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In the early and mid-1900's indoor air quality, CO2 levels, and air contamination were not fully understood. An airflow rate of approximately 15 CFM of outside air per person was used mostly to control odors. However, during the oil embargo of 1973, outside air was reduced to 5 CFM per person to reduce energy usage. While this was very effective at reducing the building energy consumption, it caused a large increase in the number of people getting sick. The cause was determined to be "Sick Building Syndrome" (cite article 1).

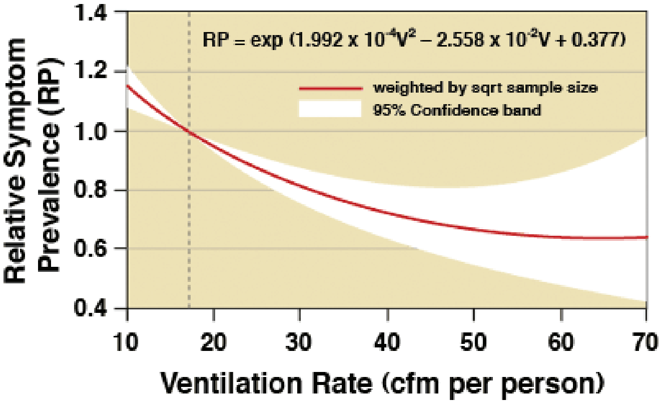
Sick Building Syndrome is a term used when occupants experience health issues as a result of spending a prolonged time in a building. There are many symptoms associated with a Sick Building that can negatively impact its occupants and overall work environment. The symptoms include "Headache, dizziness, nausea, eye, nose or throat irritation, dry cough, dry or itching skin, difficulty in concentration, fatigue, sensitivity to odors, hoarseness of voice, allergies, cold, flu-like symptoms, increased incidence of asthma attacks and personality changes" (cite article 2).

The reason for the increase in the number of occupants experiencing health issues is the lack of fresh air to dilute the concentration of contaminants. As a result, the contaminant concentrations continued to increase in the building, leading to the increase in number of occupants with health issues. In 1989, ASHRAE Standard 62 was revised to increase the minimum outside air flow rate to 15 CFM per person for general building use, 20 CFM per person for office spaces and up to 60 CFM per person depending on the space application (see ASHRAE Standard 62-1989).

This helped to reduce the number of cases of Sick Building Syndrome but did not eliminate it. In most modern buildings, between 10% to 20% of the occupants will experience sick building syndrome symptoms (cite article 3). This percentage is higher if the air quality is contaminated or the HVAC system is poorly designed. As a result, employers are seeing a reduction in occupancy comfort, employee happiness and employee productivity.

However, there is a way to reduce the amount of employees experiencing Sick Building Syndrome. In a review of 27 studies by an Indoor Air Quality Research Group, they found a direct correlation between increasing in the outside air flow rate and lowering the number of Sick Building Syndrome cases (cite article 5 and corresponding reference 23). A further review by an interdisciplinary group from Europe found that an outside air ventilation rate of 53 CFM per person can significantly reduce the number of cases (cite article 5 and corresponding reference 37). The largest U.S study of 100 representative office buildings found 20-30% reductions in Sick Building Syndrome cases in buildings with 20-25 CFM per person vs 15-20 CFM per person (cite article 5 and corresponding reference 45). An analysis of the data in the study resulted in Figure 1 showing the correlation between the number of employees with symptoms and ventilation rates (cite article 5 and corresponding reference 46 & 47).

Figure 1




This analysis means that small changes in air exchange rates can have a large impact on employee health. To help mitigate the spread of Covid-19, the CDC is recommending "employers should work with facility maintenance staff to increase air exchanges in room" (cite article 4). Unfortunately, most existing HVAC systems cannot be adjusted to suddenly increase the outside airflow rate. However, adding a make-up air unit to an existing HVAC system to supply neutral outside air to a space can improve occupancy comfort without increasing the heating or cooling load on the existing HVAC system. A programmable thermostat can be used to turn on the make-up air unit shortly before occupancy and off at the end of business to minimize the impact on the building operating cost while ensuring a healthier environment for building occupants. This will lead to an increase in employee health, happiness and productivity.

References

1. https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2796751/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1568418/?page=1
4. https://www.cdc.gov/coronavirus/2019-ncov/community/critical-workers/implementing-safety-practices.html
5. https://iaqscience.lbl.gov/vent-syndrome

[23] Seppänen, O.A., W.J. Fisk, and M.J. Mendell, *Association of ventilation rates and CO2 concentrations with health and other responses in commercial and institutional buildings.* Indoor Air, 1999. 9(4): p. 226-52.

[37] Wargocki, P., et al., Ventilation and health in non-industrial indoor environments: report from a European multidisciplinary scientific consensus meeting (EUROVEN). Indoor Air, 2002. 12(2): p. 113-28.

[45] Mendell, M.J., et al., *Outdoor air ventilation and work-related symptoms in U.S. office buildings - results from the BASE study.* LBNL-56381. 2005, Lawrence Berkeley National Laboratory: Berkeley, CA.

[46] Fisk, W.J., A.G. Mirer, and M.J. Mendell, *Quantitative relationship of sick building syndrome symptoms with ventilation rates.* Indoor Air, 2009. 19(2): p. 159-165.

[47] ASHRAE, ANSI/ASHRAE Standard 62.1-2010. *Ventilation for acceptable indoor air quality.* 2010, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.: Atlanta, GA.

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