A Breath of Fresh Air

The importance of air quality in aged care design

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The Dementia Centre HammondCare is committed to providing excellence in dementia care. Older and younger people living with dementia deserve services that are designed and delivered based on evidence and practice knowledge of what works. This is achieved through providing research, training and education, publications and information, consultancy and conferences.

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The Pelgromhof aged care residence in Zevenaar, Netherlands. Credit: Damian Utton

Foreword

External and internal air quality play a major role in how our physical environment supports or undermines our health and wellbeing. From Vitruvius in the 1st century BC to the modernist architecture of Alvar Aalto, air quality has been central to design for health, quality of life, reduced disease transmission and a range of other environmental issues. However, good planning and design has not always prevailed, and this is resulting in poor health outcomes in our towns, cities and buildings. Sadly, the devastating impact of COVID-19 has highlighted the role of air quality and shown the importance of good ventilation, air filtration, and the importance of outdoor spaces and fresh air for safer social interaction.

Air quality is also a universal design issue, as poor air quality can affect accessibility and usability, impairing human performance and social participation by causing lethargy and fatigue, dizziness or confusion, breathing difficulties, stress, eye irritation, voice hoarseness or headaches. Unlike physical barriers in poorly designed buildings, air quality is typically invisible, sometimes odourless and tasteless, and often very difficult to fully appreciate or monitor.

Air quality is particularly important for us as we get older, when impairments of ageing, physical and sensory difficulties, or health issues can make us more susceptible to a poor environment. Again, COVID-19 has illustrated the importance of air quality for older people who have greatly suffered during the pandemic. In addition to direct health impacts, a person with dementia may be very vulnerable to poor air quality as they may be acutely sensitive to their environment and incapable of articulating their discomfort, or simply unable to open a window, go outside, or make other adjustments to improve their situation.

Whilst poor air quality is linked to lung diseases, there is also emerging research showing a correlation between COVID-19 infection rates and pollution levels. Furthermore, there is growing evidence linking exposure to pollutants with a heightened risk of developing dementia. This reinforces the importance of sustainable and healthy planning, design and material selection, firstly to reduce air pollution, and secondly to ensure that the built environment helps to protect people against harmful emissions and any associated short- and long-term negative health outcomes.

A Breath of Fresh Air deals with these issues and challenges in a straightforward and in-depth manner.

It provides a good foundation with clear definitions of pollution and air quality and how these impact on health, with a focus on issues related to ageing and dementia. It sets out the main outdoor and indoor pollutants that we should be aware of and outlines design strategies for the various stages of a building's design, construction and maintenance.

The short case studies ground the information contained in this book within realistic and familiar contexts. These help to reinforce and explain key issues and, in some cases, illustrate simple solutions to common air quality problems.

This booklet will be useful for a wide range of readers, from those who want a better understanding of how to manage their own environment, to family members, carers, health professionals and facility managers who want to improve the health and quality of life for those in their care. It will also be invaluable to building professionals such as architects, mechanical engineers and HVAC (heating, ventilation, and air conditioning) experts.

Annie Pollock, HammondCare, and the contributors to *A Breath of Fresh Air* should be commended for this work. It provides an excellent source of information in a complex and challenging area and will help to improve the quality of life for older people and people living with dementia in a range of settings.

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Shanghai, planted wall to help combat pollution visible in the sky. Credit: Annie Pollock

Chapter 2
Air pollution indoors

People with poor health are at greatest risk from indoor air pollutants. They are frequently less mobile and may spend more time indoors, often with poorer ventilation (noted as a way in which the current COVID-19 pandemic is spread). Those of us (of all ages) with respiratory diseases, allergies and asthma are particularly vulnerable to poor air quality, but the older you are, the more you will be affected.[30]

The following quotes from the Royal College of Physicians in London show the importance of being aware of and avoiding materials that can emit pollutants:

> *Being indoors can offer some protection against outdoor air pollution, but it can also expose us to other air pollution sources. There is now good awareness of the risks from badly maintained gas appliances, radioactive radon gas and second-hand tobacco smoke, but indoors we can also be exposed to NO_2 from gas cooking and solvents that slowly seep from plastics, paints and furnishings. The lemon and pine scents that we use to make our homes smell fresh can react chemically to generate air pollutants, and ozone-based air fresheners can also cause indoor air pollution.*
>
> *… the concentration indoors is as much as ten times higher than that outdoors because of the presence of internal sources. This emphasises the importance of indoor air quality – not only do we spend considerably more time indoors than out, but the range and concentration of pollutants inside buildings are often much greater than those found outdoors.*[31]

In addition, human activity can also create unpleasant odours and excess moisture; management of these can often exacerbate the problems of poor air quality.

This report, quoted above, also notes that measured levels of CO_2 or of total volatile organic compounds (VOCs) are useful indicators of indoor air quality.

1. Carbon dioxide (CO_2) and carbon monoxide (CO)

Carbon dioxide: this is the most common pollutant, the most significant and long lived greenhouse gas in the Earth's atmosphere. Inside buildings, levels of CO_2 can build up in the following ways, causing people to feel drowsy and fall asleep.

- Fuel burning appliances (e.g. open fires, wood burning stoves, charcoal BBQs, gas cookers) can use up the available oxygen resulting in an over-abundance of CO_2.
- Respiration by the occupants of a room can cause CO_2 levels to build up if the ventilation system is poor, i.e. windows and doors are shut or mechanical ventilation has been poorly maintained. This can happen with just a few people in a small room, if windows are shut and ventilation is poor.

Credit: PIKSEL

In care homes, living room windows are often shut. Residents become drowsy, which staff may attribute to their age and dementia. In reality, the CO_2 levels are likely to be far too high due to lack of fresh air and the number of occupants.

LESSONS LEARNED

For all of us and particularly older people and those with dementia, lack of fresh air can cause us to feel drowsy during the day – and then be unable to sleep at night. In a care setting, those who cannot sleep at night may be given drugs to help them sleep, when all that is needed is plenty of fresh air during the day.

Similar conditions have been reported in Australia:

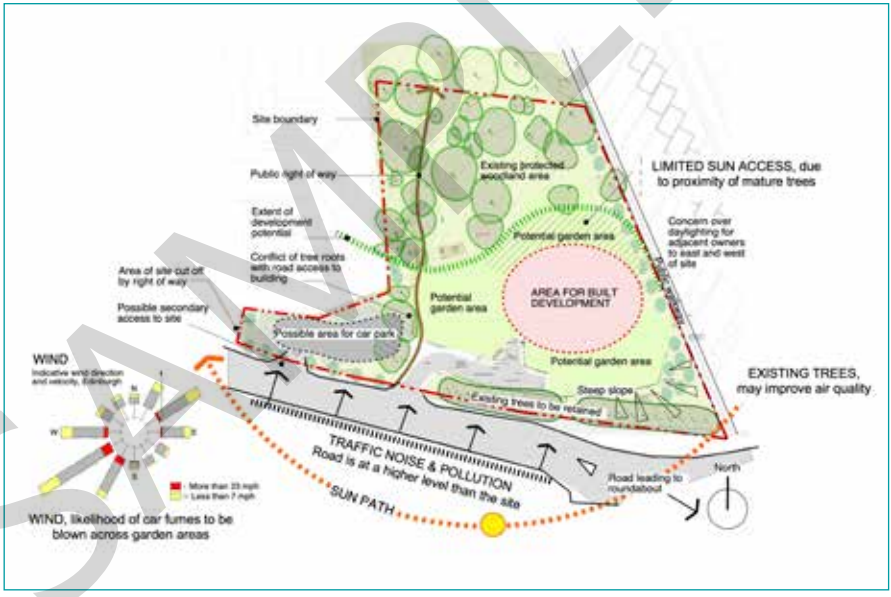
> *Project lead Associate Professor Priya Rajagopalan from RMIT's Sustainable Building Innovation Lab said surveys indicated that Australians spend more than 90% of their time indoors, yet the importance of indoor air quality was often overlooked.*[32]

> *Why are so many aged care residents and staff becoming infected with COVID-19? New research suggests poor ventilation may be one of the factors. RMIT researchers are finding levels of carbon dioxide in some nursing homes that are more than three times the recommended level, which points to poor ventilation.*[33]

Chapter 3

Design considerations and strategy

Discussions at briefing stage for new-build or refurbishing projects are essential to minimise pollutants in our buildings and to ensure that residents, staff and visitors will be comfortable.



Source: Annie Pollock

Factors which should be considered include site selection, minimising air pollution, building layout, thermal comfort, building materials, furnishings and ventilation.

1. Site selection

Because polluted outdoor air can enter buildings and degrade the quality of the indoor air that we breathe, there is much to be gained by building schools, hospitals etc. away from heavily polluted roads. A location's postcode can be used as a reasonable surrogate for exposure to certain outdoor pollutants.[50]

(Note: This report was updated in 2018, sadly noting that the air quality crisis is growing, not reducing).

At the outset of any building design or renovation, the design team should assess the local outside air quality and consider the building design in relation to this.

Interestingly, a very recent report (September 2020)[51] notes that: *'Asphalt-based materials are abundant and a major non-traditional source of reactive organic compounds in urban areas, but their emissions are essentially absent from inventories.'*

Asphalt has only recently been noted as a possible outdoor pollutant that can add to indoor pollutants, if windows and doors in proximity to an asphalted area are open. This research paper is based on US studies but is relevant world-wide. It notes the following:

> *Liquid asphalt is a petroleum-based product widely used in cities…urban areas comprised of 45%+ paved surfaces and 20% roofs.*
>
> *The total emission factor for primary road asphalt rose with temperature.*
>
> *The vast majority of asphalt is used outdoors, where solar radiation represents a major environmental factor.*

Clearly in hotter climates this poses greater issues – and should be taken into account in the siting and design of a building.

Recommendations:

- Consider climate, landform and geographical factors that may affect the local environment, for example, mountains, hills, flat ground, coastal or inland, forested or open; city or country location; local industry and planting (trees and shrubs). All of these can affect air temperature and quality.
- Site a building away from traffic-based pollution, e.g. noise, exhaust emissions and particles from tyre wear and brake linings. Even with electric cars, pollution will only be halved. When designing the building layout, avoid car parking or loading near residents' windows, doors or outdoor spaces for their use.
- Ideally choose a site near public transport routes, minimising the need for staff and visitors to use cars.
- The possible building layout and design should take into account sun angles and wind direction.
- Consider access to outdoor space or at least a balcony or terrace. For further information on this we refer you to an earlier publication, *The Room Outside*.[52]
- Ensure that outdoor spaces and living or bedroom windows do not open over large asphalted surfaces, especially in hot climatic areas.

Case study 1 – 'A home for life', Fortune Place, Edinburgh, Scotland

Architects: ***Smith Scott Mullan Associates 378 Leith Walk, Edinburgh EH7 4PE***
Client: ***Castle Rock Edinvar, 1 Hay Avenue, Edinburgh EH16 RW***

Credit: Smith Scott Mullan Associates

Our site is adjacent to Gilmerton Park (The Dell) which provides lots of open space and fresh air for recreation. Within our site, we created secure communal landscaped gardens to encourage movement, which contain seating, raised planters and access to an outside toilet to increase confidence in using the space. A Garden Room with kitchen and toilets was provided in the shared garden. This has large glazed screens so the room can be opened to the garden. The extensive use of glass gave people a visible connection to each other, to see if they want to be involved, or watch from a distance.

Credit: Castle Rock Edinvar, Amelia Jacobsen

Older people living in their own homes and the need for controls

It is generally recognised that there are many benefits for older people and those with early-stage dementia to remain, as long as possible in their own homes. However, we need to consider the issues that might affect them and how they might need assistance.

The following gives examples for consideration, when selecting windows:

- Some people may turn off heating or cooling appliances and be reluctant to open windows. Being economical with fuel bills can be very ingrained in older people's memories.
- Others may feel most comfortable by opening windows, which was common practice before the 1960s when fresh air was recognised as an aid to good health – yet be unaware of the weather conditions outside.
- Older people may have dulled temperature perception or impaired homeostasis and not recognise when their environment is too warm or cold.
- Someone living alone in their own home may have difficulty in removing or adding appropriate clothing or adjusting the indoor temperature by altering thermostat settings.
- Their homes may be less than functional due to lack of maintenance.
- If the outdoor environment is noisy, the resident may shut their window to sleep at night, so this needs to be considered at an early stage in the design process to include windows that allow ventilation even if closed.

Case study 7– HammondCare Darlinghurst inner city aged care, Australia

Architects: ***Integrated Design Group***

HammondCare Darlinghurst is a purpose-built, residential aged care home for older people experiencing homelessness, or at risk of homelessness, with high care needs.

Located in inner Sydney, Australia, the home helps fill a gap in existing services by providing permanent accommodation and high-level health care to those experiencing homelessness in an area where services are needed most – the inner city.

The five-storey building accommodates 42 private bedrooms with ensuite shower rooms. The building is divided into four apartments of 11 or 9 bedrooms each and each apartment has a dedicated domestic-style kitchen where all meals are prepared for the household, as well as a dining room, lounge areas and outdoor spaces.

The building and its interiors are designed to make residents feel comfortable and at home, especially those who require specialised dementia and psycho-geriatric care. The overriding purpose is to help restore dignity and maximise independence for its residents.

The inner-city location presented challenges to maximise airflow and access to the outdoors for residents. This challenge was addressed with the following measures:

- access to private balcony spaces in most bedrooms
- prioritisation of openable windows/french doors in bedrooms and living spaces
- use of glazed louvres to maximise air flow and give control to the residents
- use of folding-sliding doors to the courtyard and internal balconies – blurring the boundary between inside and outside
- use of a courtyard space increasing the external envelope and maximising cross-ventilation.

Each living area has direct balcony access

Attractive views encourage time spent outdoors (left). Central courtyard area provides green space and maximises air flow (right).