AIC 21

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ARE WE GETTING OUR VENTILATION ALL WRONG?

The value of windows has been re-appraised in recent years as a function of the demands being made for heat insulation. The aim has been to cut down heat losses occasioned by the processes of transmission and joint ventilation (infiltration due to wind pressure), and this aim has been largely achieved by the use of heat insulating panes and sections and by the incorporation of sealing devices. However, draught-proof windows are also in demand to cut down noise levels.

Insufficient attention has often be paid to space ventilation. On the one hand, its function is to limit the air flow to the top of a room to avoid undue heat losses and, on the other hand, to similarly limit it at the bottom of a room in order to avoid structural damage and to guarantee healthy air conditioning.

- What are the future prospects for domestic ventilation?

- Do central aeration and de-aeration systems by ducting satisfy requirements?

- Or will ventilation requirements be met by window systems only?

- What consequences do these considerations have both for the people living on the premises and for those whose job it is to construct windows and other ventilation systems?

We shall address ourselves to these and other questions in the following article.

Are our windows too draught-proof?

In the case of windows without sealing devices, exchange of air still takes place through the joints of the closed windows. It is, however, not continuous, since it depends on external climatic conditions. During the heating period, the cold air entering the room from outside has to be heated up to room temperature, and here the absence of draught-proofing and the state of the weather outside can lead to considerable energy losses. This is why, among other reasons, the Heat Insulation Order set a limit on the wind pressure penetration factor (the so-called 'a' value) of 2.0 or 1.0 m^3/h.m. Practical experience indicates, however, that the 'a' value is well below this maximum limit in the case of draught-proofed windows.

It is a well-known fact that new windows with draught-proofing have an 'a' value of <0.1 to 0.4 m^3/h.m, because joint ventilation is reduced by about 90% i.e. down to 10%. At the same time, energy costs caused by joint ventilation are reduced correspondingly - which was, of course, the object of the Heat Insulation Order.

However, the amount of sealing protection given to window jointing is also an indispensable factor in promoting sound insulation: if, for example, the 'a' value is changed from 0.1 to 1.0 m^3/h.m, the noise damping effect of a sound-proofed window is reduced from R_w = 35 dB to 28 dB.

Draught-proofed windows are essential if it is desired to save energy on ventilation and reduce noise. There is, thus, no point in any further discussing this aspect.

The objects of space ventilation

The air in a room where people are living and/or are occupied in various ways contains sundry noxious substances, the actual amount of air pollution depending on the number of people in the room and the chemical/physical processes occurring. The effects of such substances must be countered by the exchange of air between the outside and the inside of the room, involving the exhaustion of the waste gases.

This means that ventilation plays an important role in conditioning the room atmosphere, since temperature and air circulation are indispensable factors of comfort. Every room, therefore, requires an adequate amount of aeration and de-aeration in order to satisfy the following requirements:

Removal of pollutants

The noxious components of cigarette smoke, various waste gases and, possibly, toxic vapours emanating from structural materials, cleaning aids and agents used for care and maintenance must be exhausted from the room. The existence of radiation effects has even been recently detected, arising from the inert gas, Radon.

Avoidance of structural damage

Atmospheric humidity, causing condensation on or in structural elements, can produce considerable damage to the structure and materially affect the quality of life in the premises. In addition, a damp-impregnated outside wall can lose half its thermal insulating properties. The existence of damage caused by damp is attributable to inadequately damp-proofed outside walls and to inadequate heating and ventilation.

Warding off danger

Life and health are threatened where open fires burn in a room where the supply of combustion air is inadequate.

Healthy atmospheric conditions

The most important factors constituting environmental comfort are:

- air temperature;
- the movement of air;
- relative air humidity;
- slight temperature difference between floor and ceiling;
- the temperature of surrounding surfaces.

General factors contributing to a feeling of comfort are:

- windows which will open;
- natural lighting;
- different room temperatures and ventilation levels, possibly as a function of varying use;
- individual control of temperature and ventilation, possibly as a function of varying use;
- radiant heat rather than convectional;
- low internal noise level;
- a concentration of unpleasant odours which is below the level of perception.

Low energy consumption

Energy consumption can be kept low when the air flow is matched, in respect of each room, to the use to which it is being put and the degree of occupancy to which it is subjected. In addition, the natural sources of energy, such as wind, temperature differences and sun can be directly harnessed in order to reduce the necessity of artificial sources.

Ventilation in summer

The experience of all of us has sufficiently demonstrated that ordinary and French windows provide enough ventilation between spring and autumn for most purposes, but only a window ventilation that is adjustable can, for this portion of the year, satisfy the high requirements made for the ventilation of individual rooms. Large adjustable cross sections of ventilation are required to provide individualized air flows without at the same time setting up high air velocities - all this without the use of artificial energy sources. Thus, we see that free ventilation is the best of all possible systems for periods of the year when heating is not required.

Ventilation in winter

The greater amount of wind and differences of temperature makes available more natural energy for space ventilation purposes in winter than in summer. Thus we have to modify the resultant greater window ventilation at this time of year to the amounts we actually want.

The ideal is a ventilation which can be called upon to provide whatever air flow is required for each room at any one time, this depending upon the degree of occupancy, the use being made of the room and the values of noxious substances and air humidity. Apart from this requirement, it is also desirable, if possible, to be able to maintain a continuous exchange of air, however slight and independently of the use being made of the room, to exhaust waste gases and toxic vapours. In calculating this factor, the requirement of shaft ventilation (without a fan) of internal toilets must be borne in mind.

Natural ventilation, however, is not entirely without its problems, such as:

- it provides no sound-proofing while in operation;

- it frequently leads to unnecessarily large energy losses as a result of the limited facilities of regulation it offers;

- it does not always provide the degree of comfort in the rooms which is required.

The following ventilation systems are nowadays relevant for consideration in the sphere of domestic construction:

- natural ventilation;

- de-centralized forced ventilation;

- central forced ventilation.

Natural ventilation

The natural ventilation of rooms in which people live/work is effected by the use of windows or other non-motorized ventilation devices (see Fig. 1).

De-centralized forced ventilation

Centralized forced ventilation is in all cases provided by a ventilator (fan), mounted in an appropriate housing. It can be fitted with or without sound-proofing, either in the window unit or on the outer wall, and be mounted either horizontally or vertically. Such a system has a constant delivery of air and is, thus, independent of wind pressures and temperature differences (Fig. 2).

Ventilation systems with combined inflow and outflow (simultaneously) of air offer the possibility of heat recovery - about 50% of exhaust heat contained in the spent air is thus reclaimed on the average. Not only is heat energy saved in this way, but the incoming cold air is also preheated, which adds to the sense of comfort in the room (Fig. 3).

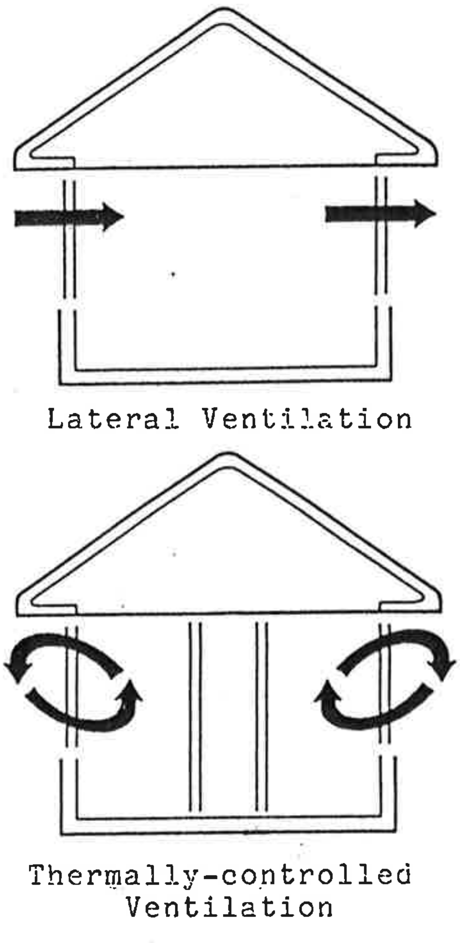

Fig. 1: Natural window aeration and de-aeration

The mechanical shaft ventilation system in bathrooms and toilets and ventilation by means of a hood to expel unwanted vapours in the kitchen are also reliable and well-tried examples of forced ventilation (Fig. 4).

The air is combined between the window and shaft ventilation systems by planned escapes in the region of the room door.

Natural ventilation and de-centralized forced ventilation - the possibilities and the limits

The aim of every planned ventilation system must be a contribution to making the air conditioning of the room approximate as far as possible to the natural condition. For this purpose, the excellent qualities of window ventilation are available, and this system can be markedly improved by de-centralized forced ventilation, particularly in winter. The combination offers the possibility of making savings on energy consumption and improving the feeling of personal comfort, achieved by the carefully planned installation of de-centralized forced ventilation in individual rooms of the house.

A de-centralized system of forced ventilation makes it possible to adjust the air requirement to the degree of occupancy and the utilisation of each individual room.

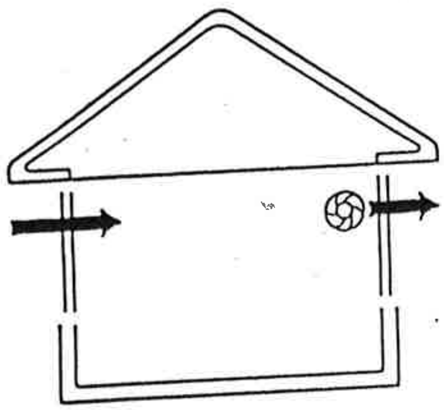

Fig. 2: Natural window ventilation - mechanical de-aeration

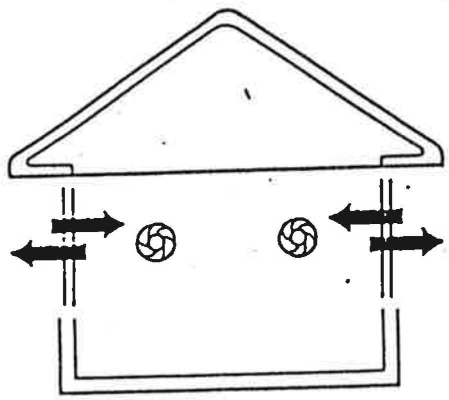

Fig. 3: Mechanical aeration and de-aeration, combined with heat recovery.

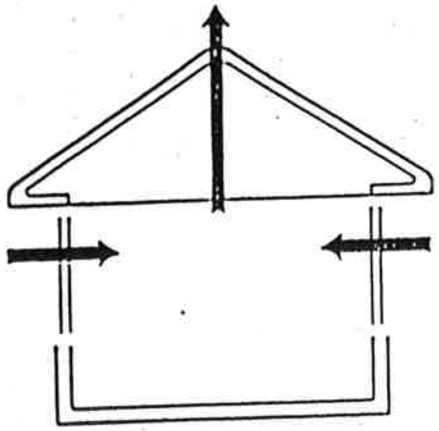

Fig. 4: Natural window aeration and shaft de-aeration

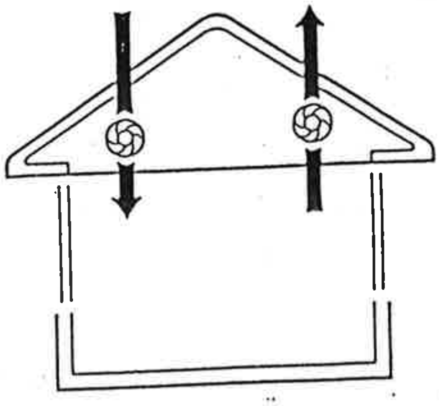

Fig. 5: Mechanical aeration and de-aeration by ducting

Central forced ventilation by ducting

The principle of this system of ventilation is that a fan provides a central supply of fresh air from outside and forces it via ducting into the individual rooms being occupied. At the same time, a second fan exhausts the spent air from the kitchen, toilet and bathroom by another system of ducts. The ducts in question, for both purposes, are made of plastic or sheet steel in varying sizes (see Fig. 5).

This ventilation system makes it possible to run the ducting for both intake and exhausting of the air in direct mutual proximity e.g. in the loft or in the operations room, which layout provides central heat recovery (see Fig. 6).

The further possibility is presented of combining with the forced central ventilation system appropriate heating elements to provide air heating, particularly if the air from outside can already be pre-heated to about 10-13°C via a central heat recovery system. The combination of the principles of heat recovery and heating of the air is technically most harmonious under this system and would appear to be economically rational.

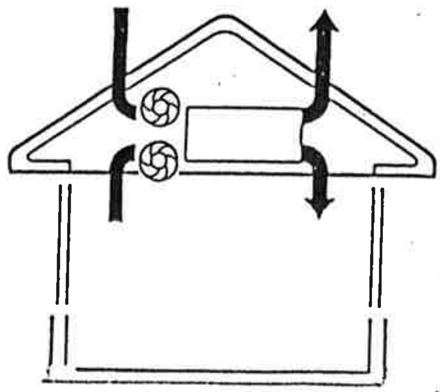

Fig. 6: Mechanical aeration and de-aeration by ducting, combined with a heat recovery system

Running and investment costs are the reason for adding a proportion of the circulating air to the air coming in from outside; the extent of this proportion depends on the external air temperature and can amount to 80% of the total air intake.

This is an all-year system of ventilation and, to be properly effective, requires that the windows remain closed. They should, therefore, only be opened for external cleaning, for use as escape routes and, in certain cases, for painting and maintenance work.

Central forced ventilation with air heating - the possibilities and the limits

The economic value of combining space ventilation with heat recovery and space heating must be considered to represent one of the chief advantages of this system. Both of these functions have quick reaction times, so that any incidence of solar energy can be utilized. As there is also no direct connection with the outside air, the system also qualifies as a sound-damping type of ventilation.

When we come to look closely at the air-conditioning effect of this system of ventilation and heating, we note the following points:

this air-heating system permits a variation between the temperature ranges of the different rooms which is too small: where we have adjoining rooms with different air temperatures e.g. bedrooms and the bathroom, there is a certain monotony of the air-conditioning, experienced as somewhat discomforting;

air heating involves the transference of heat by circulating air (convection); this system demands higher air temperatures than for normal methods of heating in which part of the load is taken by radiated heat;

the air stream with space ventilation produced by mechanical ventilating plant is frequently greater than with naturally ventilated rooms and can reach velocities which promote a feeling of discomfort;

at times when the movement of air is slighter than at other times, dust is precipitated in the heating chambers and air ducts; this dust is later swept up by the greater volumes of air required at other times and blown on to walls and ceilings, blackening them. It has been proved that this is conducive to the irritation of the mucous membranes, respiratory diseases and allergies towards domestic dust;

economic considerations dictate the admixture of up to 80% of circulating air when external temperatures are very low; even after filtering, exhaust air which is loaded with noxious substances, odours and smoke does not match the purity of the outside air;

yet a further problem is set by the noise transference from one room to another, including the noise made by the ventilators themselves and the air streams they promote;
the air ducts will act like speaking tubes and the inherent noise of the fans may amount to 30 or 40 dB(A). Transferred noise can only be controlled by incorporating silencers.

We thus conclude that central forced ventilation by ducting, accompanied by air heating, has no place in the domestic sphere and its use must be confined to special applications.

The window as a ventilating element

Provided that no noise-damping measures are required of windows, their usefulness as a means of ventilation during periods of the year when houses are not required to be heated is beyond all question. This form of summer ventilation can be adjusted by different functions of window construction and, hence, be made to provide variable volumes of air to suit the individual requirements of each room at all times.

Domestic medicine has long recognized the validity of these arguments and insists on window ventilation for psychological reasons and in the interests of healthful air. The very possession of a window that will open is in itself a source of comfort that beggars description.

During the heating period of the year, and provided that there is sound-proofing of the front (of the house ? Trans.), the properly arranged application of extra mechanically-driven ventilation equipment can provide a substantial addition to the quality of living. For this purpose, the architect needs to consult with the manufacturer of windows and their fitments to search for the way ahead; in so doing the following factors should be borne in mind:

- the need to produce the right health conditions;

- economy;

- the saving of energy;

- comfort retention.

Summary

Care must be taken to ensure that the modern window is draught-proof when used for ventilation. Provided that it is not required to be also noise-damping, window ventilation presents no problems at all. During the heating period, ventilation must be regulated to suit the conditions of utilization in order to avoid unnecessary heat losses.

However, the avoidance of heat losses during ventilation is by no means the only consideration. For medical reasons, space ventilation must be separated from the heating function.

The "Deutsche Gesellschaft für Wohnmedizin" (= German Domestic Medicine Company) has condemned ventilation systems which:

- offer inadequate cleaning facilities;

- cause considerable build-up of dust;

- give rise to draughts by reason of high air velocities;

- cannot restrain the transfer of noise from one room to another, including that from the ventilators.

The more we depart from natural means of ventilation and sell our souls to technical aids, the greater is the danger to health and our dependence on artificial energy.

We call upon those responsible for making recommendations, drawing up guidelines and issuing regulations for the domestic ventilation of the future not to allow themselves to be solely controlled by a consciousness of the importance of energy considerations - this might have dire consequences. Let us confine ourselves to postulating that the sole aim of proper ventilation and heating technology is at all times the comfort and health of mankind.