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Title: Health Effects of Modern Airtight Construction: Research Needs and Future Directions

Gráinne McGill^{*1} ; Tim Sharpe¹ ; Graham Devereux²

¹Mackintosh Environmental Architecture Research Unit/ Glasgow School of Art/ United Kingdom, ²Applied Health Sciences/ University of Aberdeen/ United Kingdom

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INTRODUCTION

In response to the challenges of climate change, a global shift in building standards and practices is currently underway. In the UK and Ireland, this has been evidenced through substantial improvements of thermal performance and airtightness in new-build and retrofitted dwellings. Whilst improvements in fabric performance should lead to health benefits (particularly for households in fuel poverty), there is now growing concern that the practice of increasing airtightness and limiting ventilation to reduce heat loss may result in indoor air quality problems. These may also be exacerbated by reduced space standards and intensity of occupation, use of new building materials and products, and problems with the provision of mechanical ventilation in new-build housing. However, while awareness of the risks of increasing airtightness on indoor air quality (IAQ) in housing is growing, there remains a significant lack of evidence of the potential health effects. Research of this nature requires a fundamental understanding of the complex interplay between the climate, building design, occupant behaviour, air quality, toxicology and health.

METHODOLOGIES

To address the challenge of delivering healthy and energy efficient homes and identify ways of resolving potential trade-offs, a multidisciplinary approach is required. Yet despite mutual interests, the fields of architectural design, IAQ and medicine are generally not well connected. To establish dialogue between these



distinct communities, a multi-disciplinary network was established, with funding from the Arts and Humanities Research Council (AHRC). The aim of the ‘HEMAC’ (Health Effects of Modern Airtight Construction) network is to bring public health, IAQ and building professionals together with architects and their clients, to identify shared research questions and develop ways of addressing these issues. The objectives include: i) To identify the current context of IAQ in modern airtight homes, ii) To establish an inclusive and active network, iii) To establish well-founded, tangible project ideas (with the aim of developing these as grant applications), and iv) To develop an online platform to facilitate sustained communication. The funding facilitated three network activities: i) A symposium to provide a platform for knowledge exchange and debate, ii) A workshop to identify shared interests, methods and key challenges within the indoor environment-health nexus, and iii) A sandpit to establish the development of novel collaborative research projects.

RESULTS AND DISCUSSION

HEMAC established a multidisciplinary steering committee of researchers and practitioners in the fields of medicine, engineering, microbiology, indoor air science, building physics, architecture and ventilation; including participants from the UK, Ireland, Belgium, Denmark, the Netherlands and China. The symposium event (Glasgow, 21/09/16), attracted a large number of participants from academia, industry and the public sector. The event included presentations from 10 invited speakers and a discussion session, which helped to stimulate debate and intellectual exchange. Research needs and priorities were presented and deliberated among speakers and participants. These were developed further through feedback surveys, completed by symposium participants.

A series of research themes emerged, which formed the basis of the workshop event (Glasgow, 30/11/16). The event included nine different workshop sessions on the following topics: i) Source Control and Material Emissions, ii) Micro-organisms in Homes, iii) End-user Interactions, iv) Guidance for Design Professionals, v) Effectiveness of Ventilation, vi) Intervention Studies for Susceptible Groups, vii) Evidence Review, viii) Airtightness and House Dust Mite Proliferation, and ix) Children’s Health and Indoor Environmental Quality. The establishment of multidisciplinary groups helped to facilitate knowledge exchange, intellectual dialogue and the dissemination of information across research boundaries.



A number of specific research gaps were identified. Overall, there exists a fundamental need to establish if and how occupant health is affected by ventilation in housing. This includes; i) whether the nature of pollutant exposure in the home environment has changed over the last few decades, ii) whether changes to hygrothermal conditions and ventilation provision may affect the type and concentration of microorganisms found indoors, and iii) whether current ventilation standards are effective to mitigate the risk of poor IAQ in airtight homes. Of particular importance is the need to establish an evidence base of the health effects of exposure to indoor air pollutants in the home environment, particularly for more vulnerable groups such as children and the elderly. The overall objective is to communicate this research to design and legislation communities and to establish effective strategies to educate and inform architects, in order to achieve practical design solutions to reduce chemical emissions and pollutant exposure through the design of buildings.

CONCLUSION

The network has established a range of interdisciplinary links, with three funding bids already submitted and a range of projects under development. It is hoped that this network will result in the stimulation of novel collaborative research projects, to help advance knowledge and establish architectural design as a central point for emerging research in the fields of IAQ and health.