

# Affordable low allergy housing

After ten years of attempts to find appropriate backing and resources for a pilot low allergy housing project Howard Liddell managed to convince Fairfield Housing Co-op in Perth that they would be the most appropriate group to take it on board. According to epidemiological research the sector of society that depends on social inclusion programmes is most likely to suffer from environmentally induced asthma and allergies. **Howard Liddell, Barbara Chapman and Sandy Halliday** report ...



**“ Good indoor air quality is a human right” Fin Jorgensen - architect**

**T**here has been an increasing concern over the past decade that housing conditions are a factor in breathing related disability. Issues concerning health effects of buildings are complex, and a wide range of environmental and genetic factors are involved. There is however an evidential basis for giving the same importance in building design to disability

designs for some years and eventually acquired a sympathetic client in the Fairfield Housing co-op in Perth. Gaia Research, the RIBA and then the ODPM supported a research and monitoring programme to help develop an affordable low allergy building specification. The aim was to design dwellings that avoid, where possible, known and suspected building related allergens and minimise the conditions in which they can have an adverse impact.

vulnerable, in particular the young, elderly and infirm.

Indoor factors are known to play a role at three levels:

- Activating the immune system (sensitisation).
- Triggering symptoms (exacerbation) in those already sensitised.
- Maintaining a sustained inflammatory state

The indoor environment has changed over the period associated with the rise in asthma. Over a thirty year period we have slowly developed buildings which are significantly less well ventilated, at a time notable for a dramatic upsurge in the use of pollutants such as synthetic chemicals in furnishings, fabrics and finishes. A change in construction materials has also affected moisture in buildings. Conditions can be exacerbated by internal moisture levels that improve fungi and mite survival rates.

There is evidence to suggest that adequate ventilation can reduce the impact of ‘triggers’ in the home. The recent downward trend in ventilation has been driven by energy benefits, but it can lead to excessive moisture levels and the build up of allergens in the air.

The challenge was not just to produce a design and specification that was appropriate but to deliver this at yardstick costs. This was as difficult as trying to achieve total accessibility for wheelchair-bound residents without incurring additional costs.

## Allergy, asthma and buildings

One study by the UK Asthma Council compared groups in the Isle of Skye, and in central London and found similar prevalence of asthma. The study concluded that external air quality could not account for the increased occurrence. They therefore began to seek to focus attention on the indoor environment. We spend 90% of our time indoors and this can increase for the

### A growing problem

The number of sufferers from asthma and allergies has increased significantly in recent years. 1 in 13 adults and 1 in 8 schoolchildren in the UK currently suffer from asthma, whilst over 40% of people suffer from some kind of allergy.

Allergy can affect mucous membranes, eyes and breathing and in extreme circumstances can have very damaging effects on the body.

Research has indicated that strict allergen avoidance can reduce attacks & improve control. It may also reduce sensitisation and contribute to prevention of the development of asthma and allergies.

through allergy and asthma as is presently the case for physical disability. It is imperative that every effort is made to minimise sensitisation and reduce the triggers that promote attacks and the conditions that exacerbate them.

GAIA has been developing low allergy

## Materials

At the beginning of the 20th century, about 50 materials were used in buildings. Now, some 55,000 materials are available, most of them synthetic. This has a number of consequences.

Allergy - there is evidence of a relationship between modern building materials, the increase in indoor allergens and an increase in allergic reaction. These include PVC, some paints, varnishes, insulation materials, timber treatments, wood composites and furnishings.

Emissions from building products - concentrations of more than 35 volatile organic compounds (VOC's) are typically up to 10 times higher indoors than outdoors.

There is also increasing evidence of the role that toxicology plays in pre-disposing people to asthma. Particulates of cobalt, nickel, cadmium and mercury have a profound effect on the immune system

## The Fairfield project

The Fairfield project, where we were to try out our theory, comprises fourteen affordable, low allergy dwellings at Toll House Gardens in Perth. The scheme is Phase 10 of a development that has seen a reversal



of fortunes from deprivation and crime to a thriving community over a period of two decades. In 2003, the development was one of 5 projects in the world to be honoured with a World Habitat Award.

Gaia Architects have substantial experience of healthy building design, including passive humidity control through the use of hygroscopic and low emission materials.

Considerable guidance was given to the prospective tenants about the housing, in advance of them moving in. Guidance notes were prepared on the ventilation strategies and their operation and on the opportunities for avoiding import of allergic materials into the new development. A number of tenants took advantage of guidance on flooring materials and bedding.

Monitoring equipment was placed in the properties at handover. All fourteen houses incorporated four loggers (temperature and relative humidity in the principal bedroom + living room). Two external loggers were also used to monitor the external climate. The evaluation included comparison of allergen & humidity levels in the houses with assessed critical levels from other research.

## Specification

The design paid attention to both the global environmental condition, through a specification which aids moisture management; through selection of appropriate materials, and also through local control which eliminates cold bridging, reduces the number of areas where dust mites might readily populate, aids good ventilation and prevents occurrence of high moisture environments. Known problem chemicals were eliminated from the design.

Timber treatment and PVC were avoided. Zero formaldehyde products were used. Walls and ceilings are finished with 'green paints' that contain no petroleum solvents, vinyl or chlorinated polymers (found in conventional paints). The paints also maintain the moisture balancing properties of 'breathing' walls and avoid VOCs

## Passive moisture management

Depending on factors such as materials selection, insulation, thermal mass, 'cold bridges' and air leakage, a building can cope with more or less moisture. Reduced prevalence of materials that have some hygroscopic properties is thought to be a factor in altering the composition of the indoor environment. Fluctuations in moisture content are greater and so are the problems caused by moisture. This has meant that the management of moisture in buildings has increasingly been given over to energy and maintenance intensive mechanical systems. The increasing association of these systems with further pollution encouraged us to look to passive control through hygroscopicity and thermal mass.

## Hygroscopicity

When the indoor atmosphere is likely to be subjected to sudden moisture loads the damp-buffering capacity of materials becomes particularly important. Bedrooms that have been empty all day experience a sudden change in moisture load when people go to bed. Moulds do not need condensation in order to develop - they can grow on a surface if the humidity reaches 70%.

Materials such as timber, plaster, aerated concrete, lime render, clay, wood, wood-fibre boards, wood-fibre cement, earth and textiles have good hygroscopic properties, so long as they are not covered with impervious coatings.

## Thermal mass

Thermal mass has an impact on moisture management. Rapid cooling of buildings gives rise to fluctuations in relative humidity that are detrimental to buildings and occupants. Many building materials can sustain very large populations of micro-organisms, e.g. plastic membranes, glass fibre etc can have colonies of fungi and bacteria that are 1,000-50,000 times greater than natural materials.

## Allergen removal

The internal climate conditions should therefore be designed to make it diffi-

cult for moulds and mites to colonise. Measures have been taken to make cleaning easier. Smooth coverings (tiles, timber floors, lino) aid the cleaning up of triggers (and their producers).

Kitchens, bathrooms and hallways were generally finished with linoleum installed using a benign glue which is not yet readily available in the UK, but produced for the Dutch market. The service pipes in bathrooms have been boxed in providing smooth, easy to clean, surfaces. Wall mounted storage and panel heaters provide smooth, easy to clean surfaces.

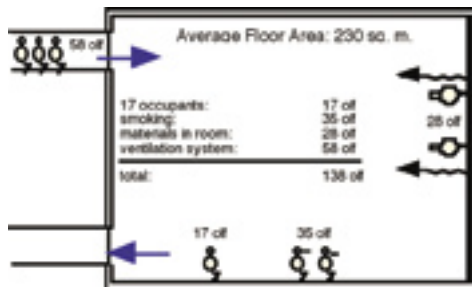
In order to minimise the problems at handover from existing furniture, etc the tenants were offered a free steam cleaning service of items identified through tests as allergenic.

### Ventilation

The ventilation strategies are of particular interest in respect of their efficacy, affordability, energy efficiency and their potential to avoid introducing further pollutants. Three ventilation strategies were compared over the first year monitoring period. Five units were fitted with Whole House Mechanical Ventilation with Heat Recovery (MVHR) provided by Baxi free of charge. Dynamic insulation has been employed in 5 houses. The remaining 4 dwellings are ventilated conventionally.

### Mechanical ventilation with heat recovery (MVHR)

MVHR transfers heat from outgoing air to pre-warm incoming air providing up to 70% heat recovery. It can reportedly control relative humidity and remove airborne irritants. A pollen filter is



supplied for filtration of the incoming air. The system aims to extract air from the areas of greatest contamination, and to replace it with an equivalent volume of pre-warmed fresh air into the living areas.

### Dynamic insulation

Dynamic insulation is a technique whereby air is drawn into a building through the fabric, in this case a porous ceiling membrane spanning the whole housing unit. The loft space of the dwelling is slightly pressurised by a fan and the roof void must be completely sealed. The ventilation air is warmed as it passes through the ceiling membrane. When used in combination with hygroscopic materials it has been shown to provide a buffer against rapid changes in moisture.

### Conventional ventilation

The remaining units are conventionally ventilated with trickle ventilation in windows and extract fans in bathrooms and kitchens.

### Air tightness

Alongside a designed ventilation strategy it is necessary to ensure that unwanted air exchange within the structure and between inside and outside is minimised.

### Heating

In general the consensus is that low allergy designs should avoid combustion products in the atmosphere. Hence, gas heating and pilot lights associated with gas cooking should be avoided. The design and research team therefore deemed electric heating to be the most suitable form of heating for this application to eliminate the risks to asthma sufferers. This does present problems at the heart of discussions on energy

efficiency measures, priorities and policy. Green tariffs were investigated.

### Cost

This project took very seriously the objective of achieving a cost competitive solution with low maintenance requirements, in order to enable implementation by owner/occupiers and carers and increase willingness amongst Registered Social Landlords and other clients to implement these measures.

The delivered costs were well within the guideline cost range for mainstream general purpose social housing in the region. However some features in the original specification, were excluded from the final design due to cost.

The financial cost of the development was compared to the cost of treating asthma-related problems. Asthma accounts for 1,500 deaths each year. 7 million lost work days due to asthma result in £350 million in lost productivity and costs approx' £60 million in sickness benefit. The costs of asthma treatment to the NHS is £850 million a year.

### Legal case studies

There have been a number of legal cases brought against landlords, homebuilders and insurers over health problems originating from poor indoor air quality, notably in the USA. In the first case of this kind in the UK, a Glasgow mother is taking a housing association to court over conditions in her home. Her seven-year-old son developed asthma and damp conditions are being blamed. High levels of exposure to dust mite faeces are claimed to be responsible for the development of the child's asthma. Dust mite samples from the mattress in the child's bedroom found levels 700 times higher than the World Health Organisation safety levels. The case is aiming to prove that the landlord failed to carry out repairs that might have improved the conditions within the house and is therefore responsible for the child developing asthma.

Howard Liddell, Barbara Chapman and Sandy Halliday

Photos and diagrams by the authors

