

PROGRESS AND TRENDS IN AIR INFILTRATION
AND VENTILATION RESEARCH

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AIR CHANGES AND SCATTER IN MECHANICAL VENTILATION
RATES IN SWEDISH RESIDENCES

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SYNOPSIS

In Sweden, the energy crisis in the early seventies resulted in attempts to lower the air change rate in buildings to reduce energy consumption. For many building categories, this led to a deterioration of the indoor climate or problems with moisture and mould growth. Today, many residents demand higher ventilation rates, often the motivation is concerns about health and comfort. In this paper, is presented results of measured air change rates in Swedish dwellings during the period 1974-88.

For some residential building categories, the average air change rate is much smaller than that prescribed by the Swedish Building Code, 0.5 air changes per hour (ACH). About half the apartments and houses with natural ventilation constructed after 1960 have a rate of air exchange that is 0.3 ACH, or lower. This is also the case for about fifteen per cent of the houses with exhaust air ventilation.

For buildings with mechanical ventilation, it has been investigated what are the differences in ventilation rates for apartments in the same building and for groups of identical houses after the final installation and control of the ventilation system. In both cases the scatter around the average is about 20 %.

AIR CHANGES AND SCATTER IN MECHANICAL VENTILATION RATES IN SWEDISH RESIDENCES

1. INTRODUCTION

Measurements of air change rates in dwellings have been carried out by the Swedish Institute for Building research since 1974. The rate of air exchange has been calculated from the measured decay rate of tracer gas concentration. The data bank now contains data on the air change rate in about 1000 dwellings.

Data do not describe the air change rate in dwellings at this instant, but is rather to be regarded as representing an average for the period 1974 -88. Also, data do not represent a true statistical sample, but have been collected in research projects having aims other than the measurement of air change rates. However, most residential categories and buildings of different age are represented in the material. A more detailed description of the data base has been given in ref. (1).

2. RESULTS

Air change rates are presented in Fig. 1. Many dwellings have a rate of air exchange smaller than that prescribed by the Swedish Building Code, 0.5 air changes per hour (ACH). About half of the apartments and houses with natural ventilation constructed 1960 or later have an air change rate of 0.3 ACH, or less. This is also the case for about fifteen per cent of the houses with exhaust air ventilation.

Regarding the houses with natural ventilation, the measured low ventilation rates can probably be explained by the gradually improved airtightness of building envelopes during this century (see ref. 2).

For dwellings with mechanical ventilation, the explanation has to be sought in terms of the quality regarding installation and control of ventilation systems. We have, therefore, investigated what is the dispersion of the ventilation rate for groups of identical townhouses and for apartments in the same building. The results are given in Fig. 2.

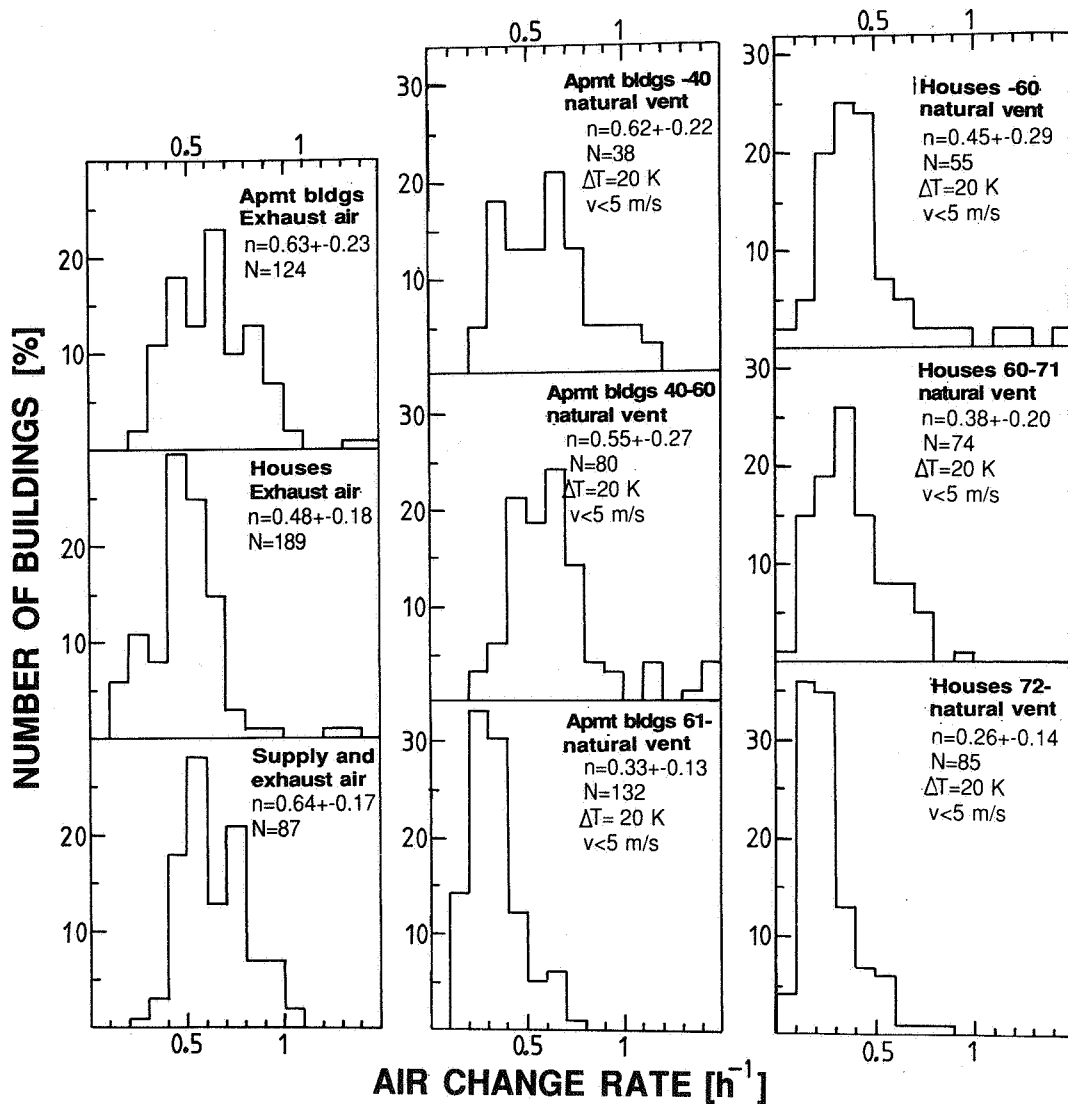


Fig. 1
 Air change rate in Swedish dwellings, dwellings with mechanical ventilation (left), houses with natural ventilation (middle), and apartments with natural ventilation (right). Dwellings with exhaust air ventilation have been divided into houses and apartment buildings. Dwellings with natural ventilation have been subdivided according to the year of construction. Also given are the number of dwellings in each group, N , the average air change rate, n , expressed in air changes per hour (ACH), and the standard deviation of the air change rate. The air change rate has, for natural ventilation, been corrected to an indoor-outdoor temperature difference of 20 K and measurements for wind speeds exceeding 5 m/s have been excluded from the data set.

Many dwellings have an air change rate below the requirement of the Swedish Building Code, 0.5 ACH. One half of the apartments and houses with natural ventilation constructed since 1960 have an air change rate of 0.3 ACH, or less. This is also the case for 15 % of the houses with exhaust air ventilation.

For apartments as well as for houses, the standard deviation of the average ventilation rate is about 20%. This means that after an installation and control aiming at a ventilation rate of 0.5 ACH, about 70% of the dwellings have a ventilation rate between 0.4 and 0.6 ACH, while the remainder may have ventilation rates down to 0.3 or up to 1 ACH.

3. CONCLUSIONS

It is found that about half of the apartments and houses with natural ventilation constructed 1960, or later, have an air change rate of 0.3 ACH, or less. This is also the case for about fifteen per cent of the houses with exhaust air ventilation.

For apartments as well as for houses, the standard deviation of the average ventilation rate is about 20% after installation and control of a mechanical ventilation system.

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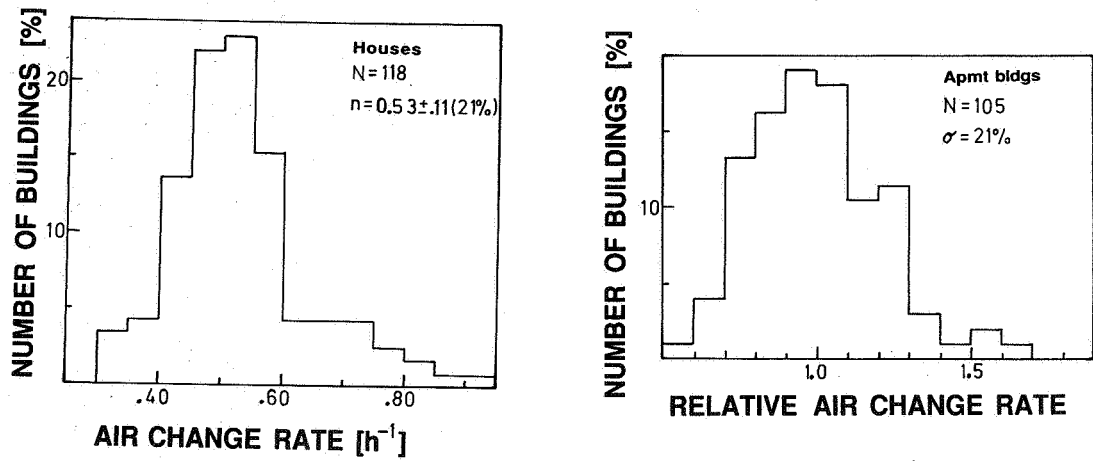


Fig. 2

Distribution of ventilation rates in townhouses (left) and apartments (right) with mechanical ventilation. The data for townhouses are from three groups of houses, the houses in each group are identical. The total number of townhouses, N, is 118. All three groups have an average ventilation rate between 0.52 and 0.54 air changes per hour. The data for the apartments are from apartment buildings where measurements have been carried out in a number of apartments varying from 5 to 15. Due to average ventilation rates differing between the buildings, all measured ventilation rates in apartments have been normalized with the average ventilation rate of the respective building.

The scatter of the ventilation rates (one standard deviation) is about 20 % for apartments as well as for houses.