

CONCLUSION AND FIRST EVALUATION
OF RESULTS

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It is generally known that in residential buildings today, about one third of the heat lost is due to the effects of an exchange of air, and two third to heat transmission processes. The change of air takes place both uncontrolled, through gaps in the building envelope (e.g. window joints and seams between various pieces of the building), and more or less controlled through the opening of windows, ventilation shafts and apertures, as well as mechanical ventilation systems. Due to the step-by-step progress in renewing and restoring the housing stock according to the new federal regulations for insulating buildings, it may be assumed that, in the future, the heating requirement of residential buildings will be determined to a great extent by the heat lost through ventilation.

It was therefore logical that the Federal Ministry for Research and Technology (BMFT) and the Federal Ministry for Regional Planning, Building and Urban Development (BMBau) introduced the R & D programme "Air Infiltration and Ventilation in Residential Buildings". Even though the main aim of this programme was to indicate possibilities for decreasing the heat lost through ventilation, it was also quite clear from the start that, in connection with this, many other questions were to be dealt with, which were only indirectly concerned with energy savings. From the beginning, therefore, studies of air hygiene, air requirement and emissions from fire-places, as well as the behaviour of the residents, were included in the programme, which thus became an interdisciplinary venture.

The programme is divided into 3 overlapping phases:

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| Phase I | Basic studies |
| Phase II | Studies of occupied houses |
| Phase III | Processing and assimilation of results |

A further important aspect of the programme is its connection with international R & D activities. The focal point here is the co-operation in appropriate committees of the International Energy Agency (IEA) within the programme "Energy Conservation in Buildings and Community Systems". The Federal Republic of Germany is member of annex VIII "Inhabitants Behaviour" and is leading the work of annex IX "Minimum Ventilation Rates".

A first presentation of the programme "Air Infiltration and Ventilation of Buildings" took place on 25.03.1982 in Jülich for participants from politics, administration, science, industry and housing, and initial results could already be presented. The 2-day-seminar in Munich furthered the exchange of information and reported on the position at the end of operational phases I and II.

The papers of the first half-day session elucidated the aim of the programme, and provided a general picture of the national and international position on R & D projects. In addition to this, a survey was given on available installations for natural ventilation and mechanical ventilation systems. In the second and third sessions theoretical and practical experiences with ventilation equipment were presented, together with studies on occupied and unoccupied demonstration and test houses. It turned out to be beneficial, that experts from outside the programme too could be won for presentation of papers and participation in discussions.

The fourth and final session concentrated on the hygienic and physical requirements on air change.

The following summary tries to give the most important results

1. The problem of ventilation in residential buildings is rather complex and involves not only various branches of technology and industry (architectural planning, window setting, ventilation techniques, fire-place planning, construction material production, interior design etc.) but also demands above and beyond that, interdisciplinary collaboration to solve the problem, especially co-operation with hygienists, physiologists (cause and effect of harmful substances) and sociologists (meaningful attitude to ventilation and the question of acceptance).

2. It was discovered during the demonstrations that the approach of the resident to ventilation is only slightly characterised by objective requirements, and is instead marked strongly by individual habits and by subjective feelings. Extremes at both ends of the spectrum ("never ventilate" or "continuously ventilate") are by no means exceptions. Even in houses with a complex fitted ventilation system, the possible savings in energy are negated by the attitude of the resident (who is generally not sufficiently informed and therefore also not motivated).

The question of the resident's acceptance plays an important part; in particular, it must be acknowledged that he has a certain freedom of choice in his approach to ventilation. In order to motivate him towards a meaningful attitude, as well as for reasons of health and safety and in order to encourage energy savings, it seems necessary to direct and intensive campaign at the public at large, through suitable media channels.

3. Although the experts present could not yet be precise about the exact figures for the air change necessary for hygienic reasons; as this depends in particular on parameters such as emissions from the building material,

as well as how frequently and in which way the rooms are used, it was recognised from the papers and discussions that a rate of air change between 0.5 and 1 per hour (in relation to the total volume of the living-quarters) should comply with normal requirements. Although the zone requiring more intensive ventilation inside the living-quarters changes during the course of the day (being dependent on the amount of use), the total ventilation required still remains within the described order.

No consensus could be reached as to the question which measures could ensure the minimal necessary change of air, when confronted with a tight building envelope and an extreme attitude from the user. The problem becomes extreme when it concerns living-quarters where fire-places, depending on room air for combustion, are in operation. In the discussion, the view on the one hand was that the present status quo was changed onesidedly if the building envelope was made air-tight, whereas on the other hand, it was argued that following the "pay as you pollute" principle, the creator of the damaging substance should deal with the fresh air supply himself.

Certainly, no practical solution can be found by generally removing, for example, a part of the window sealings - as was suggested in the discussion. Not only because it would mean a return to the "Middle Ages" of building technology, but also because a definable air change cannot be obtained in this way: in some cases it would not suffice whilst in many others, too much fresh air would be induced.

Because of the factors particular to each building, lying within a broad spectrum of variations, it is impossible to find a general (and at the same time) purposeful solution. It seems more realistic to take a single case by using a suitable method for measuring the airtightness or airchange and adjusting it in a controlled way by appropriate measures (ventilation grates for example). Measuring principles which are exact enough for this purpose are already known and could be developed ready for application.

5. When considered from the viewpoint of energy and hygiene, mechanical fan ventilation offers the best solution. It ensures - independently from wind and thermal influence - the necessary air change at all times and, with only a small amount of electricity needed, and permits up to 2/3 of the heat lost by ventilation to be recaptured. At the same time, there is an increase in the level of safety and comfort. A precondition: a meaningful approach from the user (see point 2). However, the experience gained in the projects, showed that the introduction of such a system brings along problems:

- the investment costs are not yet redeemable through the saving in energy alone;
- the system demands careful planning, especially with regard to sound generation and transmission and draught-free air flow;
- the installation trade is often unenthusiastic about the system;

- the adjustment of the completed systems often leaves much to be desired;
- regular cleaning and filter changing is essential, but is often not ensured.

All in all, it seems that further developments in the direction of simpler, better suited and more easily installable (and thus more cost-effective) solutions should be considered.

6. The results show that the demands for satisfactory air quality, dehumidification, and energy savings are not sufficiently fulfilled (not all at the same time in any case) by current methods of free ventilation (that is: window ventilation, change of air through leaks in the building envelope and shaft ventilation). The factors of wind pressure and thermal lift, which determine the air change, are too variable. Yet there cannot be assumed that motorised ventilation will assert itself generally in the the future, least of all in the housing stock. There exists, therefore, a desperate requirement for simple ventilation fittings, which can be installed in an already completed building, and which are in a position to maintain the exchange of air independently from the influences of wind and thermal lift. Such fittings could be, for example, automatic air shutters, controlling the amount of air flow. There would, however, already be a clear improvement, if better, finely adjustable window fittings were used - with the precondition that the user is correspondingly informed and motivated.

7. The results of the programme "Air Infiltration and Ventilation in Domestic Buildings" could be transferred, in many aspects, to buildings with different usage (e.g. office and administration buildings, schools). Indications of this appeared in various contributions and in the discussions. An application of the results to these other areas should therefore be aimed at, and supplementary investigations initiated where necessary.

8. The fact that the status seminar was attended by a relatively large number of foreign participants (especially from Switzerland, Austria and the Benelux countries), proves that it is not only in the Federal Republic of Germany that the question of ventilation is recognised as an important matter.

TEIL I.

RATIONELLE ENERGIE NUTZUNG IN WOHNGEBÄUDEN
- NATIONALE UND INTERNATIONALE AKTIVITÄTEN

Economic Use of Energy in Residential
Buildings

- National and International Activities