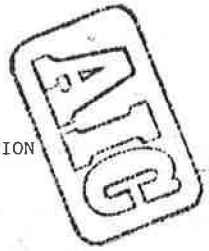

MEASUREMENT OF A BUILDING'S INFILTRATION

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Heat balance of the heated rooms

A way to define the heat balance in steady-state conditions may be as follows:

$$\dot{Q}_{TR} + \dot{Q}_{INF} - \dot{Q}_{S} - \dot{Q}_{IS} = \dot{Q}_{H} \qquad (1)$$

where $\dot{Q}_{TR}$ - heat loss by the heat transmission
$\dot{Q}_{INF}$ - heat loss by air infiltration
$\dot{Q}_{S}$ - heat gain by sunlight
$\dot{Q}_{IS}$ - indoor heat sources
$\dot{Q}_{H}$ - effect of the heating equipment

Here we are dealing with the air infiltration only. Other aspects of the heat balance are supposed to be known. Many times the heat loss by air infiltration is a dominant factor of the heat requirement. It comprises nearly as much as the heat gain by the sunlight. It is dependent on the outdoor temperature changing room by room. An indifferent zone develops due to the effects of many things. The location depends on the number of the building floors, the speed of the wind, the number and sizes of the doors and windows, and their air infiltration characteristic, etc.

The heat loss by air infiltration is almost nil in the indifferent zone and close to it. Under this the heat loss is higher, over this the heat loss is lower. The heat loss is maximum in the lower places when the outdoor temperature is low and the speed of the wind is high. If the outdoor temperature increases, the place of the indifferent zone changes. The speed of the wind is very important for the air infiltration. In the formula (1) all the parts are in the first kind "heat-types", except for the heat loss by air infiltration. Because of the air infiltration the rooms need extra heating, and this can warm up the air coming through the slits of the windows and doors.

Finally, if we know the quantity of the infiltrating air, we will know more about the heat loss of the buildings. It is difficult to compute because the occurrence is problematical.

The building-physical researches agree with each other on the existence of the air filtration; but the quantity of the air is the subject of debate.

At the Department of Heating, Ventilating and Air-Conditioning of the Technical University of Budapest we have developed a method for determining the quantity of the air on the spot. This method is "in situ".

Before we make the measuring method known, let us look at the following.

The air pressure in the room is stable, so the air, which is coming in, will go out as well. The boundary condition is as follows ($\dot{V}$ = const.):

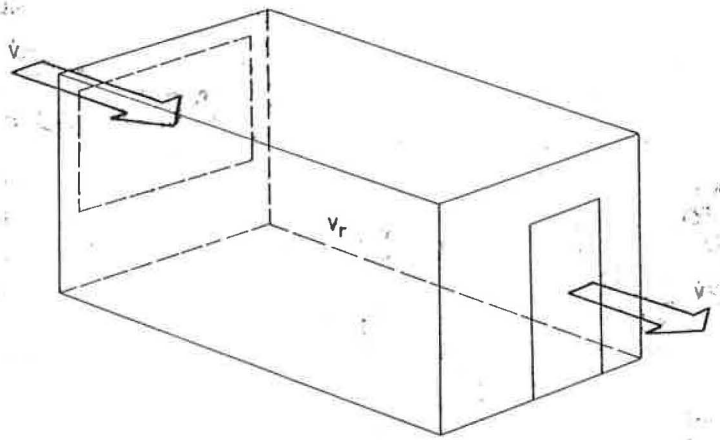
$$\frac{\partial^2 V}{\partial \tau} = 0$$

In this case the number of air changes (n) is as follows:

$$n = \frac{\dot{V}}{V_{room}} \qquad (2)$$

This condition is shown in Fig. 1.

Fig. 1. Theoretical scheme



The aim of the measurement is to determine the air current through the room.

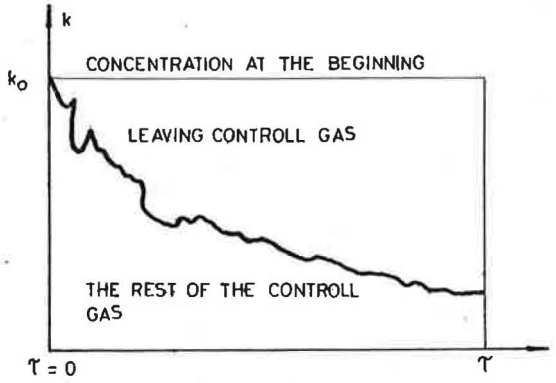
The method is as follows: mix the room's air with some control gas, detect the degree of gas concentration, because it depends on the intensity of the air infiltration. The control gas is spread equally in the room. We are measuring the degree of its concentration and registering it over a period. In this way we can calculate the air infiltration of the room. We have to choose the control gas very carefully. It must not be poisonous.

Carbon dioxide is suitable for the method. The degree of the gas concentration was about 3-4% at the measurements. To measure the concentration we used an infrared gas analyser.

The results of the measurements

We have obtained a characteristic from the measurement, which is shown in Fig. 2. The figure shows how the degree of concentration of the carbon dioxide gas changes over time.

Fig. 2. Characteristic of the measurement.



As can be seen in Fig. 2, the curve is not smooth. We had to apply the evaluation graphical integration or curve approximation method.

The patent consists of this method in Hungary. We have used it many times. The dissemination of this method is in progress.

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SUMMARY

J. Menyhárt, I. Majoros: Measurement of a Building's Infiltration. In the heat balance of buildings the necessary heat for the heating of the infiltration air coming through the slits of the doors and windows is very important. Considering that the process is problematical, the computing of it is difficult. The Department of Heating, Ventilating and Air-Conditioning of the Technical University of Budapest has developed an "in situ" method for measuring the infiltration of buildings.

RESUME

J. Menyhárt, I. Majoros: Mesurage des échanges respiratoires des bâtiments. Dans le bilan thermique des bâtiments la chaleur, nécessaire pour le chauffage de l'air affluant par les joints de la porte et les archieres, est d'une grande importance. Comme ce phenomene est complexe, il est difficile d'en opérer un calcul. A l'Université technique de Budapest les spécialistes ont élabore des procédés de mesurage "in situ" pour mesurer les échanges respiratoires des bâtiments.

KURZFASSUNG

J. Menyhárt, I. Majoros: Die Messung der Luftwechselung bei den Gebäude. Bei der Wärmebilanz der Gebäude ist wichtig die Wärme, die zu der Aufwärmung der Luft nötig ist, die durch die Spalte der Türen und Fenster einströmt. Da das Prozess kompliziert ist, gibt es bei der teoretischen Berechnung Schwierigkeiten. In TU Budapest, an der Institut für Heizung-, Lüftung und Klimatisierung est das Messverfahren "in situ" zur Messung der Luftwechselung in Gebäude ausgearbeiten worden.