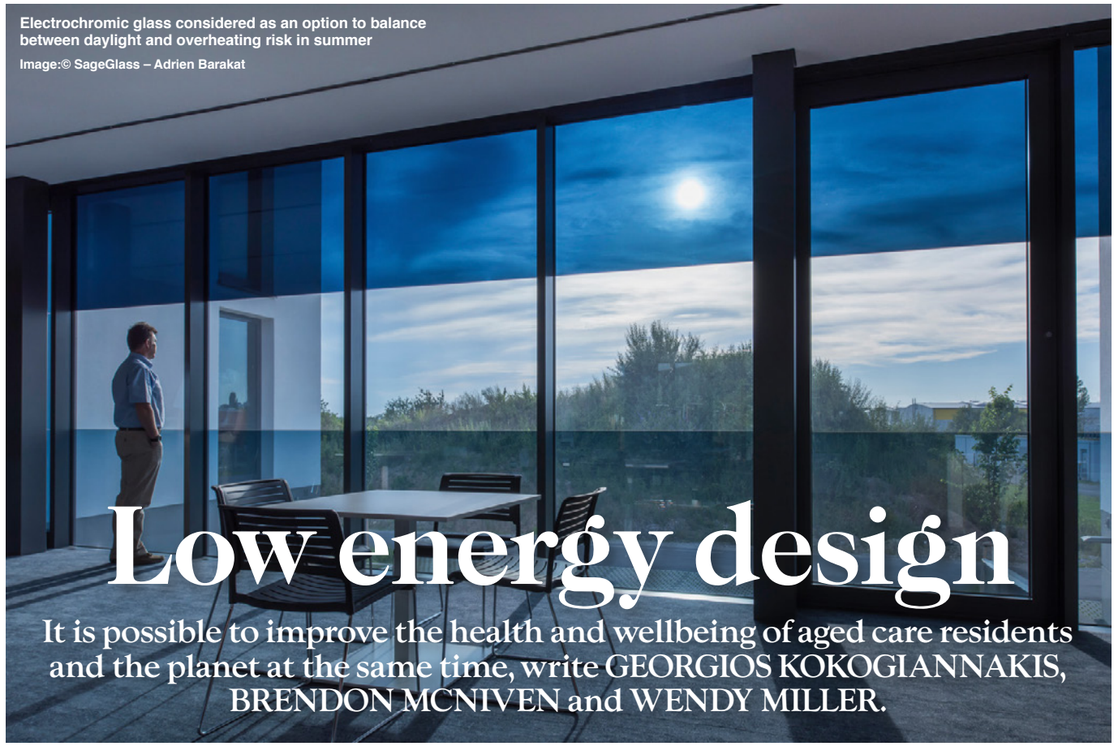

Electrochromic glass considered as an option to balance between daylight and overheating risk in summer

Image:© SageGlass – Adrien Barakat

Low energy design

It is possible to improve the health and wellbeing of aged care residents and the planet at the same time, write GEORGIOS KOKOGIANNAKIS, BRENDON MCNIVEN and WENDY MILLER.

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The focus on energy use and carbon in the built environment has never been higher. The building and construction sector is responsible for almost 40 per cent of all energy and process-related carbon emissions globally making action in this area a key part of achieving targets recently discussed at the Glasgow COP26 conference.

To help, the University of Wollongong, University of Melbourne and Queensland University of Technology have joined forces to address this through integrated design, which is the marrying of architecture and engineering to deliver better technical performance in buildings without compromising architecture.

The program has focused on a variety of building typologies including aged care facilities.

Our results show two key benefits. You can reduce the energy needed in the manufacture of the materials that make up the building (embodied energy) as well as that required for the operation of these facilities once constructed (operational energy). At the same time, you can improve the indoor air quality and environment, benefitting the health and wellbeing of aged care residents.

New and future building designs are expected to demonstrate high environmental performance and meet global sustainability targets for net zero carbon and net zero energy use. The successful delivery of such high performance designs is particularly challenging for aged care buildings.

Typically, low carbon design solutions will need to exclude gas while covering for energy loads that maintain essential functions in aged care facilities such as:

- appropriate thermal comfort options in the variety of settings
- cost-effective and reliable hot water provision for laundry, bathing, cooking and cleaning
- suitable building services solutions that support medical functions and maintain appropriate infection control.

Compromising an aged care home's operational functionality to reduce energy use and carbon emissions is not an option hence the need for integrated design. The concept involves architects, engineers and clients coming together from the start of early design discussions to co-design the facilities with technical solutions that are an integral part of the architecture.

There are of course barriers to this approach, such as traditional adversarial project procurement methods, collaboration challenges between architects and engineers and the client's distance from design teams.

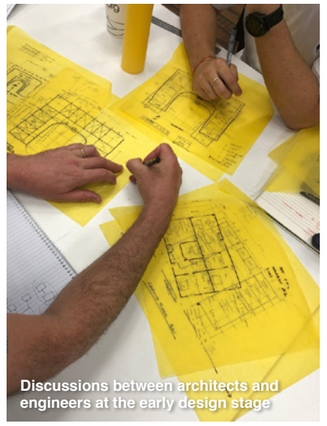
However, the benefits include the ability to address design complexity and introduce a plethora of innovative solutions early in the design process that pay back later in better performing buildings.

Our work is being carried out as part of the Innovation for Affordable Heating and Cooling initiative (i-HUB), initiated by the Australian Institute of Refrigeration, Air conditioning and Heating and funded by the Australian Renewable Energy Agency's Advancing Renewables Program.

Teams in each institution run an Integrated Design Studio (IDS) to apply and test the design process across four different aged care facilities covering three different climate zones. These design studies include:

- an aged care facility at the Health and Wellbeing Precinct being developed at the Innovation Campus of the University of Wollongong with IDS client Lendlease
- a greenfield site in the Melbourne suburb of Ringwood with IDS Client Active Community Group
- a brownfield site that is part of a staged development in sub-tropical Caboolture in Queensland with IDS client Bolton Clarke
- a greenfield site adjacent to an existing facility in tropical Cairns in Queensland with IDS client Bolton Clarke.

The four IDSs are essentially facilitated design workshops in a studio format. They include industry practitioners (practicing architects and engineers), academics and students working with the above clients on the aged care building designs, as pictured above.



Discussions between architects and engineers at the early design stage

Once the semester design work is complete, the consultants collate the technical findings into a vetting report assessing carbon outcomes. The process has proved to be very successful in facilitating sustainable design and delivering ideas that reduce operational and embodied carbon compared to business as usual.

Stakeholder feedback from clients, students, architects, engineers and academics has also been positive, recognising the potential integrated design methods offer for better design outcomes on projects.

Some of the design solutions produced include:

- vertical greening systems for the two climates in Queensland to provide energy and financial benefits from reduced cooling requirements as well as health benefits, especially for residents with dementia
- roof top solar combined with battery storage, super capacitors and potentially hydrogen powered generators
- evaluation of the complexity of choice of construction materials considering the competing needs for cyclone requirements in Queensland, longevity and embodied energy, including the impact of climate change
- integration of industry training and wellness facilities with aged care services
- electrochromic glazing (pictured opposite) to allow for maximising views, flexibility in window design and reduction in energy cost
- non-conventional heating, ventilation and air conditioning systems such as ground source heat pumps and two-pipe heat recovery VRF [variable refrigerant flow] systems. These systems enable energy to be moved around the building to recover sources of waste heat, and to draw energy through temperature differentials from sources such as the ground.
- cross-laminated timber (CLT) structure as a lower embodied carbon option, however, concerns about maintenance and fire regulations were raised in this case
- optimised air flows by using cross flow natural ventilation and an atrium in common spaces
- optimised passive solar principles of orientation, glazing and shading strategies from the start of the design using energy simulation tools in order to minimise heating and cooling loads and maximise daylight utilisation
- high-performance building fabric through enhanced thermal insulation performance (better thermal properties) of the façade systems, reduction in thermal bridging and control of airtightness.

In accordance with the ethos of integrated design, many of these design solutions result in improvement to the health and wellbeing of occupants.

Aged care residents are provided with access to the best indoor environment quality possible. Factors such as access to daylight, thermal comfort control, airtightness and well-designed ventilation systems improve the quality of life within the facility while reducing energy and carbon at the same time.

Overall, the IDS process has proven valuable for all participants and is now intended to become a permanent approach in the training of students at the three universities involved in this study.

It has empowered participants to overcome constraints in relation to their field of expertise – architecture and engineering – to improve technical outcomes and enable the architecture rather than compromising on it as is often the case.

The lessons learned can hopefully be put to use to benefit aged care residents' health and wellbeing as well as deliver lower carbon buildings to assist in combating climate change.

Project partners include clients Active Community Group, Bolton Clarke and Lendlease and architects Cox Architects and Place Design. The engineer and contractor partners are Arup, Atelier 10, Built Environment Collective, Hansen Yuncken, JHA Consulting, MI Engineers, Norman Disney & Young, Stantec Australia and WSP. ■

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