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A METHOD OF DETERMINING WATER VAPOUR TRANSMISSION THROUGH OUTER WALLS

Af Vagn Korsgaard og Thomas Lund Madsen

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A METHOD OF DETERMINING WATER VAPOUR TRANSMISSION THROUGH OUTER WALLS

VAGN KORSGAARD and THOMAS LUND MADSEN

The Technical University of Denmark
The Thermal Insulation Laboratory, Copenhagen
Denmark

This paper deals with some measurements, designed to evaluate a very simple method of determining the amount of water vapour transmitted through outer walls during the heating season.

The method is briefly as follows. At the outer surface of the wall whose diffusibility we wish to know, a flat metal box is placed. The box, which is open against the wall, is sealed round the edge with a weather resistant material. The result is that the box and the wall together form a flat cavity. The dimensions of the cavity in these measurements were 2 x 45 x 55 cm. See Fig. 1.

The water vapour leaving the outer surface of the wall will during winter conditions condense on the cold front side of the box, and then run down and accumulate

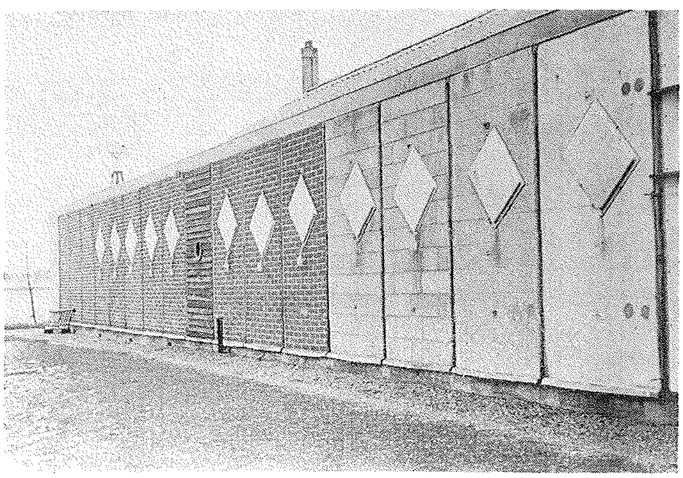

Figure 1. The metal boxes placed at the surface of the test walls.

in the bottle which is connected to the lower corner of the metal box by a narrow plastic tube.

MEASUREMENTS

During the winter season, 3 December 1963 to 2 March 1964, the amount of water collected from the boxes was measured for the walls listed below.

Six 30 cm hollow brick walls, plastered inside, and without any external treatment. The walls were insulated with the following cavity insulation materials,

Wall No. 5. granulated mineral wool
6. karbamid foam
7. none
8. vermiculite
9. light expanded clay clinker
11. 8 cm mineral wool batts

Further, three 23 cm lightweight concrete walls, plastered inside and with the following external surface treatment,

Wall No. 15. none
16. Miramatt splash plaster
17. plastered and painted with Cempexo

For each wall, the average amount of water accumulated was measured in cm^3/m^2 day. The results are shown in Fig. 2.

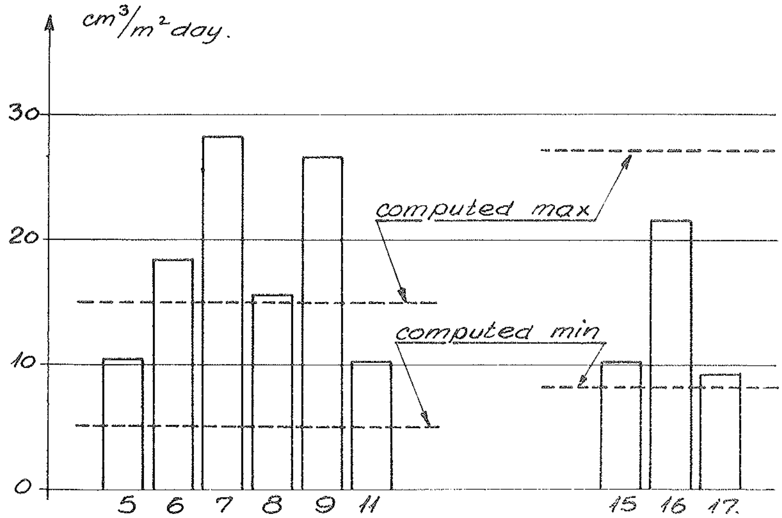

Figure 2. Average of the measured volumes of water from 3. 12. 1963 to 2. 3. 1964.

From continuous measurements of the inside and outside air temperatures and humidities the average vapour pressure difference across the wall, when there is no metal box, was computed. This vapour pressure difference was found to 5.00 mm H

The stated values of the diffusion coefficients for building materials vary widely in the standard handbooks, and this leads to a considerable uncertainty in the theoretically computed values of the quantity of water diffused through the various walls.

Using the largest and smallest diffusion coefficients given in these handbooks, the quantity of water vapour diffused through the two types of wall was computed. The contribution of the insulation materials to the diffusion resistance is neglected for the purposes of this rough calculation. The results are shown in Fig. 2.

The principal fact to be noticed is that the measured quantities of water are all larger than the computed minimum values, and for four of the brick walls, the measured quantities of water are larger than the computed maximum values. This, together with the large dispersion in the experimental results seems to indicat a defect in the experimental method.

CRITICISMS OF THE METHOD

The presence of the metal box affects the climate within the measuring area.

1. Driving rain

The measuring area is protected by the box from driving rain, but the large quantities of water measured seem to indicate that the wall inside the measuring area is gaining water other than that which comes from the air inside the wall.

In the measuring period, the recorded amount of driving rain on this frontage was 2.6 mm or 2600 m^3/m^2. In this same period, the boxes on the various walls collected from 746 cm^3/m^2 to 2540 cm^3/m^2.

After a period of driving rain, it is likely that the water will disperse into the brick wall by capillary action, and part of it will find its way into the measureme area behind the box. It may be noted that half the area behind the 45 x 55 cm box forms a ring of width only 7.5 cm.

2. Change in the U value of the wall

The metal box will increase the U value of the wall inside the measuring area by about 0.20 kcal/h m^2C. This will of course increase the temperature of the outer surface of the wall.

The average difference between the inner and outer air temperatures during the measuring period was, 21.5 - (-1.1) = 22.6 C resulting in a temperature difference between the outer surface of the wall and the inner surface of the box, ranging from 1.6 C for wall No. 11 to 4.7 C for wall No. 7. Consequently there is a water vapour pressure differential across the box of 0.9 mm Hg at 100 % relative humidity for wall No. 11, and 2.1 mm for wall No. 7, which is 19 % and 42 % respectively of the computed difference in water vapour pressure between the inside and outside air.

These water vapour pressure differentials are shown in Fig. 3, and a clear correlation can be seen between the vapour pressure differentials and the volumes of water collected.

The reason for this is probably that during some part of the measuring period the walls were saturated as a result of driving rain, and, as a result, evaporation from the wall surface has been determined solely by the vapour pressure gradient in front of this.

In order to find how large a part of the experimental error is due to driving rain, and how much to the change in temperature, water vapour pressure and evaporation in the box, it is planned during the winter of 1964-65 to place an impermeable membrane inside wall No. 5. The volume of water collected from this wall during the measuring period is very similar to that collected from wall No. 11. In the proposed conditions, wall No. 5 should after a certain time yield water from driving rain only, whereas wall No. 11 will continue to yield the same quantity of water as at present.

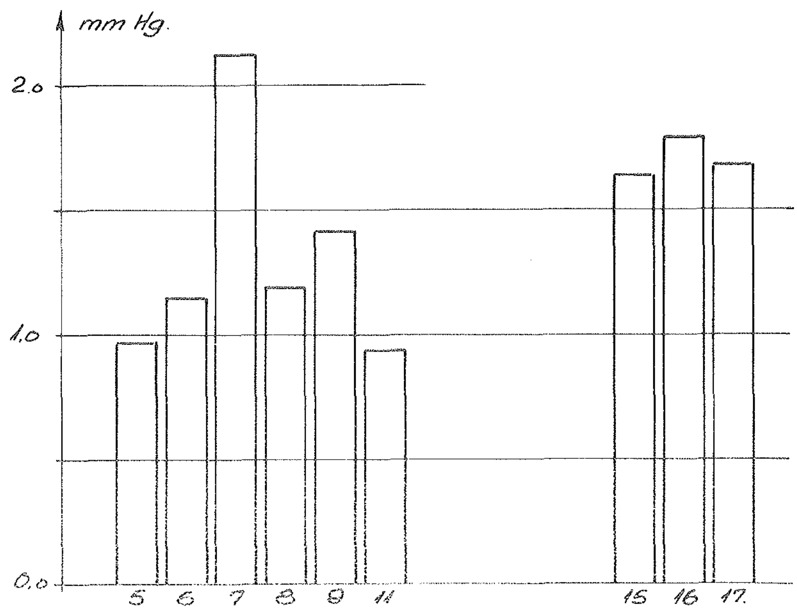

Figure 3. Average of water vapour pressure differentials between the outer surface of the wall and the inner surface of the box.