#4014

Ventilation for people *and* buildings

Pollution in buildings is not just due to occupants – the buildings themselves make a major contribution. New research has developed an approach to determing ventilation rates that takes this into account.

Buildings pollute their own air more than the people in them. That surprising conclusion is the result of research by Professor P. O. Fanger and calls into question fixing a building's ventilation requirements according to the number of occupants. It also indirectly challenges the modern energy efficient practice of providing minimal fresh air when a building is unoccupied.

> *"For every occupant, the building itself produces air pollution equivalent to another six"*

Professor Fanger looked at the air quality in both occupied and unoccupied buildings and found that, on average, for every occupant, the building itself produced indoor air pollution equivalent to another six.

To provide a scientific approach to assessing ventilation requirements he introduced two new measures of pollution.

One is the *olf*, a unit of pollution load that is equivalent to one person. If that person smokes, he represents a further 5 olf of pollution – bringing the total to 6 olf.

The other new unit is the *pol* – a measure of air pollution. For practical purposes the *decipol* (0.1 pol) is normally used. As air pollution increases, so the number of decipols increases. Conversely, as air quality improves, the number of decipols decreases, so that decipols also provide a measure of air quality.

The measure of air quality is achieved by a judgement by a panel. The extremes of outdoor air quality are on mountains or at sea (0.01 decipol) and during a smog (greater than1 decipol). In cities with moderate air pollution, the outdoor air quality ranges from 0.05 to 0.3 decipol.

Professor Fanger has derived a mathematical equation for perceived indoor air quality which, although mathematically quite complex*, produces a number that can be used to determine the ventilation rate required. The equation is based on the percentage of people dissatisfied with the indoor air quality and produces the following results for indoor air quality.

5% – 0.31 decipol.
10% – 0.61 decipol.
20% – 1.41 decipol.
30% – 2.53 decipol.

Before Professor Fanger's new approach can be used, the pollution load on the ventilation system presented by the building needs to be known. A field study of 15 randomly selected buildings in Copenhagen found a pollution load ranging from 0.1 to 0.9 olf/m², with an average of 0.4 olf/m². This data is used to calculate ventilation rate using the equation

$Q = 10G\,(C_i - C_o)$

where Q is ventilation rate in l/s, G is total pollution sources in olf, C_i is perceived indoor air quality in decipol, and C_o is perceived outdoor air quality in decipol.

Ventilation rate

A target for indoor air quality is 1.4 decipol, amounting to 20% dissatisfied as specified in a new ASHRAE ventilation standard (62 – 1989). Assuming one person per 10 m² in an office building, a building pollution strength of 0.4 olf/m², no smokers and unpolluted outdoor air suggests a ventilation requirement of 3.6 l/s/m² – or 36 l/s per person in this example. Allowing for 20% smokers, the ventilation requirements becomes 43 l/s per person. Increasing the density of occupation to one person per 5 m² and assuming non-smokers, the ventilation requirement becomes 21 l/s per person.

These figures are very much more than the ASHRAE specification of 8 l/s per person. They are even considerably more than the 14 l/s per non-smoking person in a DIN standard for large offices.

An alternative to providing these high rates is to reduce the pollution load of the building itself to, say, 0.1 olf. Such a building, with an occupancy of one person per 10 m² and 20% smokers, would have a ventilation requirement of 21.4 l/s per person, which is near to a DIN standard for large offices housing smokers.

Higher rates

This approach to calculating ventilation requirements is said to be the first to recognise all sources of pollution in buildings – not just people and smokers. That is why it leads to higher ventilation rates. □

*$C_i = 112\,[\ln PD - 5.98]^{-4}$
C_i is the perceived indoor air quality in decipols, and PD is the percentage of people dissatisfied.

Upstanding services from Denco's Airlighter

With the use of buildings and spaces within them changing frequently comes the need for services to be reorganised simply and quickly. An answer to this need is provided by Denco's Airlighter system, which combines air conditioning, uplighting, raised access flooring, data, power, telecommunication cable management systems, services distribution and acoustic ceiling.

Bases on underfloor distribution of air and electrical services, the system provides easily relocatable air distribution, with all lighting and cable outlets at the floor surface. It eliminates any need for ceiling voids, with the attendant difficulties in servicing and maintenance.

Conditioning air is distributed from the floor cavity upwards through the 1.8 m-high vertical almunium column of the Airlighter. The cylindrical unit is fixed to a floor panel; it can be repositioned simply by interchanging it with another floor panel.

The air-conditioning system is designed for each project. The standard air-handling unit provides 14.5 kW of cooling and designed to operate at low noise (NR40).

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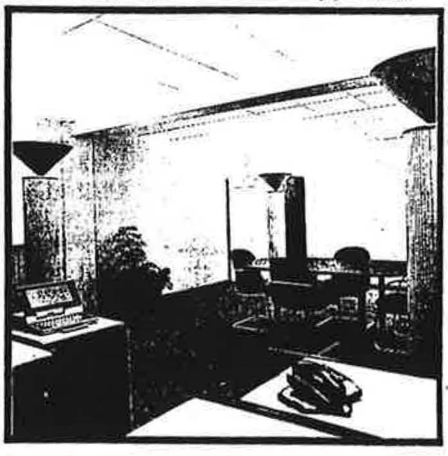

Serviced from under a raised floor, Denco's Airlighter columns can easily be repositioned as required.