The Determination of Leakages by Simultaneous Use of Tracer Gas and Pressurization Equipment

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Introduction

The air leakage distribution in a building is, in certain circumstances, difficult to determine. One example of this is the ceiling of the dwelling illustrated in figure 1 and 2. It is almost impossible to make the ceiling perfectly airtight; this means that a measurement by difference is impossible. The inclined roof is not airtight at all. A rather simple and easy technique is to perform measurements using tracer gas and pressurisation equipment at the same time.

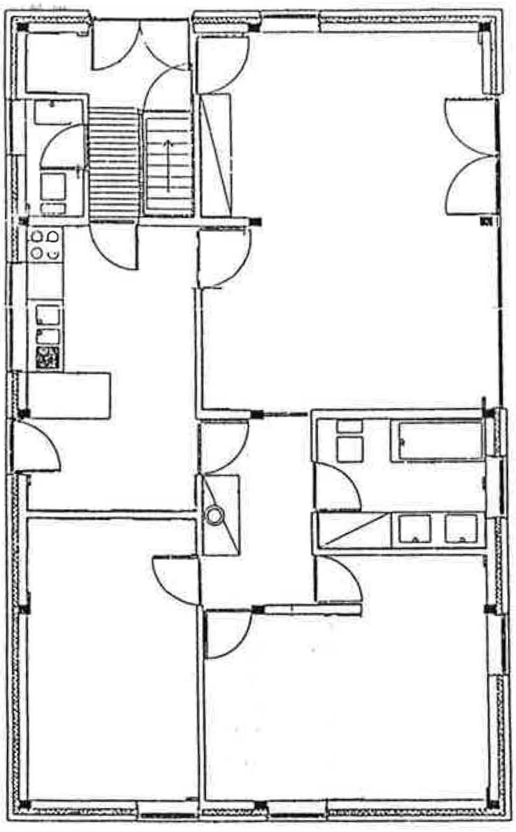

Figure 1. Plan view of test house.

Principle of the measurement

The essential characteristics of the measurements are:

1. A more or less constant concentration of tracer gas in the attic. This can be done by using constant concentration equipment or by using the constant injection technique if the weather conditions are stable.

2. The rest of the house is under depressurisation, for example $\triangle P_{ie}$ = 50 Pa.

3. The measurement of the gas concentration in the attic and at the entrance of the pressurisation door:

   $CONC_D$ = concentration in the dwelling

   $CONC_A$ = concentration in the attic.

It is clear that the gas measured in the house is coming through the leakages in the ceiling.

Therefore:

$$\frac{\text{effective leakage area in the dwelling } (ELA_D)}{\text{effective leakage area in the ceiling } (ELA_A)} = \frac{CONC_D}{CONC_A}$$

ELA_D can be obtained from a global pressurisation measurement, so that:

$$ELA_A = ELA_D \times \frac{CONC_D}{CONC_A}$$

It is evident that this relation is theoretically only valid for the $\triangle P_{ie}$ used during the measurement. The results are only valid if a good mixing of the tracer gas in the attic can be obtained.

The principle is based on steady-state conditions. One can show that these are almost fulfilled after 2/n hours (n = air change rate during the pressurisation test).

This means that for a dwelling with a n_{50}-value of 5 h^{-1} the measurements can be started after 2 x 1/5 hour or 24 minutes if $\triangle P_{ie}$ = 50 Pa. In this case of very airtight houses, a non-steady state analysis may be necessary.

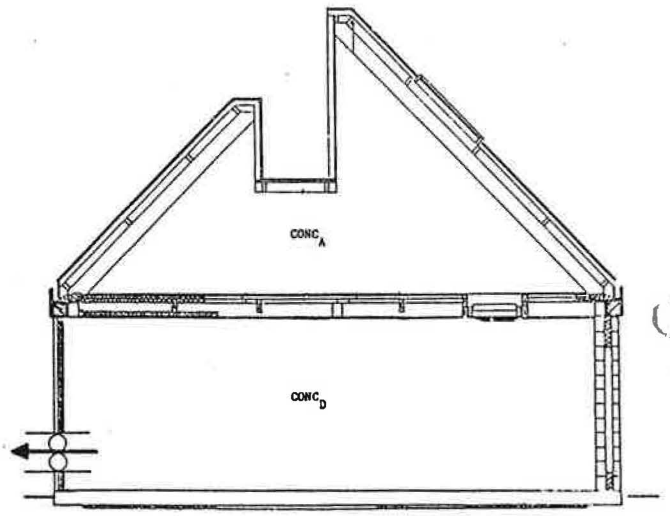

Figure 2. End elevation of test house.

Example

Table 1 shows results obtained in two identical houses at the Belgian Building Research Institute.

	% of leakages	
	Ceiling	Floor above cellar
Dwelling 1	16	22
Dwelling 2	28	17

Table 1 – The total percentage leakage area in the attic and the cellar ($n_{50} \simeq 10\ h^{-1}$).

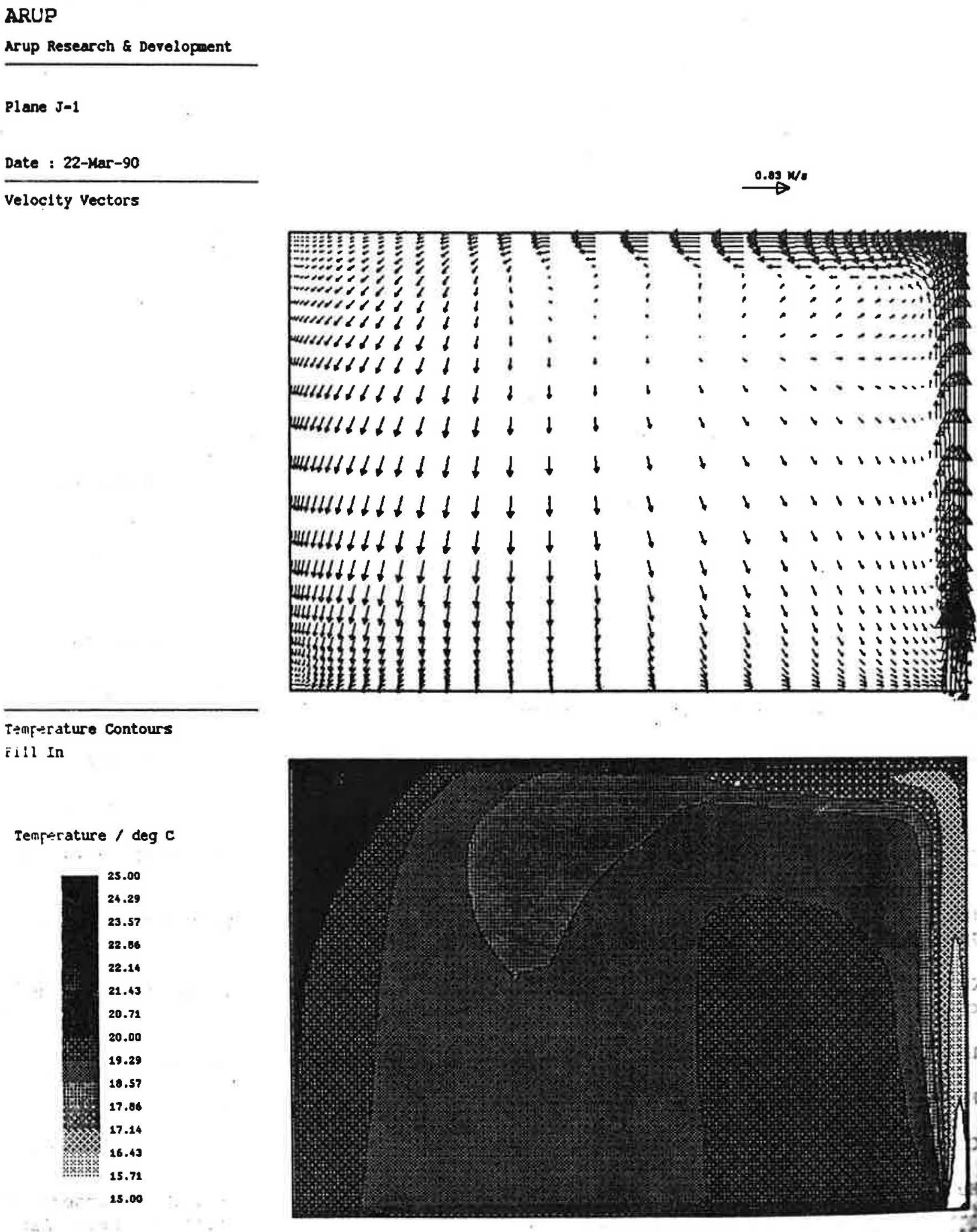

FIG 1 Projection using boundary conditions generated by ROOM.

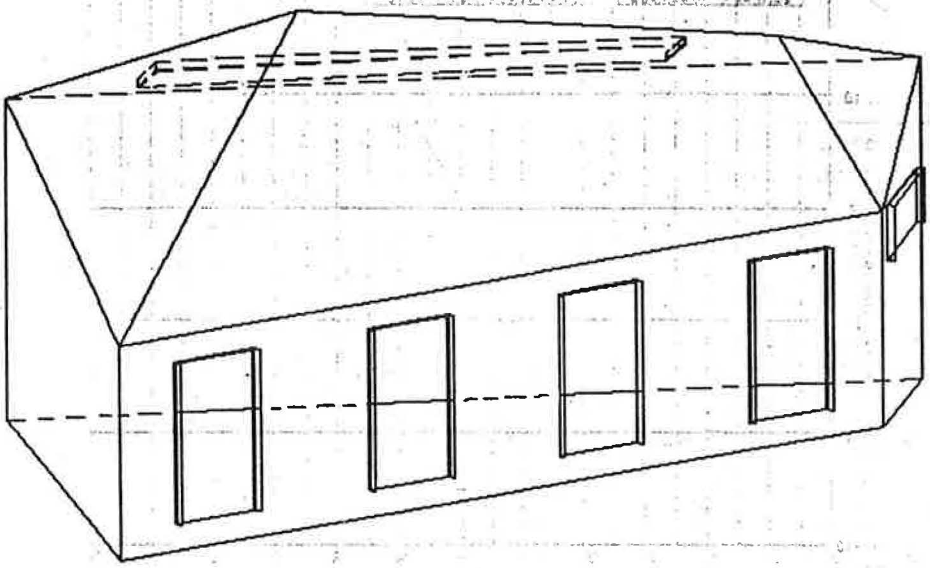

FIG 2A Sketch of the building

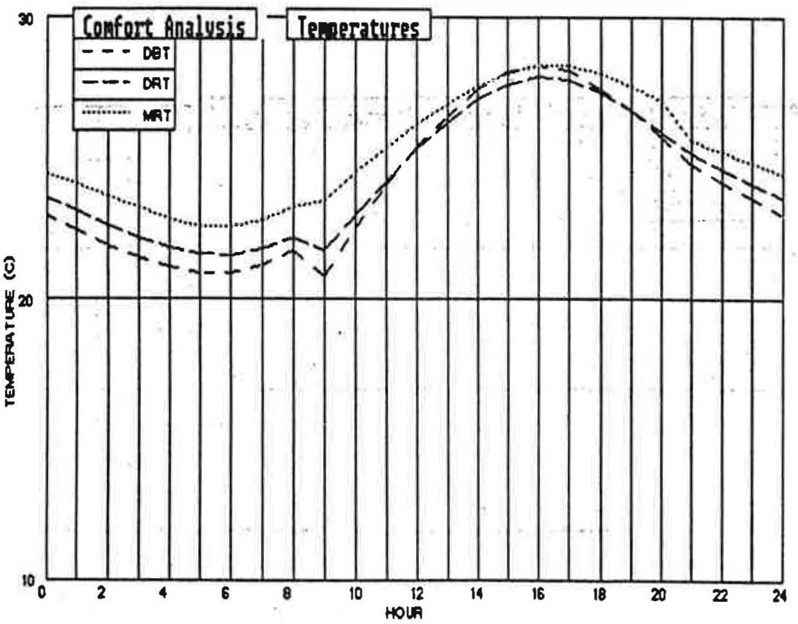

FIG 2B Space Temperatures

DBT - Dry Bulb
DRT - Dry resultant
MRT - True mean radiant - includes influence of direct solar radiation

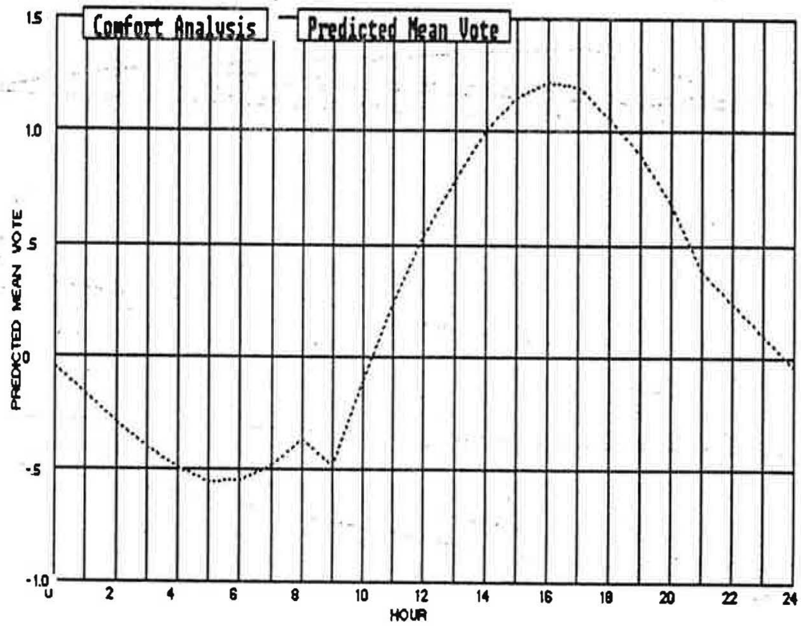

FIG 3A Space average 'Predicted Mean Vote'

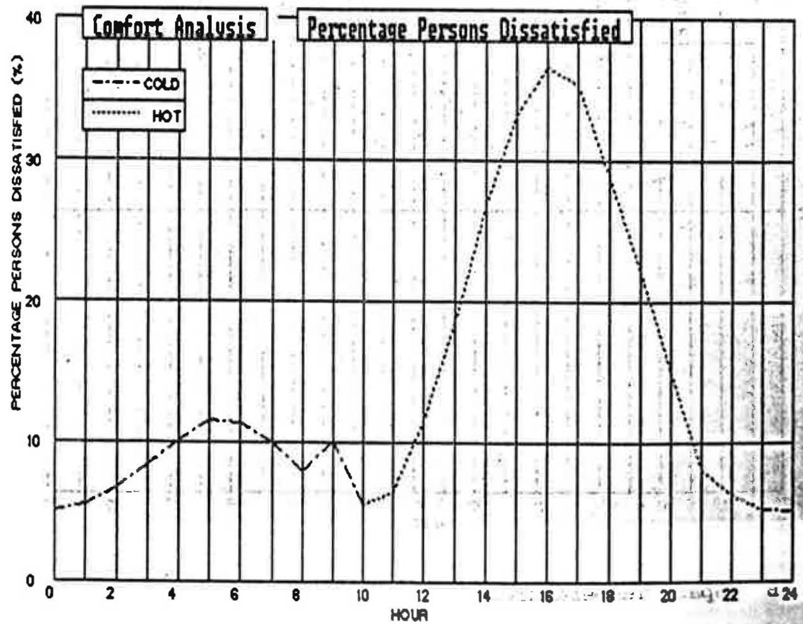

FIG 3B Space average 'Percentage Persons Dissatisfied'

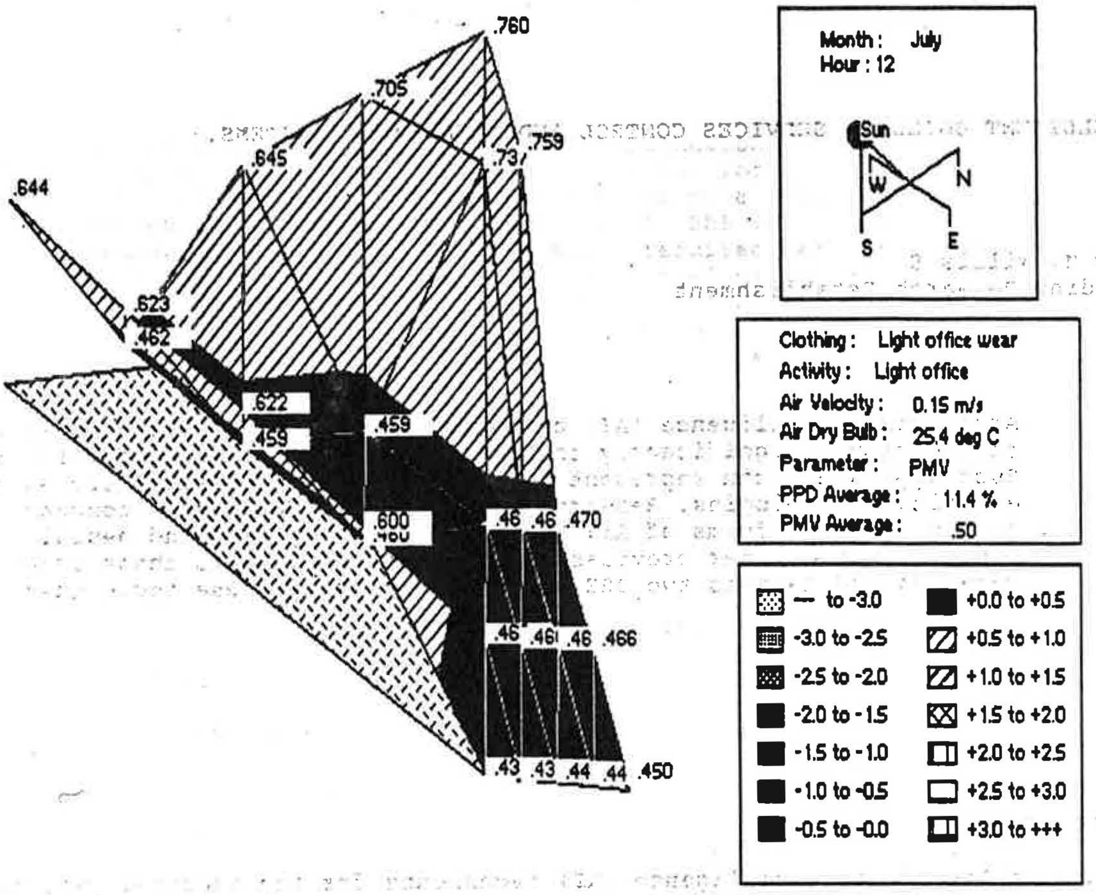

FIG 4A Distribution of Predicted Mean Vote (3D display)

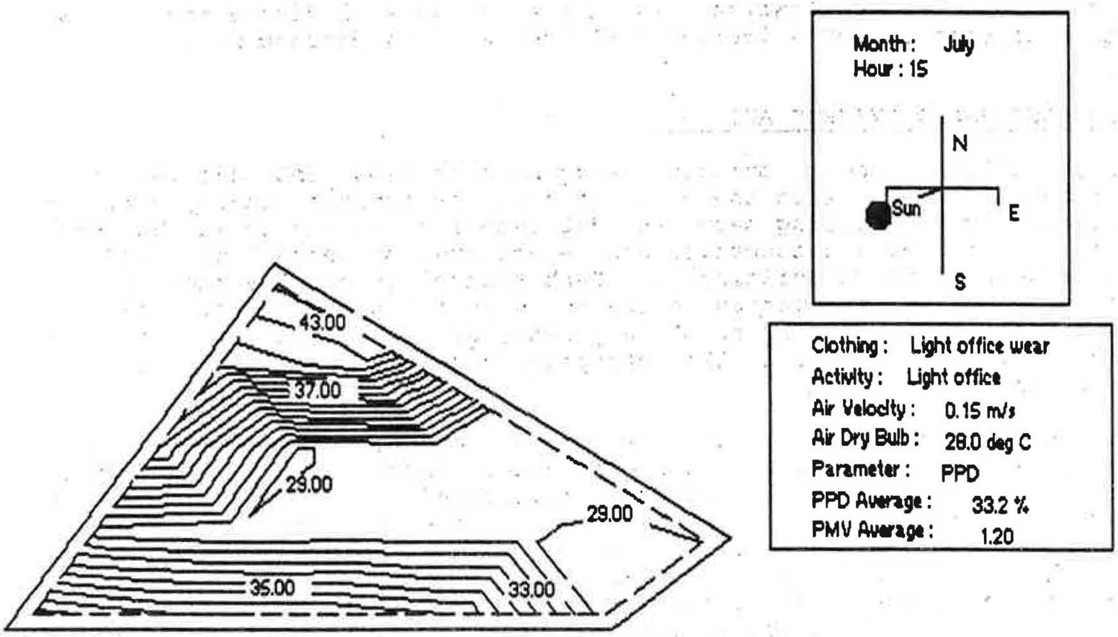

FIG 4B Distribution of Percentage Persons Dissatisfied (Contours)