Heat Recovery Ventilation Trial: The Newcastle Case Study

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Case Study Duration: 5th November 2009 - 13th January 2010
Product trial carried out on behalf of the Local Authority by Simba Solutions Limited, in the Shieldfield area of Newcastle upon Tyne.

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Introduction

This report presents the work carried out during, and the resulting findings of, a trial designed to demonstrate Heat Recovery Ventilation (HRV) in a residential property as a solution to persistent condensation, damp and mould problems. Such problems are the single largest cause of complaint received by local authorities, and so guaranteed solutions are highly sought after. HRV requires no control by the tenant, needs little to no maintenance, is cheap to run, and is energy efficient; its installation removes the need for passive ventilation such as the opening of doors and windows, and thus helps to cut down fuel costs and limiting the chances of tenants being forced into fuel poverty.

Other works are carried out multiple times in many properties to manage the problem, but to no avail; from passive ventilation such as air bricks and trickle vents in windows and doors, to the installation of extractor fans. Alongside these interventions, advice is given to tenants to use the vents and extractors and to keep the heating on to promote circulation and allow the walls to dry. However, tenants very often choose not to take this advice due to the cost of fuel in keeping a passively ventilated home heated, only to lose the heat right through the installed interventions! This leads to the persistence of the problem and puts the landlord back to square one.

Additional attempts at a solution, such as cavity wall insulation and double-glazing, serve to seal the house in such a way that industry experts have come to refer to such homes as having the ‘tupperware box syndrome’ in that humidity rises dramatically since there is less natural ventilation.

Generally, condensation and mould can be solved throughout a home by promoting circulation in every room, which is one aspect of HRV. Mould can still present itself in rooms within very well ventilated homes, in areas that receive little or no circulation.

Condensation and Mould

Wherever mould growth is present it is indicative that relative humidity levels are in excess of 60% for prolonged periods; conditions which allow mould spores to thrive. Everyday activities such as washing up, bathing, cooking, ironing and drying clothes generate vast quantities of moisture which must be expelled, or absorbed by the air or into the fabric of the building. A typical family of 4-5 people produces an average of 14-17 litres of moisture per day. Over a litre is generated just sleeping, while 4 litres can be generated cooking and washing up. Washing and drying clothes can produce a staggering 10 litres of airborne moisture per day.

Health risks of toxic mould can be extreme, causing many known illnesses and conditions such as: chronic bronchitis, learning disabilities, heart problems, cancer, chronic fatigue, lupus, fibromyalgia, rheumatoid arthritis, bleeding lungs, dermatitis, burning sore throat, headaches and diarrhoea.

A paper in the British Medical Journal, Vol. 298, as far back as June 1989, stressed the higher incidence of ill health in damp buildings with accompanying mould growth. It is now accepted that air pollution is a major reason for the huge increase in asthma sufferers of whom children and the elderly are often the most vulnerable.

Heating the air increases the amount of moisture that it can contain, and allows the surfaces to dry. However, this causes the mould on the surface to lay dormant, rather than die, until the surface next becomes damp following the subsequent cooling of the air. Furthermore, the dried mould that is left on the surfaces becomes airborne and lands on adjacent surfaces, furthering its spread. Only fungicidal treatment or a complete air-change within the property will eliminate the mould spores, and thus prevent the problem.
Condensation and Mould Control – Why Heat Recovery?

The prevalence of the problem and the lack of a consistent, cheap solution have been the motivation for the development of HRV technologies. The solutions offered by Simba are novel in that they promote air circulation throughout every room in the property without the need to use air bricks, or to lose expensive heat by opening doors, windows and trickle vents, and by turning on extractors in kitchens and bathrooms. Simba’s solutions involve ducted fans that supply and extract air to and from rooms in the home in a custom-designed way to optimise circulation. Fresh air intake supplies clean, dry air to the home from outside, and stale, moist air is exhausted. The most distinctive feature of Simba’s solutions is that this cold, fresh air from outside is heated — using a specially designed heat exchanger — by the energy in the warm, stale air that leaves the property, ensuring that heat loss is minimised and thus helping the tenant stay out of fuel poverty while living in a fresh, clean and healthy home.

Simba Solutions Limited have a legal responsibility to ensure that we show a duty of care in our recommendations. We are fully aware that home owners, and private and social landlords are faced with differing legislation, regulations and standards, all of which is taken into consideration when making a recommendation of our solution for the cure of condensation and mould within any given property.

- The Housing Health and Safety Ratings System.
- The Decent Home Standard.
- Building Regulation Part F – Means of Ventilation (Latest Revision).
- DETR Energy efficient Ventilation in Housing - Good practice guide 268.
- UK Fuel Poverty Strategy.

Our experience and expertise in condensation and mould control solutions is based upon working with a team that has carried out thousands of successful surveys and installations in thousands of private households and for hundreds of Local Authorities, Social Landlords, Housing Associations and ALMOs. We have an unrivalled knowledge of this industry. Based upon this experience, HRV is the only solution that fully meets all of the criteria of all of the legislation, and provides a permanent cure to condensation and mould.
The Newcastle Case Study

Simba Solutions approached Newcastle’s Local Authority with a proposal to demonstrate HRV solutions in a particularly troublesome property, with a history of condensation and mould, as well as failed interventions. Such a property was suggested. The property was of particular interest as the Local Authority had had a long history of failed interventions designed to solve the mould problems. Following the trial, should it be unsuccessful, the Local Authority would condemn the property as unlivable, and move the residents out. Simba’s specialist survey and inspection team visited the property to determine what solution was required to solve the problem.

The property is a two-bedroom flat with adjoining properties on each flank and North and South exterior elevations (See Figure 1). Although there was no visible evidence of water penetration, walls and ceilings, where accessible, were tested with an electronic moisture meter, readings were low and this would indicate that the structure was free from dampness.

The tenant attributed mild sickness and a ‘clamminess’ in the atmosphere to the condensation and damp that were present in the bedrooms. Furthermore, her eldest child — a girl of four years — complained of ‘sticky eyes’ and a conjunctivitis-like condition, upon waking in the mornings.

At the time of inspection (between 16:20 and 17:30) humidity was recorded between 57 – 64% and heavy condensation was present on the windows in both bedrooms, in the master bedroom the condensate was running down the wall and had begun to saturate the carpet. Severe mould growth was visible around the frames, the wall below the window and on the ceiling. Mould had also started to take hold on the ceiling of the children’s bedroom. Both bedrooms are generally cooler than the rest of the property, which is largely due to the exterior being North-facing and that 2 metres of the concrete floor project above the public access walkway.

Figure 1: Floor plan of trial property
High relative humidity and low temperature in the adults’ bedroom adjacent to the North-facing wall.

More extensive black mould against the North-facing wall of the adults’ bedroom, and damage to ceiling.

Visible black mould against the ceiling of the adults’ room. Over 30cm of mould on the ceiling, along the entire wall.

Line of mould against the edge of the North-facing wall of the adults’ room. Over 20 cm of mould visible to the eye.

Mould growth along the cold edge of the North-facing wall of the children’s bedroom, adjacent to the adults’ room.

Adults’ bedroom showing damage to the wall beneath the North-facing window, as well as the mould against the ceiling.
The bathroom and separate WC are provided with vents that are ducted to a central extraction unit sited on the roof. Vents have also been cut in the fan lights above the internal doors, probably to aid the through-flow of air into the hall/landing area. However, this is also aiding the migration of moist air from the bathroom into the opposite bedrooms. The kitchen is provided with a cooker hood extract unit but this is not vented to free air and therefore rarely used.

Upon inspection, black mould was visible on the North-facing wall of each bedroom, and in the North-East corner of the adults’ room, as shown in the previous images. A passageway runs directly beneath both bedrooms and so the whole Northern end of each room is externally exposed, and thus presents substantial cold areas. There is no natural ventilation available other than the opening of windows and the front door (only exit). Mould was so widespread that it had damaged carpets, bedclothes, and even clothing in the wardrobes. The kitchen and living room showed no signs of mould, yet the bathroom ceiling had a layer of mould across its whole surface.

The family expectedly produces much water vapour in the living spaces, through hygiene, cooking, cleaning, and, notably, drying clothes on radiators and maidens in the living spaces. The warm and moist air from these living spaces migrates through to the cold, North-facing bedrooms, and mould is allowed to settle on these surfaces. Despite attempts by the local authority to solve the problem, and frequent cleans and repaints, the problem was still prevalent. In fact, the tenant noticed that the problem had worsened on two occasions: when the first child was born four years ago, and when the double-glazing was fitted two years ago.

The condensation and mould growth problems in this property are mainly due to inefficient and inadequate ventilation, and the presence of a substantial cold spot on the North-facing wall of both bedrooms: air is migrating into these rooms and cooling. With limited ventilation the water is condensing out of the air, and mould is settling on the condensation. The tenant’s attempts to heat the air or ventilate the room result in the mould spreading after drying and becoming airborne, or more water vapour condensing to promote its spread.

**Simba Recommendations**

The recommended design proposed by Simba Solutions for the problems presenting at the property used a small HRV unit placed within the adult bedroom, in the corner adjacent to the external wall and the children’s bedroom. The unit takes air from outside and ducts it through to the landing area. This pressurises the air in the landing to promote migration of air through to the bedrooms to ensure regular air changes. The warm, moist air that has been pushed through to the two bedrooms is extracted from each room adjacent to the unit and is pumped outside. This warm air transfers its heat to the cold air that is initially pumped into the hall to ensure that minimal heat is lost by the ventilation process. Drawings of this proposed design are shown in Figure 2.

This unit runs on two settings: trickle and boost, and is designed such that it should never be turned off. It is rated by the manufacturer to run at 23dB on trickle and 42dB on boost, which are the noise levels expected of a whisper at five feet and general ambient room noise respectively. The unit runs at a cost of around £6 per year assuming that it is on boost setting for 10% of the time.

**The unit was installed as per the proposed designs on the 7th of December 2010.**
Figure 2: Drawings of the bedrooms in the property. Upper view of the external, North-facing windows, and lower view from the interior of the property (landing area).

External wall with intake and exhaust vents. Vents are ideally spaced apart to prevent moisture from the exhaust from being taken back into the property through the intake.

Extraction vent from children’s bedroom can be seen on the wall in the corner of the room, adjacent to the installed unit through the wall in the adults’ room.

Small HRV unit is placed inside boxing in the top corner of the adults’ room. Ducting is shown from the box to the hallway area and down to the intake vent.

Proposed solution is illustrated, with the supply vent visible above the adults’ room doorway. Fresh air that has been heated by the extracted cold air is supplied to the hallway area.
Trial Results

Our installation engineers asked the tenant to record humidity levels at three points throughout the day during the previous month.

The temperatures within the adults’ bedroom are shown in Figure 3 while the humidity recordings are shown in Figure 4.

![Figure 3: Temperatures (in Centigrade) recorded with a digital thermometer by the tenant. Readings taken in the adults’ bedroom three times per day. Vertical grey band indicates dates upon which the unit was installed.](image)

![Figure 4: Humidity recordings measured by the tenant using a digital moisture meter. Recordings taken in the adult bedroom three times per day; in the morning, in the afternoon and in the evening. Region A is pre-install of the HRV unit, while region B shows the two-day period in which the unit was installed. No ventilation took place during region C as the unit was tested and rewired.](image)
There is little remarkable about the temperature recordings, which showed rather consistent temperatures from 17 - 19°C. There is a general trend for the temperatures to increase overall, probably as a response to the very bad weather at the time of the trial. Dips in temperature can be seen in late November, which are due to the tenant opening windows in order to ventilate the property. This has not been necessary after the installation of the unit, a fact which is supported by the more regular temperatures after the installation.

Humidity readings can be seen to decrease after the installation of the unit (8th and 9th December), with humidity being between a minimum of 62% and a maximum of 81% pre-install, and having a range of 48-70% after installation. During the period of the 12th - 16th December, the HRV unit was replaced and rewired, and so no ventilation was taking place. A noticeable increase in humidity in this period can be seen. Following the 16th December the tenant had control of the main fuse spur for the unit and has been turning it off at nights, then onto boost upon waking. The humidity is almost consistently higher in the mornings and lower in the afternoons, which is more pronounced pre-installation. The lowest morning humidity pre-install is higher than the highest morning humidity recorded post-installation (72% and 69% respectively). Overall, these results are typical of the immediate effect of heat recovery ventilation in properties such as this.

Further to this quantified immediate improvement in air quality in the home, the sickness and ‘clamminess’ that the tenant previously experienced has also stopped. The eldest child also no longer suffers from the ‘sticky-eyes’ upon waking. The family have greatly benefitted from the HRV solution, and feel that their home is healthier, and a more comfortable place to live, following the installation.

**Conclusions of HRV Trial**

A solution to the problems persisting in the property was presented and installed on behalf of the local authority by Simba Solutions Ltd. This solution has been shown to decrease humidity and, coupled with the fungicidal mould clean and painting work, there has been no evidence of a reoccurrence of mould in the property in the time since installation.

The Local Authority have acknowledged that the installed design has solved the problems that have persisted in this property for the previous four years despite numerous interventions. Therefore they no longer believe that this property must be condemned, and the family are free to continue living there without ill health. The family also report a better, healthier-feeling atmosphere, along with the subsidence of a number of minor ailments that were prevalent prior to the installation.

Work is currently underway to install HRV throughout Newcastle and surrounding areas. Simba Solutions aim to improve quality of life by offering affordable new technologies that solve common problems and meet needs that many of us share. Heat Recovery Ventilation is such a technology, and it solves one of the most considerable problems in housing.
For more information

www.solvemouldproblems.co.uk

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