

Ventilation research a breath of fresh air

Nelson Mandela University studies how building design is key to healthy indoor air quality

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The global pandemic has put the spotlight on Nelson Mandela University's research into indoor air quality.

Department of construction management doctoral student Ashvin Manga and building science lecturer Chris Allen have been investigating the vital area of Indoor Air Quality (IAQ).

The World Health Organisation (WHO) reports that nine out of 10 people on this planet breathe air with high levels of pollutants, leading to sevenmillion deaths every year.

Many people are unaware, though, say Manga and Allen, of research showing that we tend to spend 90% of our day indoors, where air can be two to five times more polluted than outdoors.

Indoor humidity levels can also significantly increase virus transmission, relevant due to the ongoing coronavirus pandemic and a warming climate future, where increased evaporation will further increase water vapour in the atmosphere.

"It is vital therefore that the air we breathe within our built environment must be managed — and ventilation is a critical component to healthy indoor environments," Allen notes.

Furthermore, IAQ is not only humidity, it is also the temperature, ventilation, and chemical or biological contaminants, of the air inside buildings.

Fortunately, Manga and Allen have found that even a relatively simple action such as adding some windows that open can help to improve IAQ.

They say also that the climate in Nelson Mandela Bay, where they conducted their research, is conducive to relatively inexpensive "passive design". This means buildings can have a strong reliance on natural ventilation to achieve healthy indoor air quality metrics. A former medical student, Manga has made sustainability and occupant wellbeing his overarching research area.

His BSc honours research, titled "Implications of a natural ventilation retrofit," was awarded the highly commended award in Building Performance.

His masters research involved the development of a computer vision application that counts the number of students in a lecture room, using CCTV cameras for improved air quality and facility management.

His doctoral research is similarly targeted to being in service of society, while adding to the field of knowledge in construction management.

"The challenge with managing IAQ is that most of the factors that reduce IAQ are odourless, which means in many cases there is nothing to alert you to the problem," Manga said.

"Your only alert is when it is already too late and you are already experiencing an asthma flare-up, sleepiness or fatigue."

In the commercial office space, this is called "sick building syndrome" and, as the working world starts to return to the office, it is a key area to address. "From a developer's standpoint, questions should be asked about design, for example, are we moving away from open-plan offices back to cubicles or will offices be a place of collaboration and thus boardrooms will become the new office layout?" Manga asked.

"There is data to suggest both outcomes.

"One thing is certain, whatever new developments take place, they will need to be future-proofed and certainly be able to withstand an airborne pathogen such as the virus that created the Covid-19 pandemic."

Manga said this was less of an issue for developers than for owners of existing commercial stock.

"There is more than Covid19 to think about when retrofitting an existing building for future needs.

“Climate change reform is soon to be policy and deep energy retrofits will most likely be in demand as owners scramble to comply with new regulations.”

As part of his BSc honours construction management treatise at Nelson Mandela University, Manga captured data on the change in indoor air quality before and after a mechanically ventilated office building was retrofitted with windows that could open.

The increased ventilation significantly improved the carbon dioxide levels, as captured by a medical grade air quality device.

“The top three symptoms troubling employees were tiredness, poor concentration and nasal congestion, all symptoms of an inadequately ventilated office.

After the window retrofit, we saw an 18% reduction in tiredness, 21% reduction in poor concentration and 26% reduction in nasal congestion.”

This showed that natural ventilation retrofits can be a solution for many office buildings in SA.

A first step, however, to improving the management of indoor air quality is to use an IAQ monitor for accurate measurement.

This would cost in the region of R2,000 which, Manga said, should be offset against the price of, for example, frequent and ongoing sick days due to exhaustion or poor health.

“People don’t associate their fatigue with carbon dioxide levels that are too high,” Manga said.

“They think perhaps they never had a good night’s sleep, it’s Monday blues, or ‘I need another cup of coffee’.

“It’s seldom that people think air we breathe is negatively impacting our health.

“But you’ll be surprised, even in your home after you’ve cooked a meal in your kitchen.

“If that space is not being ventilated adequately, the stale air has nowhere else to go and it just builds up.”

Manga’s ongoing research is part of the drive by the faculty of engineering, the built environment and technology to combine top facilities, state-of-the-art technology and stimulating training to produce highly sought-after graduates.

Allan said: “[Nelson] Mandela University has a core focus on building safety, which means that IAQ is hugely important to the air we breathe within our internal built environment.

“Research areas therefore now include the maintenance of social distancing using AI and CCTV cameras, and the role of poor air quality in viral spread. Other research topics, among others, include improvement in construction methodology, human settlements and waste management.”