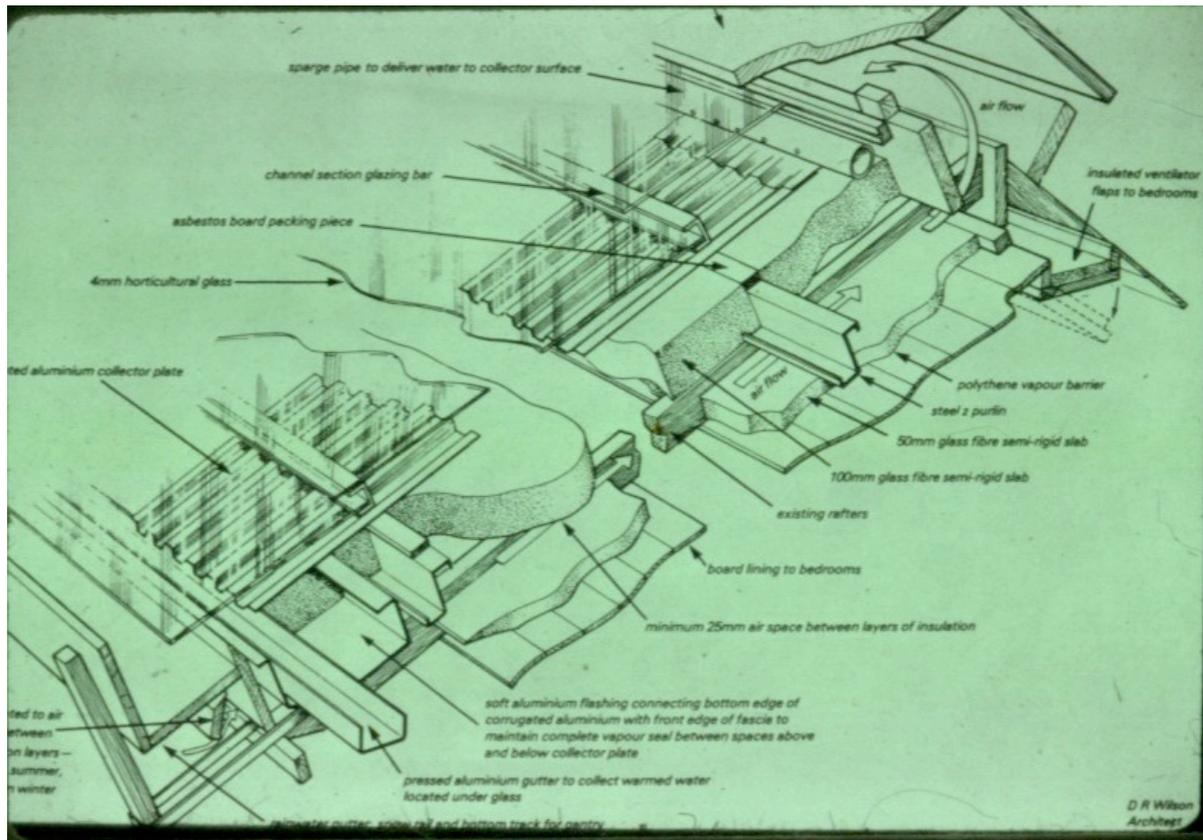


Air-Inlet slot under radiator



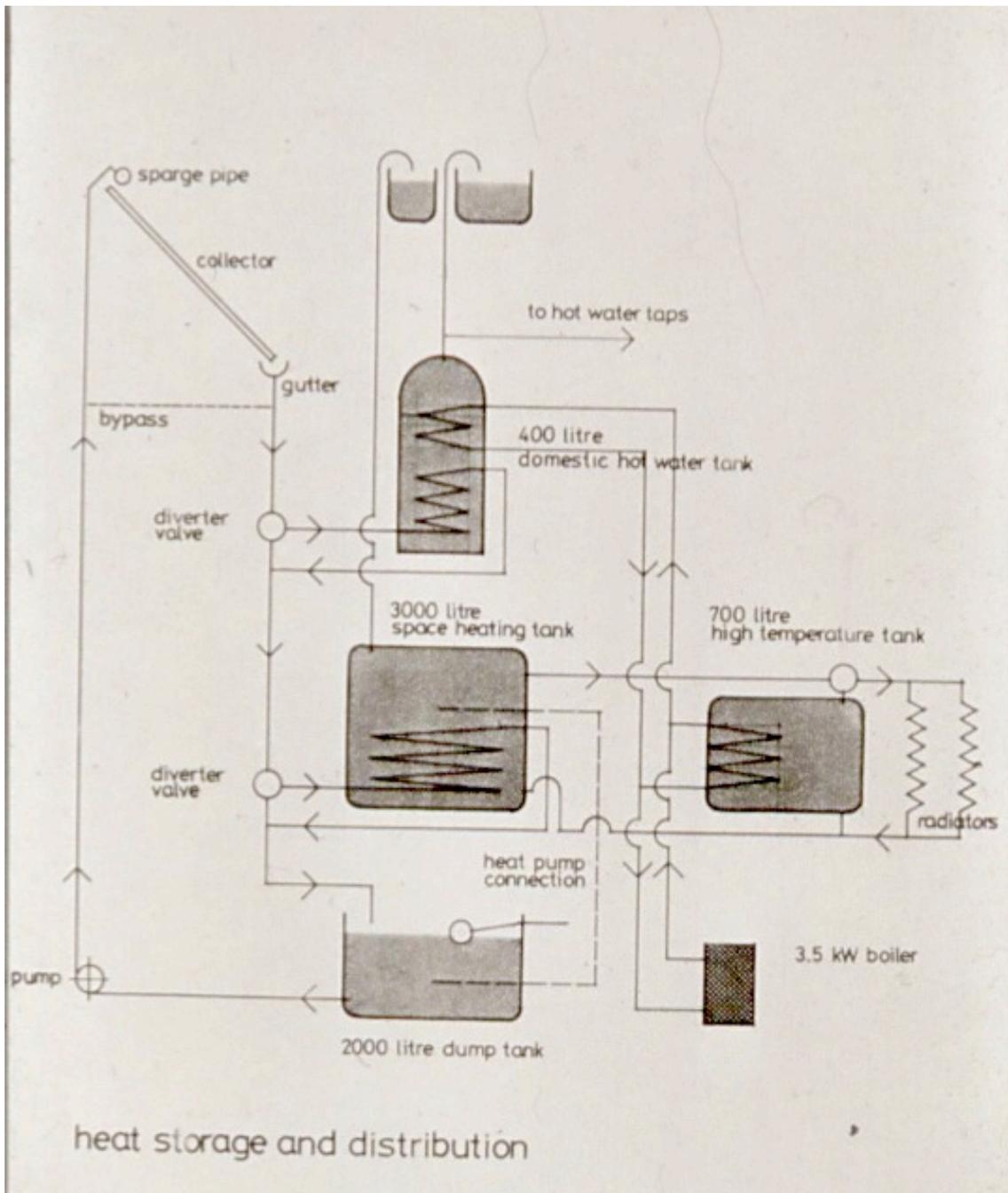
Solar Roof under construction

In order to make use of solar radiation there was to be a solar hot water panel incorporated into the roof and because the orientation of the roof was south-west rather than the ideal due south it was decided that the whole of the south-west side of the roof should form a 44m² solar collector. Some decisions were taken at this stage which proved, in hindsight, to have been far from ideal but, from the point of view of the television programme, it was not necessary for everything to work perfectly. For example, it was decided that the solar collector should be of the trickle type which meant that air could circulate through it as well as water running down it from a sparge pipe at the ridge. This eventually led to serious problems of algae growth.



Solar Roof showing complicated double gutter

In order, it was hoped, to be able to extract heat from the solar collector even when there was very little sunshine, a number of extra storage tanks and a water-to-water heat pump, with the whole system having very complicated controls, were installed. There was to be a 2000 litre solar 'dump tank', a 3000 litre space heating store, a 700 litre high temperature connected to a 3.5kW boiler and a 750 litre domestic hot water tank. An essential element of this solution was the ability to heat the building with hot water at a temperature well below the normal 75°C and so the solution would involve a large heating surface. Standard radiators were to be used but the surface area was about twice what would normally have been expected.



Arrangement of tanks, heat pumps and solar roof

Consideration was given at an early stage to the use of some form of 'windmill' and plans included the use of a scrap metal street lamp standard to support this. Two types of rotor were actually built, one with rigid blades and one resembling a traditional Cretan windmill. The intention was that the 'windmill' would drive a small generator and the energy would be used to preheat domestic hot water. As an experiment using largely scrap parts which were assembled by amateurs, this was considered a success but safety issues were not fully resolved and the notion was abandoned.

A single-glazed conservatory was attached to the house on the south-west elevation in such a way that it acted as a large entrance lobby for the front door and this conservatory incorporated a 12m³ rock store underneath its floor. Air could be drawn through this rock store during hot days from the highest point inside the conservatory and the under-floor fan which blew this air was arranged in such a way that reversing the fan and opening a small flap over it allowed the heat from the rock store to be released into the conservatory in the evening.



The extended Conservatory in 2006



Hollow bricks allow air to pass through rock store under conservatory



Reversible fan in floor of conservatory

Performance

The solar roof was abandoned after only a few years. It had suffered badly from corrosion and algae growth and the monitoring revealed that it was typically contributing less than 2% towards the annual energy requirements. The heat-pump and complicated controls which were an integral part of the system designed to maximise the energy extracted from this solar roof were also abandoned.

Over a twelve month period between 1977 and 1978 the house was found to have consumed 22,000kWh of energy and this was about 40% of what would have been expected for a house of similar area built to the Building Regulations in force at the time. The monitoring revealed that the contribution to the annual energy bill from direct solar gain through the windows was about 22%. The house was generally found to be warm enough in winter and not too hot in summer and considering that 1976 was the hottest summer in most people's memory, this second part was no mean achievement.

The most successful part of the system according to the occupants was the mechanical ventilation system but they also praised the ridge ventilators in the bedrooms which could be opened to increase air flow in very hot weather.



Openable flap to allow warm air from conservatory into bedroom



Ridge vents in bedroom

Update

The building has been modified over the last 30 years with the addition of an end extension providing an integral garage with a new master bedroom above having an en suite bathroom. An extra room has been added on the north-east elevation as a music practice room and the conservatory has been extended into the garden and upgraded to have double-glazing.

Geoff Grant decided to sell the house in 2005 and was amused to report that *none* of the prospective purchasers was as interested in the energy saving features as they were in such things as the number of bathrooms and the size of the garden!



Geoff Grant in front of the 'Nerve Centre' of the house

Sources

- A Specific Application of Solar and Wind Power; D R Wilson. Conference : The Selection of Energy Resources for Housing, University of Salford, Sept 1976
- Private Communication – A E Mould
- Private Communication – B Trueman
- Private Communication – G W Brundrett

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