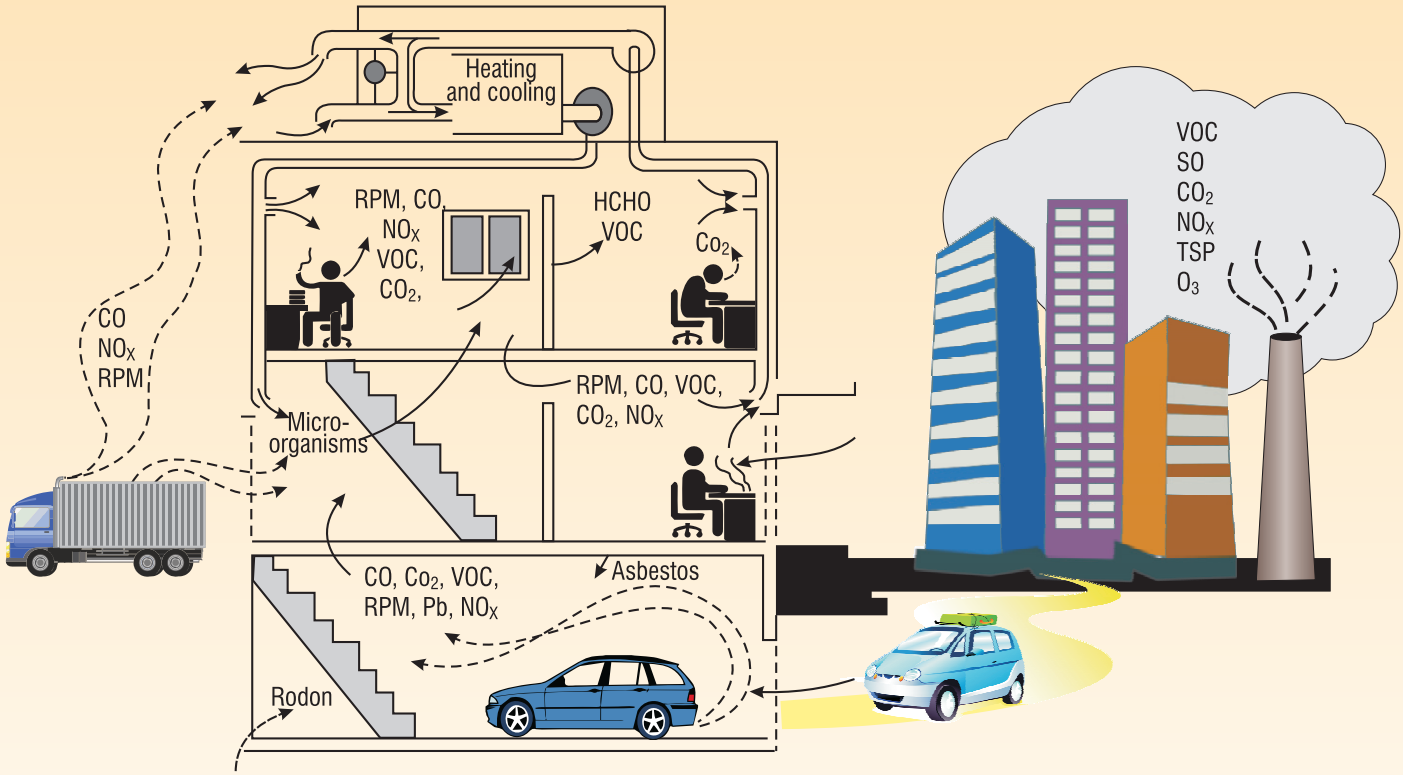

CO=carbon monoxide; CO_2=carbon dioxide; HCHO=Formaldohyde; NO_x= nitrogen oxides; Pb=leod; RPM=respirable particulate matter, VOC = volatile organic compounds.

Residential Demand Controlled Ventilation

By Makarand Kendre
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Introduction

Indoor air is polluted by a number of sources: occupants (breathing, sweating), their activities (cooking, showering, heating, smoking), and by the building itself and its furnishing (radon, volatile organic compounds, paint, glue, varnish, detergents, etc.).

Consider the following facts:

- A new building has 3000 to 5000 litres of humidity, and humans produce about 1 litre of sweat every day during normal activity.
- If humidity is above 75% for more than 72 hours, there will be mould in the building.
- Dust mites increase exponentially with increase in humidity, and they are the main cause of allergies.
- The concentration of all these pollutants indoor can be 2 to 5 times worse than outdoor levels, occasionally even much higher.
- The CO_2 level in an average room will reach an unhealthy level in 3 hours if the room is not ventilated adequately.
- Radon is a dangerous radioactive gas, and is widely found in houses.
- One does not see these pollutants, but they are there and they have an impact on occupant health if action is not taken to get them out of the building.
- 16% of all heath spending is related to air quality.

With the increasing trend towards airtight construction, there are problems of humidity, CO_2 and various other substances staying inside the building if adequate ventilation is not provided. Excessive insulation and inadequate ventilation create dead

About the Author

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and stale air that accumulates mites, moulds, viruses, bacteria, moisture and harmful chemicals. It has been proven that breathing large amounts of these pollutants for even a short period affects occupant health, causing irritation of eyes, nose and throat, headache, sickness and other issues as well as comfort problems like odours, condensation and moisture. Thus, it is necessary to ventilate buildings regularly and properly.

Ventilation

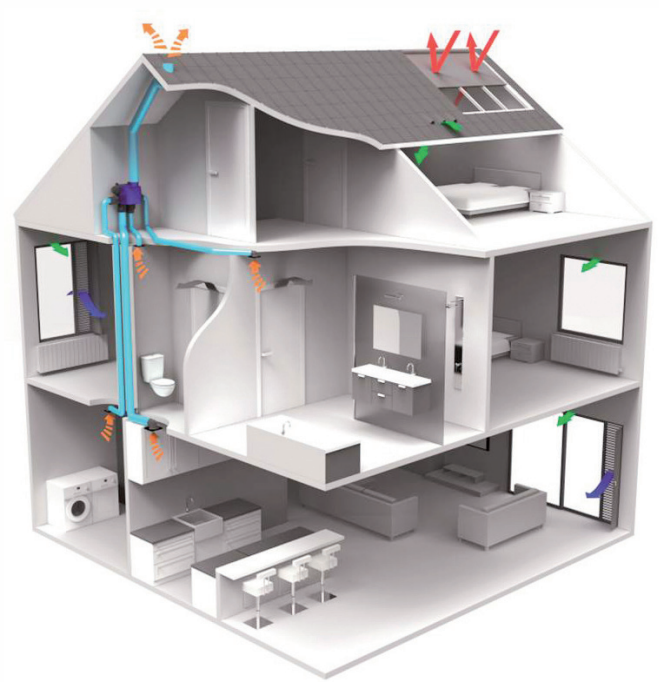
Humans need about 20 m^3 of fresh air to feel well. Fresh air, full of oxygen, gives energy, improves concentration and avoids sleepiness. In the past, ventilation was not a significant issue, as most of the old buildings had their own 'natural' ventilation through cracks in the construction. Today, our buildings are constructed as airtight as possible, and architects and builders need to include elements that address the indoor air quality.

It is commonly believed that opening windows from time to time is sufficient. However, the effect of opening windows is only temporary and ventilation through open windows is uncontrollable and, therefore, energy-wasting. In addition, it leads to other problems such as noise, risk of burglary, intrusion of insects, etc. Many buildings are also equipped with air conditioning. The overriding desire for energy saving leads to the air conditioning system being starved of fresh air by those responsible for building operation and maintenance. As a result, pollutant concentration in the conditioned space increases. Controlled ventilation, 24 hours a day, is essential to obtain good indoor air quality and healthy inner climate.

The A, B, C, C+, D of Ventilation

In general, there are 4 ways of ventilating a residence, all of them based on the same three principles:

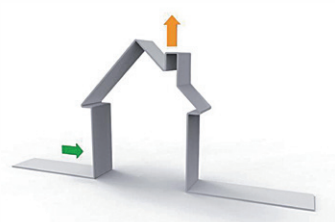
- Supply of fresh air to dry rooms, such as the living room and the bedroom.



- Circulation of air through the residence via halls by means of louvres in the doors.
- Extraction of polluted air from the wet areas, e.g. toilet, kitchen and bathroom.

These ventilation systems are classified by the way air is supplied and extracted.

A: Natural Supply and Extraction



This is the easiest and most economical way of ventilating, which does not always respect the standards. The circulation of air happens in a natural way based on the differences in pressure. Air enters the residence through adjustable openings in windows, walls or the roof. These openings are adjustable as they can be opened or closed just a little bit. This way, one can prevent ventilation from going into overdrive during windy days. Some of these openings are self-regulating, which means they determine the volume of supplied air depending on the weather. Slits under doors allow the air to circulate through the residence, ending in the wet rooms, from where it is extracted in a natural way by means of adjustable extraction openings.

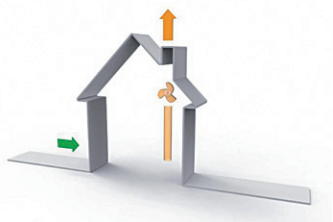
B: Mechanical Supply and Natural Extraction

In ventilation system B, fresh air is supplied mechanically and is circulated throughout the residence via integrated ventilation channels. The mechanical supply of air causes a chimney effect, resulting in the automatic extraction of air in a natural way. Combining mechanical supply with natural extraction, this system can be used to ventilate high noise level areas or places where

odours can appear. The supplied air can be directed through a filter before entering the residence. This kind of ventilation is, however, rarely employed because it consumes a constant amount of electrical energy irrespective of the amount of fresh air required.

C: Natural Supply and Mechanical Extraction

This system can be easily integrated into new and renovated buildings. The installer has to integrate only a few ducts and, apart from the regular maintenance of extraction louvres and the self-regulating window vents, no other maintenance is needed.



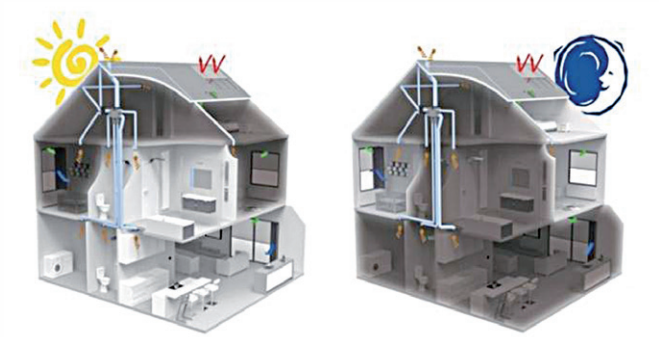
C+: Natural Supply and Demand Controlled Extraction

Ventilation system C+ combines a constant supply of fresh air through self-regulating vents and its transit via door grilles with the extraction on-demand of polluted air in the wet as well as dry rooms. A central extraction unit with a powerful motor equipped with control modules ensures proper ventilation of all connected room at all times.

Demand controlled extraction or C+ means that there will be more ventilation in rooms with higher occupancy and activity levels. When the occupants are watching television in the living room, for example, the extraction level from the living room is raised. When they go to sleep, the extraction from the living room is reduced and more polluted air is extracted from the bedrooms. The ventilation system, thus, follows the movement and activity of the residents.

The difference between C and C+ is that extraction is controlled by demand in the latter, using modulating extraction louvres. The ventilation level adapts to the occupancy level in each room and the activity. As the ventilation level is not higher than really needed, energy consumption can be optimized. This kind of system uses a central extraction unit, combined with extraction louvres in the various wet rooms.

As an example, when an occupant gets up in the morning and goes to the toilet, the sensors call for an immediate increase in the ventilation level there. When the occupant moves from the toilet to the bathroom to take a shower, the sensors detect the increase in humidity and automatically adapt the level of ventilation in both the rooms. When the occupant goes to work, the ventilation is reduced to a minimum.



DCV can be extended to the bedroom also. Since bedrooms are seen as dry rooms, normally only the supply of fresh air would be integrated, not extraction. By adding extraction from the bedroom to remove CO_2, humidity and other pollutants, conditions are created for a restful sleep. As excessive amount of CO_2 has a negative effect on the quality of sleep, it is important to not only extract CO_2 from the wet rooms, but also from the bedrooms. Therefore, it is necessary to adapt the ventilation level to the needs of the residents in an intelligent manner, based on CO_2, humidity and/or VOC level measurement through dynamic sensors. Demand controlled ventilation is, therefore, useful to achieve optimal air quality without excessive energy costs.

In order to prevent draughts, it is advisable to use self-regulating window vents. The more the wind, the more the valve closes, resulting in constant volume of air supplied at all times. For residences along a road with a lot of traffic, one can use acoustic window vents to shut out the disturbing noise.

D: Mechanical Supply and Mechanical Extraction

System D is based on the mechanical supply and extraction of air by means of ventilators. Both, the supply and extraction, can be controlled, but one needs to have a double duct net: one for supply to the dry rooms, and one for extraction from the wet rooms. In most cases, systems with heat recovery are used. The supplied air is then cooled/heated using the temperature difference with the extracted air. This system has its advantages in some cases, but is more expensive due to the need for more ducts, and the maintenance and change of filters on a regular basis.

Conclusion

Demand controlled ventilation (DCV) allows air to be circulated according to a residence's use and occupancy. DCV uses sensors to monitor and measure ambient conditions and feed real-time data back to a controller, which adjusts the fan speed modulating the ventilation rate to match the use and occupancy of the residence. Ventilation rates are kept to a minimum in rooms that are not occupied. Ventilation is increased when people are entering a specific area of the residence. This results in good air quality in every room and reduces energy use significantly. ❄