

A Selection Of Documented Benefits of Ventilation

Breezway Technical Bulletin

7 August 2020

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Background

The benefits of ventilation are generally self-evident, everyone has enjoyed a cooling breeze from an open window, but it is harder to put facts and figures to what we know intuitively to be good. With a bit of searching though, data and evidence can be found that prove the benefits of improved ventilation.

Data and Evidence On The Benefits Of Increased Ventilation

Decreased Energy Consumption

- A study of 39 offices at Sydney University in 2002 identified annual energy savings on heating and cooling of 79%
David Rowe and Cong Truc Dinh (2001) An Experiment with Hybrid Ventilation: A More Sustainable Approach To Thermal Comfort. Architectural Science Review, Vol 44, Iss. 2, 2001.
- A 2001 study of 18 UK buildings identifying an average of 52% measured annual savings in heating and cooling energy.
Bunn R. and Cohen, R. (2001) Learning from PROBE, Building Services Journal, May 2001.
- In 2001 the CSIRO calculated that in a 12 hour a day building, mechanical cooling is not necessary 48% of the time
Quoted in "Emerging technologies in ventilation" by Dr Mark B Luther and Dr Zhengdong Chen in TEC12, Nov 2002

Occupant Comfort In Naturally Ventilated Buildings

- Research undertaken across thousands of users in an assortment of building types in different climatic zones around the world shows those users of naturally ventilated and hybrid buildings are more comfortable than or at least as comfortable as, users of an airconditioned buildings.
(De Dear, Nicols, Roaf et al)
- "In an airconditioned building with comfort levels controlled through the commonly used temperature set points, there will always be 10-15 per cent of occupants dissatisfied.
- The empirical research undertaken worldwide across a range of climates and buildings indicates a naturally ventilated facility will have around the same levels of user dissatisfaction."
"Making the building do the work: Natural ventilation design" by John Brodie, published on thefifthestate.com.au
- "Occupants in naturally ventilated buildings were tolerant of a significantly wider range of temperatures explained by a combination of both behaviour adjustment and psychological adaptation."
Gail S. Brager, Richard de Dear, 2000
- "Studies by Humphreys and Fergus Nicol... ..suggested that the indoor temperature preferred by occupants around the world varied according to the current outdoor temperature. In other words, during the hotter summer months, an office worker would prefer a warmer indoor temperature than he or she would in the winter."
"The comfort zone" by Nancy B. Solomon, AIA, Greensourcemag.com March+April 2011

Improved Health

- A model was developed using previous studies (primarily in office buildings) relating building ventilation rates, perceived air quality, and temperature to occupant symptoms and productivity. The model estimates that increasing the average ventilation rate from 0.45 to 1.0 air exchanges per hour would reduce the sick leave used by office workers from 5 days per year to 3.9 days per year.

Seppanen OA and Fisk WJ 2005. Some quantitative relations between indoor environmental quality and work performance or health. Proceedings of Indoor Air 2005, 10th International Conference on Indoor Air Quality and Climate, Beijing, China. Beijing China, Tsinghua University Press.
- It is estimated that increasing the average ventilation rate from 0.45 to 1.9 exchanges per hour would reduce the sick leave used by office workers from 5 days per year to 3.9 days per year.

Seppanen and Fisk (2005) used previous studies (primarily in office buildings) to develop a model relating building ventilation rates, perceived air quality, and temperature to occupant symptoms and productivity.
- A study across 434 classrooms from 22 schools showing that carbon dioxide levels (an indicator of ventilation rates) 1,000 parts per million above the outdoor concentrations of carbon dioxide was associated with 10 to 20 percent increases in student absences.

Shendell DG, Prill R, Fisk WJ, Apte MG, Blake O and Faulkner D 2004b. Associations between classrooms' CO₂ concentrations and student attendance in Washington and Idaho. *Indoor Air* 14:333-341.
- A German study of multiple buildings identified a 33% reduction in reported headaches and a 28% reduction in reported frequency of head colds in naturally ventilated office buildings as compared to air conditioned office buildings.

Kroeling, P. (1998). Health and well-being disorders in air conditioned buildings; comparative investigations of the "building illness" syndrome. *Energy and Buildings*, 11(1-3): 277-282.
- A case study of office workers moved from a building with sealed windows and mechanical ventilation to a building with operable windows and natural ventilation identified a 71% reduction in absenteeism.

Sterling, E. and Sterling, T. (1983) The Impact Of Different Ventilation Levels and Fluorescent Lighting Types on Building Illness: an Experimental Study. *Canadian Journal of Public Health*, Vol 74, Nov/Dec 1983.
- A laboratory study showed that the performance of simulated office work was increased by 6 to 9 percent by the removal of common indoor sources of air pollution by increasing the clean air ventilation rate from 3 to 30 L/s per person. These laboratory findings were then confirmed during an 8-week field investigation.

Wyon DP (2004) The effects of indoor air quality on performance and productivity. *Indoor Air* 14(Suppl 7):92-101.
- A study of 3,720 hourly employees of a large Massachusetts manufacturer in 40 buildings with 115 independently ventilated working areas, the researchers found a consistent relationship between the rate at which outdoor air was supplied for ventilation and the amount of sick leave taken.

Milton K, Glenross P and Walters M 2000. Risk of sick leave associated with outdoor air supply rate, humidification, and occupant complaint. *Int. J. indoor Air Qual. Clim.* 10:211-221.
- In a study in a hot and humid climate, researchers found that students attending naturally-ventilated child care centres had lower levels of asthma symptoms and allergies than those in air-conditioned child care centres.

Zuraimi, M.S., Tham, K. W., Chew, F.T., & Ooi, P.L. (2007). The effect of ventilation strategies of child care centres on indoor air quality and respiratory health of children in Singapore. *Indoor Air*, 17(4), 317-327.

Improved Learning Outcomes/Productivity

- **Children in classrooms with higher outdoor air ventilation rates tend to achieve higher scores on standardized tests in math and reading than children in poorly ventilated classrooms.**
Shaughnessy, R., U. Shaughnessy, et al. 2006. "A preliminary study on the association between ventilation rates in classrooms and student performance." *Indoor Air* 16(6):465-468.
- **One international review of 30 green schools, Greening America's Schools: Costs and Benefits, found that green schools and universities deliver:**
 - 41.5% improvements in health of students and teachers (such as reduced incidence of asthma, 'flu, respiratory problems and headaches),
 - Up to 15% improvement in student learning and productivity,
 - Up to 25% improvement on test scores from good lighting and ventilation.

<http://www.gbca.org.au/resources/greening-your-school/why-green-our-schools/a-healthy-and-productive-place-to-learn/2152.htm>
- **Controlled studies show that children perform school work with greater speed as ventilation rates increase. The performance of adults, including teachers and school staff, has also been shown to improve with higher ventilation rates.**
Wargocki, P., D.P. Wyon, et al. 1999. "Perceived air quality, SBS-symptoms and productivity in an office at two pollution loads." *Proceedings, Indoor Air '99: The 8th International Conference on Indoor Air Quality and Climate*. Edinburg, Scotland.2:131-136.
Wargocki, P., D.P. Wyon, et al. 2000. "The effects of outdoor air supply rate in an office on perceived air quality, sick building syndrome (SBS) symptoms and productivity." *Indoor Air* 10(4):222-236.
- **A European Multidisciplinary Scientific Consensus Meeting reviewed the scientific literature on the effects of ventilation on health, comfort and productivity in offices, schools, homes and other nonindustrial environments. The group agreed that ventilation is strongly associated with comfort and health and found an association between ventilation and productivity (performance of office work).**
Wargocki P, Sundell J, Bischof J, Brundrett G, Fanger PO, Gyntelberg F, Hanssen O, Harrison P, Pickering A, Seppanen OA and Wouters P. 2002. Ventilation and health in non-industrial indoor environments: Report from European Multidisciplinary Scientific Consensus Meeting (EUROVEN). *Indoor Air* 12:113-128.
- **A 2005 study of 10-year-old school children showed that increasing ventilation rates could improve the children's performance in tasks representing eight different aspects of schoolwork, from reading to mathematics.**
Wargocki P, Wyon DP, Matysiak B and Irgens S 2005. The effects of classroom air temperature and outdoor air supply rate on the performance of school work by children. *Proceedings of Indoor Air 2005*. Beijing, China: Tsinghua University Press.
- **A literature review by Mendell and Heath found evidence suggesting a link between low outdoor ventilation rates in buildings and decreased performance in children and adults.**
Mendell MJ and Heath GA 2004. Do indoor pollutants and thermal conditions in schools influence student performances? A critical review of the literature. *Indoor Air* 15:27-52.

- **A study in eight English primary schools of over 200 pupils showed significantly faster and more accurate standardised test responses (by up to 15%) when classrooms had high ventilation rates compared with low ventilation conditions.**
Bako-Biro Zs, Clements-Croome DJ, Kochhar N, Awbi HB and Williams MJ 2011. Ventilation rates in schools and pupils' performance. *Building and Environment* 48 (2011) 1-9.
- **A University of Sydney study showed an 18% improvement in perceived productivity.**
David Rowe and Cong Truc Dinh (2001) An Experiment with Hybrid Ventilation: A More Sustainable Approach To Thermal Comfort. *Architectural Science Review*, Vol 44, Iss. 2, 2001.

Reduced Transmission Of Infectious Illnesses

- **A study comparing the ventilation rates of 70 naturally ventilated clinical rooms to 12 mechanically ventilated respiratory isolation rooms in hospitals in Peru found that natural ventilation provided much larger ventilation rates than mechanical ventilation system did, even at low wind speeds. Greater ventilation rates lower the risk of airborne contagion and is particularly suited to limited-resource settings and tropical climates.**
Escombe AR, Oeser CC, Gilman RH, et al. Natural ventilation for the prevention of airborne contagion. *Plos Med* 2007;4:e68. 10.1371/journal.pmed.0040068
- **An investigation into the infection risk of health care workers in different wards with different window sizes in two hospitals during the 2003 SARS outbreak in Guangdong found that larger ventilation windows showed a lower infection risk.**
Jiang S, Huang L, Chen X, et al. Ventilation of wards and nosocomial outbreak of severe acute respiratory syndrome among healthcare workers. *Chin Med J (Engl)* 2003;116:1293-7
- **Researchers concluded that there is strong and sufficient evidence to demonstrate the association between ventilation, air movements in buildings and the transmission/spread of infectious diseases such as measles, tuberculosis, chickenpox, influenza, smallpox and SARS.**
Li Y, Leung GM, Tang JW, et al. Role of ventilation in airborne transmission of infectious agents in the built environment - a multidisciplinary systematic review. *Indoor Air* 2007;17:2-18. 10.1111/j.1600-0668.2006.00445.x
- **Researchers modelled the theoretical spread of an outbreak of influenza through both contact and airborne droplet routes. Their results showed that building ventilation rates can have significant effects in airborne transmission-dominated conditions. Moreover, even when the airborne route only contributes 20% to the total infection risk, increasing the ventilation rate had a strong influence on transmission dynamics, and it also could achieve control effects similar to those of wearing masks for patients, isolation and vaccination.**
Gao X, Wei J, Cowling BJ, et al. Potential impact of a ventilation intervention for influenza in the context of a dense indoor contact network in Hong Kong. *Sci Total Environ* 2016;569-70:373-81. 10.1016/j.scitotenv.2016.06.179

Maximising Ventilation

The most obvious way to increase ventilation is to increase the ventilation openings in a room. With no fixed panes and blades that open to almost 90 degrees, Altair Louvre Windows offer ventilation through the entire window area.

