Mechanical ventilation with heat recovery

Current Building Regulations require that new homes are built to high levels of air tightness. This can result in poor indoor air quality if condensation and pollutants from normal living (cooking, cleaning and bathing) are not vented effectively to the outside. Poor indoor air quality can, in turn, lead to a number of health-related issues.

Mechanical Ventilation with Heat Recovery (MVHR) is one way of providing the necessary whole-house ventilation to ensure good air quality, but with the added benefit of recovering heat that would otherwise be lost.

In this issue of Foundation Facts, we review two research reports into MVHR, including one that looks at 10 units in use. Read more about the research on pages 4, 5 and 6.
Events round-up

The NHBC Foundation will be at three of the industry’s biggest events in the first half of 2014.

In the early part of the year, The NHBC Foundation will be at most of NHBC’s Building for Tomorrow events across the UK, which inform the industry on topics that directly impact current and future house building. The full schedule of dates and locations can be found at www.nhbc.co.uk.

After a year’s break, we will be back at Ecobuild, London ExCel on 4 to 6 March. Ecobuild is one of the world’s leading events for sustainable design, construction, energy and the built environment. The NHBC Foundation will be on stand N802, close to entrance N3. For more information and to register, please visit www.ecobuild.co.uk.

And for the third year running, we will be at Greenbuild Expo, Manchester Central on 8 to 9 May. Greenbuild Expo is an essential and informative event for the industry, covering everything from training and renewable technologies to sustainable materials and legislation. The NHBC Foundation will be on stand F1, close to the main entrance. For more information and to register, please visit www.greenbuildexpo.co.uk.

Notes from the editor

Welcome to the autumn 2013 edition of Foundation Facts, the twice-yearly newsletter that provides an overview and analysis of the recent research and guidance from the NHBC Foundation.

Over the summer, we have launched two reports on Mechanical Ventilation with Heat Recovery (MVHR). The first of these, the final report from the Zero Carbon Hub-led task group Mechanical Ventilation with Heat Recovery in new homes, is featured on page 6, and assessment of MVHR in use in Assessment of MVHR systems and air quality in zero carbon homes is looked at in more detail on pages 4 and 5.

We also look at the report Fires in cavities in residential buildings, which provides guidance for contractors, building control authorities and other building professionals on best practice relating to the installation of cavity barriers and inspection techniques both during and post-construction.

And finally, our latest publication, Low- and zero-carbon technologies in new homes: learning from the experiences of consumers and on-site sales teams is featured in more detail on page 3. Following on from NF 42 A survey of low and zero carbon technologies in new housing published in May 2012, this new research provides detailed insights into the marketing and use of homes with LZC technologies.

As we look to the future, a number of research projects are due to be published over the coming months, but we always welcome new proposals from interested organisations. For more information please visit the website or contact us by email.

The next issue of Foundation Facts is scheduled for March 2014 to coincide with our return to Ecobuild, but in the meantime please continue to catch up with our latest news at www.nhbcfoundation.org, sign up for our monthly e-newsletter and follow us on Twitter @nhbcfoundation.

We are always looking for constructive feedback on all our communications, so please feel free to email us at info@nhbcfoundation.org with your suggestions.

Are you receiving the Foundation e-bulletin?

Our monthly e-newsletter contains information on new and forthcoming research, with direct links through to each of the publications. It also looks at recent information posted to the website and Twitter, keeping you up to date with what’s going on.

To ensure you get your copy every month, please register through the website and make sure you don’t check the box to opt-out.
Experiences of low and zero carbon technologies identifies room for improvement from builders

New primary research has found that the owners of homes fitted with low and zero carbon (LZC) technologies are still not recognising and taking best advantage of the benefits that these bring.

Building on earlier research presented in NF 42 A survey of low and zero carbon technologies in new housing, published in May 2012, this new study Low and zero-carbon technologies in new homes: learning from the experiences of consumers and on-site sales teams, is an in-depth study by Reading University of six homes across four separate developments.

The qualitative approach undertaken through in-home interviews and looking at the way homeowners actually lived with the technologies, has produced a rich picture of actual experiences and insight. Similarly, the sales team interviews were carried out in some detail, to ensure that all aspects of the promotional mix were investigated.

All the households monitored during the study stated that the LZC technologies had not been a factor in deciding to purchase the property. Significantly, none were able to demonstrate an understanding of how, in principle, the technologies worked. They were also unimpressed with the written information provided on the technologies, with all six households rating it as ‘unsuitable’.

These findings are consistent with earlier research carried out by NHBC Foundation in 2011 and published in 2012, NF 40 Today’s attitudes to low and zero carbon homes, which identified that action was needed to help consumer understanding of use and maintenance of renewable technologies. Although most of the home occupiers in this earlier study had been presented with instructions and/or training on how to use the technologies, it was widely recognised that the quality of this information was inconsistent.

But while most of the homeowners in this new research could not clearly express the benefits of the LZC technologies ahead of purchase, post-occupancy the majority would recommend them to a friend.

This new study also includes interviews with sales teams across six developments. Despite half of the sales teams claiming they demonstrated a good understanding of the LZC technologies (in all but one development) the sales teams felt they were unable to make specific claims about the technologies’ performance, or introduce the benefits and limitations to potential purchasers early on in the process.

As a result, the report’s author has developed a continuous improvement cycle, which looks at the understanding of LZC technologies across six phases: design and production, imagination, purchase, identification, function and feedback and opinion. The cycle provides a process for house builders to monitor, evaluate and improve the marketing and sale of their new homes incorporating LZC technologies.

Recommendations for house builders are structured around the report’s improvement cycle. The report identifies that the critical phases of the cycle are the initial ones, because when house builders get those right, it is likely that the other phases should take care of themselves.

A copy of the primary research is available to view and download at www.nhbcfoundation.org/LZCtechnologiesinnewhomes.

Key findings

Homeowners

- Occupiers did not understand the underlying principles of the low and zero carbon technologies but were mostly comfortable operating them.
- Despite being largely unable to articulate the benefits of LZC technologies clearly, four of the six households in the study would recommend them to friends.
- All of the households expressed that the technologies had not been a factor in purchasing the house, and that the written information provided on the technologies after purchase was unsuitable.

Sales teams

- The sales teams had a very limited ability or willingness to communicate the benefits and opportunities of the LZC technologies in a way that the prospective purchaser could understand or be inspired by.
- There was a varied level of understanding among sales teams of the specific LZC technologies being fitted to the homes.
- Homeowners are not routinely invited to provide feedback to the sales teams post-occupancy on either the design of the home or the sales process.
Assessment of MVHR and air quality in zero carbon homes

The move towards higher levels of energy efficiency in new homes and improved airtightness has led to around a quarter of new homes being fitted with Mechanical Ventilation with Heat Recovery (MVHR) systems, according to NHBC analysis.

The changes to Building Regulations have introduced a practical and regulatory need to ensure that the indoor air quality and ventilation provision in new homes are appropriate, as well as designing the home in such a way that reduces the amount of energy used for space heating. MVHR systems work by providing fresh air ventilation, while at the same time recovering heat from exhaust air that would have otherwise been lost.

With most people in developed countries spending an estimated 80% of their time indoors, good indoor air quality is vital for the comfort, health and wellbeing of occupants. Poor indoor air quality can be connected to a wide range of serious health effects, including allergic and asthma symptoms, lung cancer, chronic obstructive pulmonary disease and cardiovascular disease.

An increasing number of house builders are using MVHR as a practical and cost effective way of meeting ventilation and energy efficiency requirements. It appears likely that the trend to install MVHR will continue, and it could well become the dominant form of ventilation for new homes.

Designed and installed correctly, MVHR can offer a number of benefits. But there is a growing body of evidence, based on academic study and practical observations that indicate MVHR systems are all too often designed, installed and commissioned in such a way that the design performance is greatly reduced.

Research from the NHBC Foundation in 2009 published in Indoor air quality in highly energy efficient new homes – a review, followed by the publication in 2013 of the Zero Carbon hub-led Ventilation and Indoor Air Quality (VIAQ) Task Group report Mechanical Ventilation with Heat Recovery in new homes (see page 6 for more information), both revealed a number of issues with MVHR systems.

To add to the limited evidence available from monitoring the use of MVHR in practice, the NHBC Foundation has released primary research that studies 10 homes in Slough, built by energy supplier SSE to Level 6 of the Code for Sustainable Homes. As well as examining design, commissioning, and installation of the systems over the course of 18 months of monitoring, the occupants were also interviewed on three occasions to provide in-use feedback.

When installed correctly, MVHR systems can deliver good performance, but it is clear from this new research published in Assessment of MVHR systems and air quality...
in new homes that a number of lessons still need to be learned. At Greenwatt Way it was considered necessary to make modifications and recommission all the MVHR systems after one year, with one needing a replacement fan unit also.

As a result of this body of research, and at the request of NHBC’s Standards Committee, it was agreed that new NHBC Standards for MVHR needed to be developed. Following the proven method of engaging with stakeholders, a group of experts from the ventilation and house-building industries was assembled, including representatives from several manufacturers of MVHR systems, a range of house builders, and academic and industry bodies. This group assessed the use of MVHR in house building, identified common problems and produced a set of technical standards to address them.

The outcome from this group is the new Chapter 3.2 Mechanical ventilation with heat recovery, which is now available as part of the 2014 edition of the NHBC Standards. It documents new technical guidance that will not only set the standard for MVHR, but significantly raise it, to the benefit of homeowners and the industry in general.

It is critical that when considering MVHR as a ventilation system for new homes, that these new benchmark standards are complied with. A well considered strategy during the design stage – before procurement and commissioning – is essential, as is ensuring that the design is followed through to the installation.

A copy of this primary research is available at www.nhbcfoundation.org/MVHRsystems.

Key findings:

- It is critical that the overall ventilation strategy is taken into consideration during the design stage when intending to use MVHR systems in homes.
- During the procurement process it is important to seek technical input from the supplier and installer of MVHR systems.
- MVHR systems should be installed by trained and experienced ventilation system installers.
- Commissioning of MVHR systems must be carried out with care and attention.
- Factors likely to adversely affect the power consumption and thermal performance by MVHR fan units during operation must be considered, such as the size and location of the fan unit, the level of insulation provided and their commissioning.
MVHR – room for improvement

The Zero Carbon Hub-led Ventilation and Indoor Air Quality (VIAQ) Task Group, which has been reviewing evidence from the UK and other countries since 2010, published its final report in July 2013 Mechanical Ventilation with Heat Recovery in new homes. The report concludes that concerted effort is needed to ensure satisfactory performance of MVHR systems in new homes.

Reinforcing the findings of the Interim Report published in January 2012 and drawing on additional evidence, it recommends that concerted Government-led action should be taken to develop and promote good practice. It believes this is essential to ensure public health and safety, with new research informing future Building Regulation requirements.

Despite the number of MVHR units installed, only a limited sample of those incorporated into recently built homes have been monitored to see how they are actually performing in practice. The vast majority of the available evidence, whether from the UK or abroad, points to issues that need to be addressed – issues with design, installation, commissioning, operation and use, all of which affect system performance and could compromise air quality inside people’s homes.

A lack of good practice across industry in dealing with ventilation systems serves to highlight competence as a key issue. Regrettably, existing training schemes have made limited progress and Task Group members are calling on DCLG to consider mandatory competency requirements for MVHR installations so that standards can be driven up.

Based on the evidence reviewed by the VIAQ Task Group, there is little doubt that poor indoor air quality is connected with a wide range of undesirable health effects. Regardless of the type of ventilation systems chosen, the Task Group’s findings reinforce the need for the design, construction and commissioning of buildings to be undertaken with internal air quality and the provision of adequate ventilation firmly in mind.

The report does, however, identify one housing development which is beginning to demonstrate that when done correctly, MVHR systems can deliver good performance. It is a development of 14 houses built in Wimbish, Essex, to the Passivhaus standard, where increased attention to detail has paid off and one from which some useful lessons can be drawn.

NHBC has responded to this research by publishing its own study into MVHR systems in use, Assessment of MVHR systems and air quality in new homes (see page 4 for more information) and completing the development of a new NHBC Standards chapter. These, alongside the concerted action between industry and government as called for by this Task Group, will significantly improve UK ventilation practice and avert potential risks to health and safety.

A copy of the Task Group report is available to view and download at www.nhbcfoundation.org/VIAQfinalreport.
Fires in cavities in residential buildings

The unseen spread of fire within wall cavities and the associated behaviour of combustible materials in fire situations has been a topic of much discussion over the years.

Evidence from fire investigations suggests that unseen spread of fire in cavities has resulted in disproportionate damage, along with anecdotal evidence that suggests the methods used for protecting cavities incorporating combustible materials may not be providing satisfactory performance.

Putting the issue into context, cavity fires in timber-framed buildings are relatively rare events, but nonetheless there are concerns that in addition to the significant property damage that can occur there is a potential risk to life safety, a challenge for the Fire and Rescue Services.

With this in mind, the NHBC Foundation investigated the issue of fire spread within combustible cavities and this new piece of primary research – *Fires in cavities in residential buildings* – is now available. This is the second NHBC Foundation report to be published on the subject of fires following *Fire performance of new residential buildings*, published in 2011.

The research project commissioned an experimental programme of 21 fire experiments at the BRE Global test facility at Watford, based on the earlier work undertaken by BRE at Cardington. The test method chosen provided a realistic assessment of the in-use condition of cavity barriers in the external wall of a timber-framed building.

The experiments consisted of two 2.4 m x 2.4 m timber panels fixed to the masonry wall and separated by a timber beam. Performance in the experimental programme ranged from rapid fire spread with flames emerging from the upper panel after approximately six minutes followed soon after by collapse of the system to complete burn-out of the localised fire load with no fire spread or damage to the upper panel.

The experiments undertaken confirmed that when specified and installed correctly all commonly used horizontal cavity barriers are capable of meeting the relevant functional objectives of the Building Regulations.

As part of the project, London Fire Brigade examined its Real Fires database to identify incidents involving fire spread through cavities in an attempt to evaluate the scale of the problem, the nature of the ignition source and the extent of damage related to cavity fire incidents. A total sample of 30,086 building fires attended in London between 2009 and 2011 were considered. Of this sample, 92 cases were identified where the fire had spread through gaps or voids in the construction resulting in fire spread beyond the floor of origin to other floors or the whole building.

The most significant lesson is to ensure that cavity barriers are installed correctly in accordance with manufacturers’ instructions and are not damaged, removed or interfered with during the period between installation and completion of the external rainscreen façade.

Those responsible for the installation, site supervision and the building control and approvals process should be made aware of the crucial role that cavity barriers play in restricting fire growth and spread in the event of a fire. It is essential to consider the implications of poor specification and installation, and the significant impact that small gaps and discontinuities within the line of compartmentation provided by cavity barriers can have on the spread of a fire.

The choice of cavity barrier to be employed in any specific scenario should be an integral part of a building’s design that should consider the likely risks and consequences associated with a fire. One adaptation that may need to be considered is the ongoing use of timber battens as cavity barriers.

Clarity is required within the construction project team on who is responsible for the installation and inspection of critical fire protection measures such as cavity barriers. The use of approved contactors and appropriate supervision at key stages during the construction will help to ensure that cavity barriers are installed correctly and the installation is not compromised by follow-on trades.

A copy of the primary research is available to view and download at [www.nhbcfoundation.org/firesincavities](http://www.nhbcfoundation.org/firesincavities).
Research projects being published soon

The following research projects are ongoing and due to be published in the forthcoming months (please note these are working titles and may change prior to publication):

- Review of co-heating test methodologies
- Cellulose-based building materials: use, performance and potential risk
- Socio-technical analysis of microgeneration technologies in the UK and France.
- Garages - what do we use them for?
- Homes through the decades.

For more information on research underway and due for publication, please visit www.nhbcfoundation.org/researchinprogress

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Expert panel

The NHBC Foundation’s research programme is now guided by a newly-formed Expert Panel, which includes the following senior representatives from Government and industry.

Rt. Hon Nick Raynsford MP Chairman of NHBC Foundation and Expert Panel
Peter Bonfield OBE Chief Executive, BRE Group
Jane Briginshaw Head of Design and Sustainability, HCA
Anthony Burd Head of Technical Policy – Building Regulations (England), DCLG
Andrew Burke Policy Officer, National Housing Federation
Claire Curtis-Thomas CEO, British Board of Agrément
Hywel Davies Technical Director, Chartered Institution of Building Services Engineers (CIBSE)
Andrew Day Director Architecture, Design & Sustainability – New Homes and Communities, Countryside Properties (UK) Ltd
Michael Finn Design and Technical Director, Barratt Developments plc
Cliff Fudge Technical Director, H&H UK Ltd
Neil Jefferson Director, NHBC and Chief Executive, Zero Carbon Hub
Rod MacEachrane NHBC Director (retired)
Robin Nicholson CBE Senior Partner, Cullinan Studio
Tadj Oreszczyn Professor of Energy and Environment and Director of the UCL Energy Institute, University College London
Geoff Pearce Director of Development and Property, East Thames Group
Mike Quinton Chief Executive, NHBC
Helen Saunders Group Marketing Director, Crest Nicholson plc
Steve Turner Head of Communications, Home Builders Federation
Andy von Bradsky Chairman, PRP Architects LLP
Karl Whitteman Divisional Managing Director, Berkeley Homes
Tony Woodward Managing Director, Kingerlee Homes
Neil Smith Head of Research and Innovation and secretary to the Expert Panel, NHBC