

Event 2: Workshop

The aim of the workshop was to elaborate on the findings from the symposium through smaller, more focused cross-disciplinary group activities; identifying complementary skills and expertise, exchanging knowledge and establishing potential areas for collaboration. The workshop was held on Wednesday 30th of November 2016 at the Glasgow School of Art.

Nine workshop sessions were identified in total, based on the key research priorities identified from the symposium event.

The purpose of the event was to identify specific challenges faced within each topic and stimulate ideas for funding opportunities. Session chairs were identified with specific relevant expertise, to help guide the sessions and ensure the discussions remained focused. The aim of each workshop session was to develop a research question and suitable methodology in an 'abstract' form, to be pitched to all attendees in the afternoon for feedback and discussion. To ensure that the discussions remained focused, numbers were limited to 15 participants per session.

The workshop brought together 46 participants from both professional and academic communities to discuss the state of knowledge in the field and identify and research opportunities. In particular, the significant involvement of industry professionals (ventilation suppliers, housing associations, architects, clinicians and consultants) and policy makers (Scottish Building Standards Division) helped to increase awareness and knowledge of the potential health effects of modern airtight construction and facilitated the transfer and exchange of knowledge between research and practice.

The event resulted in the submission of three multi-disciplinary funding proposals based on specific gaps in knowledge that were identified through the session discussions.

Workshop Programme

10:30	Registration, tea and coffee
11:00	Introduction and Overview
11:30	Parallel workshop sessions (1 hour 30 minutes) Prof Jan Sundell , <i>Tsinghua University Beijing</i> Cross sectional study on children's health and IEQ Dr Catherine Lawrence , <i>University of Strathclyde</i> Airtightness and House Dust Mite Proliferation in Scottish Homes Prof Graham Devereux , <i>University of Aberdeen</i> Intervention studies for susceptible groups Ian Mawditt , <i>Fourwalls</i> & Dr Mich Swainson , <i>BRE</i> Effectiveness of ventilation systems
13:00	Lunch
14:00	Parallel workshop sessions (1 hour 30 minutes) Prof Tom Woolley , <i>Rachel Bevan Architects</i> Source control and material emissions Prof Cath Noakes , <i>University of Leeds</i> Microorganisms in homes Prof Rajat Gupta , <i>Oxford Brookes University</i> End-user interactions Dr Sani Dimitroulopoulou , <i>Public Health England</i> Evidence Review: IAQ & ventilation in modern airtight homes Chris Morgan , <i>John Gilbert Architects</i> Guidance for design and construction professionals
15:30	tea and coffee
15:45	Presentation pitches: Outcomes from workshop sessions
17:30	Discussion
18:00	Close

Summary of workshop discussions

Cross sectional study on children's health and IEQ

This session kicked off with a presentation from Prof Jan Sundell, which provided context and rationale for the workshop session and an overview of the purpose of the proposed study. A study proposal was presented (Phase 1: Cross-sectional study, Phase 2: Case-control study), based on previously completed studies undertaken by Prof Sundell and colleagues in China, Denmark, Korea, Texas, Sweden and Singapore. Some findings of these studies were also presented, including risk factors identified for asthma and allergies among children (such as the presence of DEHP and the use of water-based paints). A case was made for further investigation, to identify why children in English speaking countries (such as the UK, New Zealand and Australia) have higher incidences of asthma and allergies than non-English speaking countries.

The discussion that followed highlighted some perceived barriers to the development of large scale studies of IAQ and health in a UK context, including a lack of collaboration between architecture, engineering and medical groups and difficulty of acquiring funding for multidisciplinary studies that fall between the remits of specific research councils (AHRC, EPSRC and MRC). Suggestions to overcome these included the development of a funding proposal for a cross-sectional doctoral training centre, establishment of coordinated university studentships or approaching multiple research councils to suggest the topic as a research agenda, with a specific multidisciplinary focus.

A study proposal was discussed in detail, including the focus on asthma onset (rather than asthma exacerbation), the importance of a randomised sample, justification for the focus on children (as opposed to adults), suitable measurement protocols and analysis techniques, and possible participant recruitment strategies. Suggested next steps included the identification of a suitable research team (UK wide) and refinement of the questionnaire and proposed methodology for a UK context.

Airtightness and house dust mite proliferation in Scottish homes

The session chair, Dr Catherine Lawrence, initiated the discussion with a short presentation outlining the rationale for a study to identify whether housing design (particularly airtightness and ventilation levels) might have an influence on House Dust Mite (HDM) proliferation in a UK / Scottish context, emphasising the need for a multidisciplinary consortium to investigate this effectively. Through the discussion, it was suggested that this might include a second stage to investigate whether improvements of ventilation provision could lead to a reduction of HDM (through an intervention style study), with physical measurements of indoor environmental conditions.

It was noted that a link between environmental conditions and health would not be established by the proposed study design, however it was suggested that future studies might investigate whether there is any association between HDM concentrations and asthma prevalence. Many elements to this study were deliberated, including discussions on a suitable sample size, methods for collecting dust samples (such as survey company or administration of dust collection kits), collection of environmental data (RH and temperature), confounding factors (such as cleaning regimes, surface materials, lifestyle etc.), analysis and interpretation of results (based on WHO sensitisation level for HDM) and the potential impact of the findings.

Proposed next steps included a collation of information from other European countries, to identify whether there is sufficient evidence to suggest a link between building weatherisation strategies and increased proliferation of HDMs, and whether there is proof of concept that increased ventilation levels might lead to a reduction of HDM concentrations in Scottish homes.

Intervention studies for susceptible groups

The focus of this session was to explore opportunities for intervention studies for susceptible groups (e.g. patients with COPD, asthma, cystic fibrosis). The session initiated with a brief introduction by the chair, Prof Graham Devereux, who put forward a number of key questions to focus the discussion. These included the following: i) Is there enough evidence to do intervention studies at the moment, ii) Are we trying to prevent disease or ameliorate people with established disease, iii) What susceptible groups are we going to look at, iv) What are the likely outcomes (design of the study), v) What interventions would we want to do, vi) Can we use large datasets?

The discussion that followed raised a number of important issues, such as the difficulty of acquiring funding for longitudinal studies that focus on primary prevention, the range of confounding factors (such as lifestyle, smoking habits, medication, co-morbidities, outdoor pollution) and the need for large datasets, the potential effectiveness of interventions (such as moisture control or improved ventilation) and the importance of choosing suitable IAQ markers (e.g. patient specimens or pollutant concentrations).

A study was proposed to investigate whether interventions to improve ventilation and indoor air quality in the home environment might reduce the rate of exacerbations in COPD patients living in modern homes. This might include an initial large scale survey, followed by a case control study (those who exacerbate and those who don't), which would involve investigation of the home environment and patients lifestyles.

Effectiveness of ventilation systems

The aim of this workshop was to stimulate ideas for projects on the effectiveness of ventilation systems in homes. The session was chaired by Dr Mich Swainson (BRE) and Ian Mawditt (Fourwalls). The session kicked off with a discussion on what is meant by 'effective' ventilation, which is defined in Approved Document Part F as, "*a measure of how well a ventilation system works in terms of delivering supply air to the occupants of a building*". It was suggested during the discussion however that effectiveness should include other elements, such as cost (energy performance), comfort, noise, usability, robustness and the effectiveness of removing (or diluting) pollutants and moisture. It was noted that ventilation rates are often expressed volumetrically (e.g. ach), which was considered to be too simplistic as does not consider effectiveness in terms of IAQ or occupancy requirements.

A number of questions were proposed for future investigation, including i) Who should be accountable to ensure ventilation effectiveness, ii) Should there be a competent person or mandatory independent inspection to test ventilation systems post-completion, iii) Do we have enough information on key elements of ventilation failure (design, installation, commissioning, operation, maintenance) or do we need more studies, iv) Do other countries have the same issues, v) How effective are filtration technologies in domestic setting?

A study was proposed to develop a depository / database of best practice UK case studies on effective ventilation in modern airtight homes, supported by physical data on performance (as built) and end-user experiences.

Source control and material emissions

This workshop, chaired by Prof Tom Woolley, explored the importance of source control to reduce indoor air pollution in homes, with a particular focus on control of material emissions. Questions deliberated included the following, i) Can ventilation remove or significantly reduce emissions successfully, ii) What material emissions are of most concern (e.g. VOCs, formaldehyde, flame retardants, radon etc.), iii) What evidence is there of higher concentrations of hazardous emissions in air-tight buildings (and resulting health problems), iv) What can be done to mitigate emissions (using materials), and v) What guidance / standards exists on specifying low emission materials and how can it be applied.

It was noted that even if the general public could be convinced on the importance of source control, there is a lack of guidance available on specifying low emission materials and a lack of supply due to a breakdown in the UK natural building material supply chain in recent years. The importance of adopting the precautionary principal was stressed, and the need to raise awareness of source control among architects, manufacturers and built environment professionals through university programmes and targeted reports.

A study was proposed to investigate the emission rates of typical UK construction materials in environmental chambers under different scenarios and conditions.

Microorganisms in homes

This workshop, chaired by Prof Cath Noakes, explored the increasing awareness that buildings can influence our exposure to a range of microorganisms indoors, which can have both positive and negative influences on health. The session focused on the relationships between building design, indoor environmental parameters, occupants and the presence of microorganisms in housing.

A range of topics were discussed, including i) Sources of microorganisms in housing (e.g. occupants, HVAC, building fabric), ii) Methods and challenges in sampling/detection of microorganisms (e.g. air samples, sequencing), iii) Confounding factors (geographic location, occupant behaviour, household demographics, seasonal variations etc.), iv) Health effects of microorganisms in housing, v) Influence of design and occupant behaviour on presence of damp and mould in housing (and impact of airtightness strategies), and vi) The microbiome of the built environment (relationships between design, ventilation, location and microbial ecology, including development of antimicrobial resistance).

A study was proposed to bring together expertise from architecture, engineering and microbiology to evaluate how building design may influence the presence of microorganisms in the home and the development of antimicrobial resistance.

End-user interactions

The focus of this workshop was to identify opportunities for multidisciplinary projects investigating the influence of end-user interactions on indoor air quality in the home environment. The session was chaired by Prof Rajat Gupta, who initiated the discussion with a presentation providing evidence of interactions and experiences of end-users from recently completed building performance evaluation studies. He noted that end-users can influence indoor air quality and ventilation in a building (through behaviour), and that indoor environmental conditions can also have an impact on the end-user (in terms of comfort, productivity and health).

The discussion that followed raised some important concerns regarding the usability and responsiveness of mechanical ventilation systems, the potential psychological implications of (perceived) lack of control, the complexity of occupant behaviour with regards to lifestyle choices, social factors, habits and values, the inherent challenges associated with trying to

change behaviour through improving awareness, the lack of effective noise standards for ventilation systems and the complexities of setting noise standards for ventilation systems in airtight homes.

A number of possible strands for future work were identified, including i) an evaluation of ventilation habits and behaviours in low energy UK houses, and ii) an investigation of the potential psychological impact of increased isolation from the exterior environment in airtight homes. Some interventions were proposed, such as providing users with data on indoor pollutant concentrations, or additional information / training on indoor air quality and ventilation.

Evidence review – IAQ and ventilation in modern airtight homes

This workshop, chaired by Dr Sani Dimitroulopoulou, discussed the available evidence on the quality of indoor air and ventilation in modern airtight homes. Sani kicked off by providing a quick update on recent indoor air quality initiatives in the UK (including the development of indoor air quality guidelines by NICE), emphasising the importance of new research to evaluate the impact of energy efficient design strategies on IAQ.

The structure of the discussion was based on a research paper published by Prof Pawel Wargocki and colleagues (2013) on a proposed research agenda for achieving IAQ and supporting health in highly energy efficient buildings. This paper outlines a number of research needs on issues including, i) Impact of user behaviour with respect to control of IEQ, ii) Development of new methods of monitoring IAQ, iii) Definition of ventilation requirements and the parameters defining these, iv) Definition of pollutants of concern in highly energy efficient homes, v) Comparison of user expectations and health risks relating to IAQ in new energy efficient, retrofitted and traditional homes, vi) Examination of the impact of non-building related variables, and vii) Development of improved and simplified toxicological characterization of pollutants.

The findings of a number of recently completed UK studies were discussed, including potential solutions to improve IAQ in airtight homes; such as IAQ labelling systems for UK building products, improved ventilation legislation, increased public awareness, changes driven by insurance claims / liability, innovations in ventilation technologies and education / training of the UK construction sector. Suggested next steps included the collation of evidence on IAQ and ventilation in UK homes. It was stressed that there is a fundamental need to work together to propose (and deliver) solutions to address these challenges from a multidisciplinary perspective.

Guidance for design and construction professionals

The aim of this workshop, chaired by Chris Morgan (John Gilbert Architects), was to establish ways to engage, educate and empower architects to consider IAQ during the design process, through the development of guidelines and/or best practice guides. It was noted that whilst it is clear that more research is required to establish a strong consensus on ventilation standards, there are some simple design strategies that can be implemented to support the achievement of good IAQ in homes.

Topics explored through the discussion included, i) The regulatory context and the lack of guidance on IAQ for architects, ii) Concerns regarding the treatment of current minimum ventilation standards in UK building regulations as target levels, iii) The focus of the guidance (e.g. new-builds and/or retrofits, airtight / non-airtight, targeted at clients, designers, specifiers and/or end-users), and iv) The potential adoption of guidance through certification schemes / bespoke IAQ plans. Suggested next steps included the exploration of funding options and the establishment of a suitable multidisciplinary team (including architects and IAQ specialists) to inform the development of the IAQ design guidelines for airtight homes.

Survey Responses

Feedback from project pitches

Large study = high costs and longer timescale. Should start now, but need other studies to get going, not wait for this one

I think this would achieve buy-in from the Scottish government, as the issue meets so many current agendas: overall health, children health, the kind of Scotland we want in the future, have a healthy workforce, reducing demand on NHS and welfare budget, etc. SG support would lend significant weight to any funding submissions.

Cross sectional study on children's health and IEQ

Useful if this ties in with microorganisms. Should not be isolated to these - opportunity to collect more detailed IEQ data

Worthy of further investigation, although it could stand as a piece of bespoke research possibly more rounded if combined with other area(s)

Airtightness and HDM proliferation in Scottish homes

Promising idea; needs more discussion and ethics consideration

Clear evidence needed to start a study on COPD. Need link between health and industry starting with NHS data collection.

Intervention studies for susceptible groups

A remarkably coherent summary of a diverse session

Needs the evidence base from other studies to identify the medical need to establish what good ventilation should be. However work can be done on existing provision - maybe follow on AHRC funding for KE

Effectiveness of ventilation systems

Characterising materials by their emission in to air would be difficult sine these vary with time and the physical conditions in the room

This is important, but this group will not fix this - we may raise awareness and promote labelling, but we need to understand better the health risks associated with off-gassing in airtight homes

Source control and material emissions

This could be combined with the cross sectional study and used as a later stage investigation. May be worth doing a pilot study in the short term as part of the AMR call

Interesting research possibilities on microbiome. Need to harden up on objectives and methods - is the interest viruses, bacteria or fungi? All are of interest medically but in different ways.

Microorganisms in homes

We need the medical evidence to illustrate the human and monetary cost of the problem - top priority

Evident that consumer does not understand the need for ventilation let alone how to do it. Therefore it has to be legislation driven to protect health rather than a desire solution.

Evidence review: IAQ & ventilation in modern airtight homes

This is an area that I personally think needs to be more fully investigated

It seems to me that a significant problem is people not realising the importance of ventilation. People will always undermine the performance of any "system" if unwanted, hence second priority.

End-user interactions

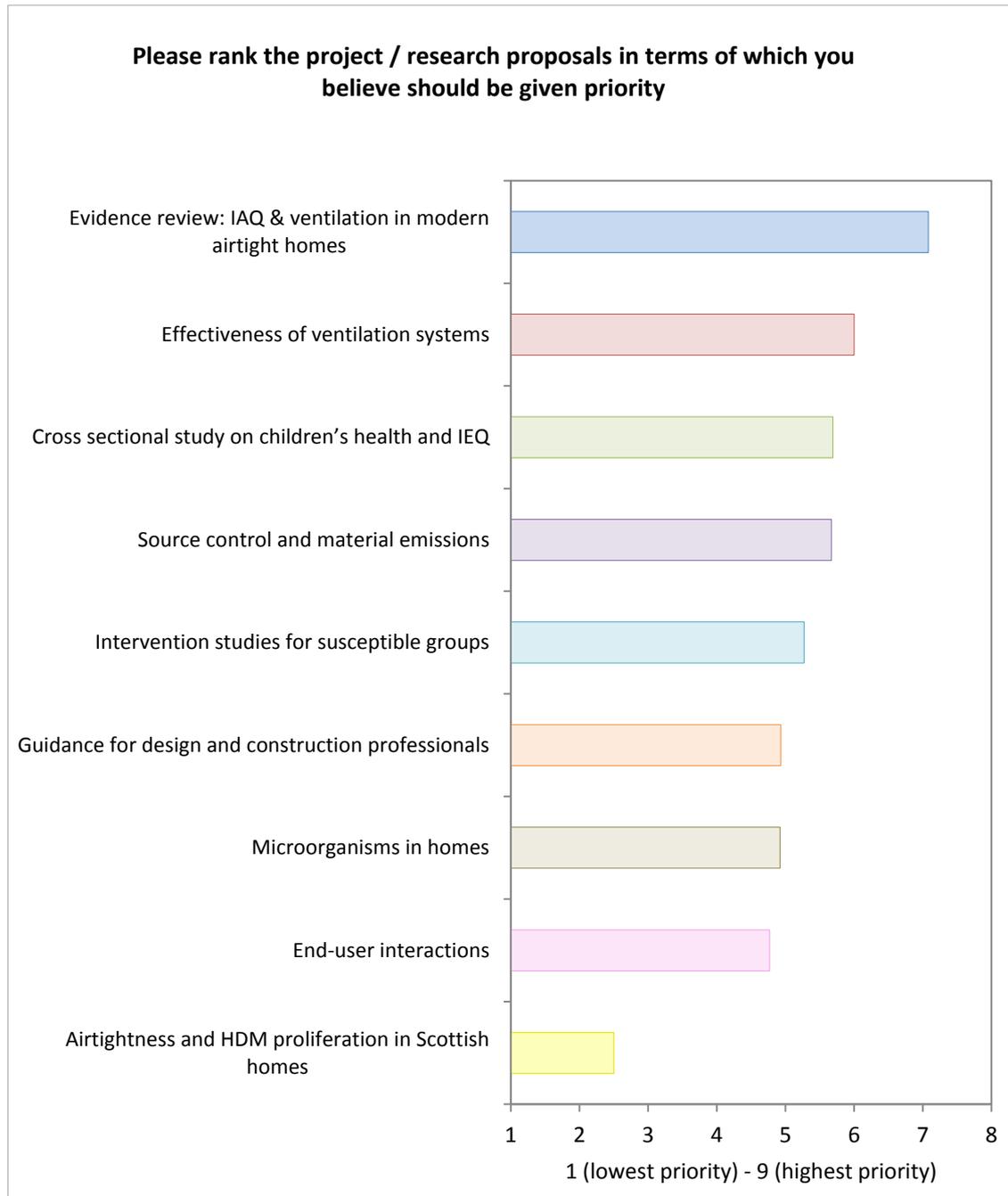
Very interesting discussion, guidance is very necessary, big cap in architecture education, also practical on-site guidance.

Essential to get information out to various participants in construction; this should include client guidance [briefing] and End User Guidance - simple to understand.

Guidance for design and construction professionals

Ranking of proposals

Participants were asked to rank the presentation pitches of project proposals in order, based on those they believed should be given priority. The results are presented below.



Photos from the workshop event



Session participants: Guidance for design and construction professionals



Session chair presentation: Microorganisms in homes