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Title: **Airtightness of New Belgian Dwellings: An Overview Picture**

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Airtightness of new Belgian dwellings : an overview picture

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1. Introduction

In the framework of the Flemish Impulse Programme on Energy Technology (VLIET), the project called SENVIVV is running from January 1995 till September 1997. The major objective is to obtain a detailed picture of various characteristics of dwellings constructed during the period 1990 – 1995. To achieve this, a representative sample of 200 dwellings is analysed in detail. The final report of this project is expected to be available at the end of 1997. This report gives an overview of detailed measurements carried out in 20 more or less representative recently constructed dwellings in Belgium.

2. Results of pressurisation measurements

All measurements were carried out on the so-called **protected volume**. This is the part of the house which is thermally insulated from the environment.

2.1 Global airtightness

An overview of the measured n50-values as a function of the year of construction is given in figure 1.

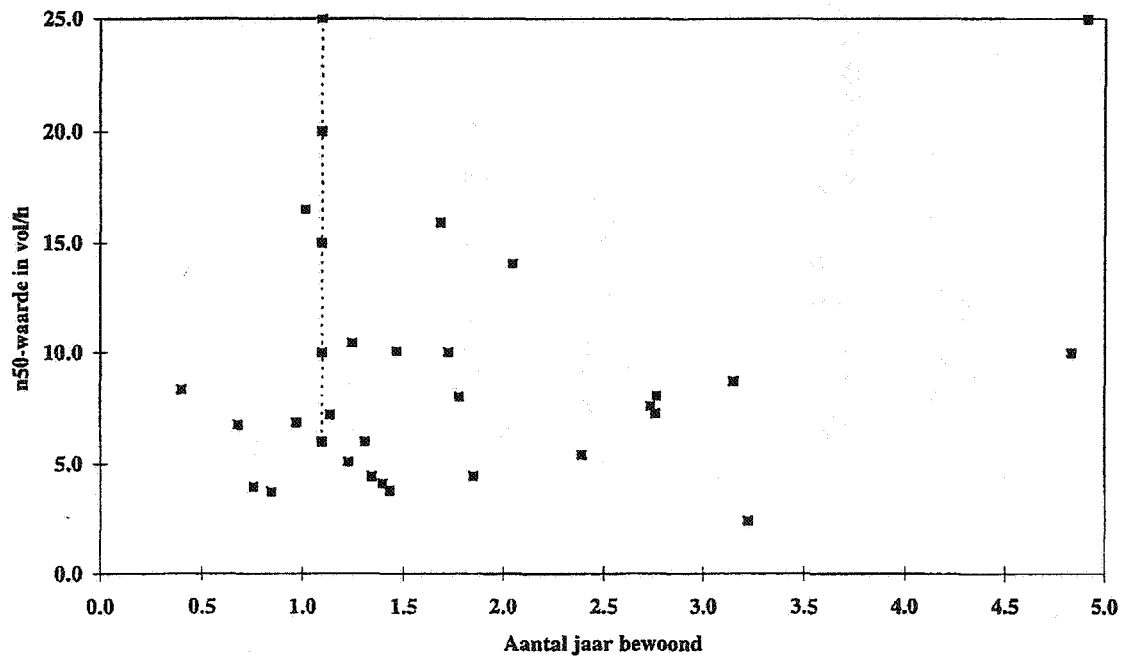

figure 1 : overview of measured n_{50}-values as function of duration of occupation

The following conclusions can be drawn :

- There is a very large spread in the results: the n_{50}-values range from 2.5 h^{-1} to 25 h^{-1} or a variation of a factor 10;
- The average value is about 8 h^{-1}. When applying the rule of thumb that the average seasonal air change rate is of the order of n50/20, one finds an average seasonal air change rate of 0.4 h^{-1}.
- There is no significant increase in the measured airtightness as a function of duration of occupation.
- The dotted line represents a dwelling of which the attic space was not yet finalised. The various points correspond with different airtightness situations.

figure 2 gives the histogram of the measured n50-values. A substantial difference is found when comparing individual dwellings and apartments. The average n50-values are the following :

- apartments : $n_{50} = 4.8\ h^{-1}$
- individual rowhouses : $n_{50} = 6.4\ h^{-1}$
- individual free-standing individual dwellings : $n_{50} = 9.6\ h^{-1}$

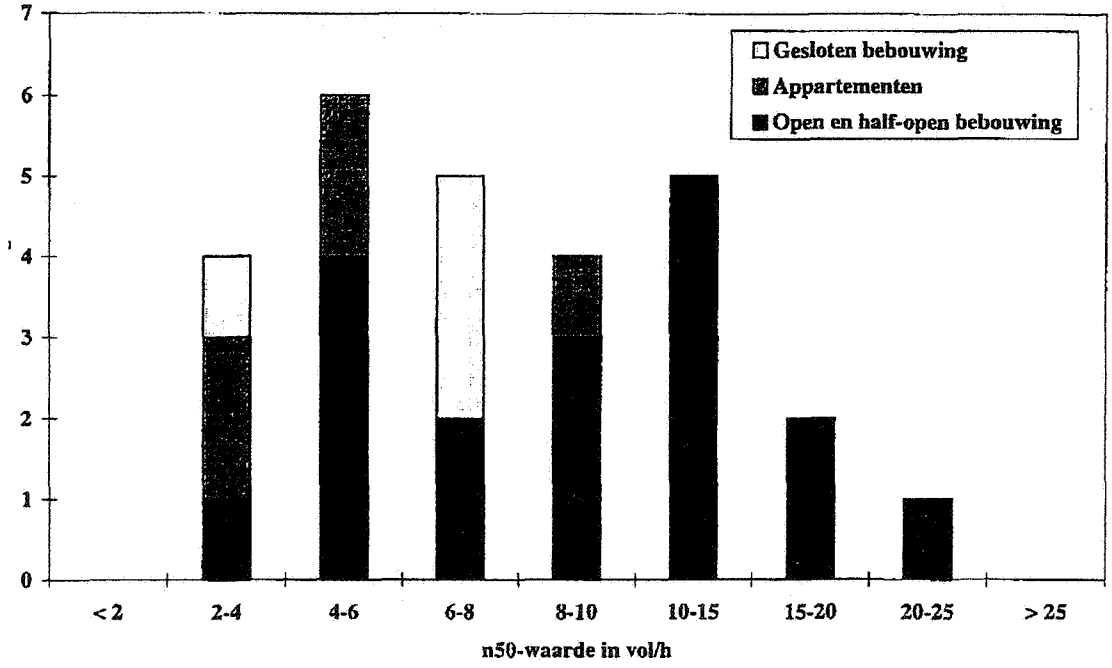

figure 2 : histogram of n50-values with splitting up as function of building type

An important information is the location of the leakages. This is discussed in the next paragraph.

2.2 Airtightness of the different leakages

- A first important observation is the fact that the most important leakages are situated in the non-occupied spaces : garage, insulated attics,...
- In case a garage exists, it represents about 1/3 of the total leakage.
- In case of an insulated attic, it represents on the average 50% of the total leakage.
- For a number of dwellings, the n50-value would drop down to less than 30% if the above mentioned spaces would be outside the protected volume.

Besides these very leaky spaces, there are also very airtight spaces. In most cases, the bedrooms are often very airtight. An overview of the measured Q50-values is presented in figure 3.

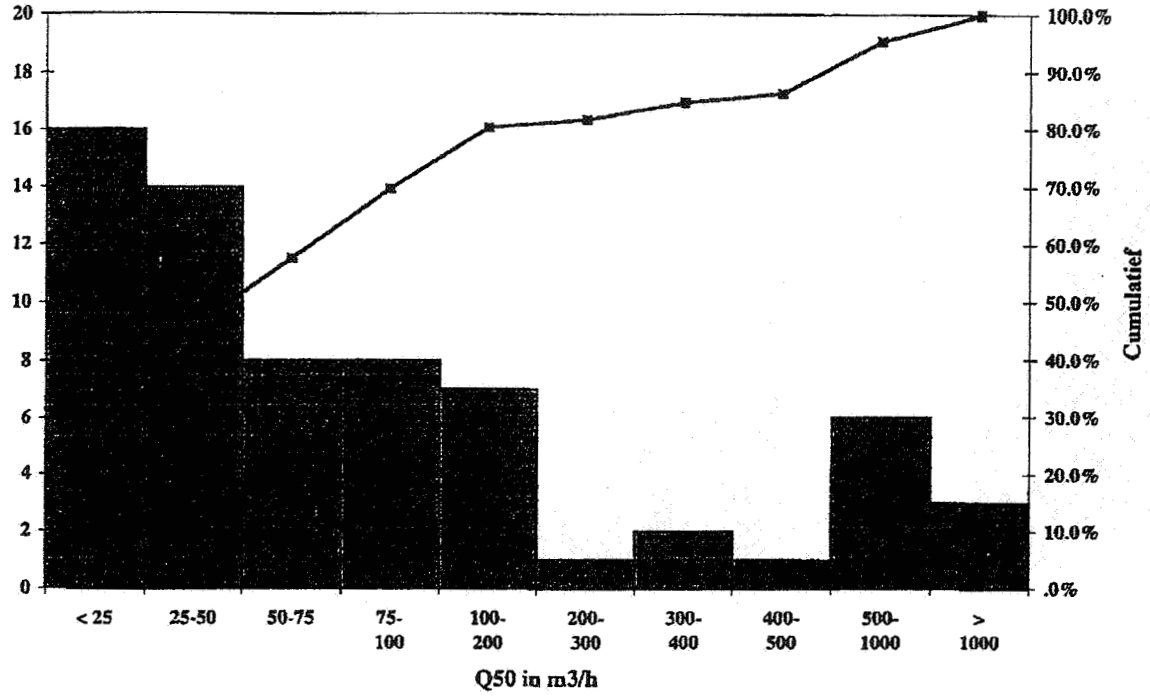

figure 3 : measured air flow rates (Q_{50}) in the bedrooms

One can observe that 70% of the bedrooms have a Q50-value which is lower than 100 m³/h. On the other hand, 15% of the bedrooms have a Q50-value which is higher than 500 m³/h. Most of the latter group are bedrooms situated below inclined roofs.

As far as the very airtight bedrooms is concerned, it is clear that the air infiltration through the leakages is insufficient for allowing a good IAQ.

Also the bathrooms are often very airtight. This is illustrated in figure 4.

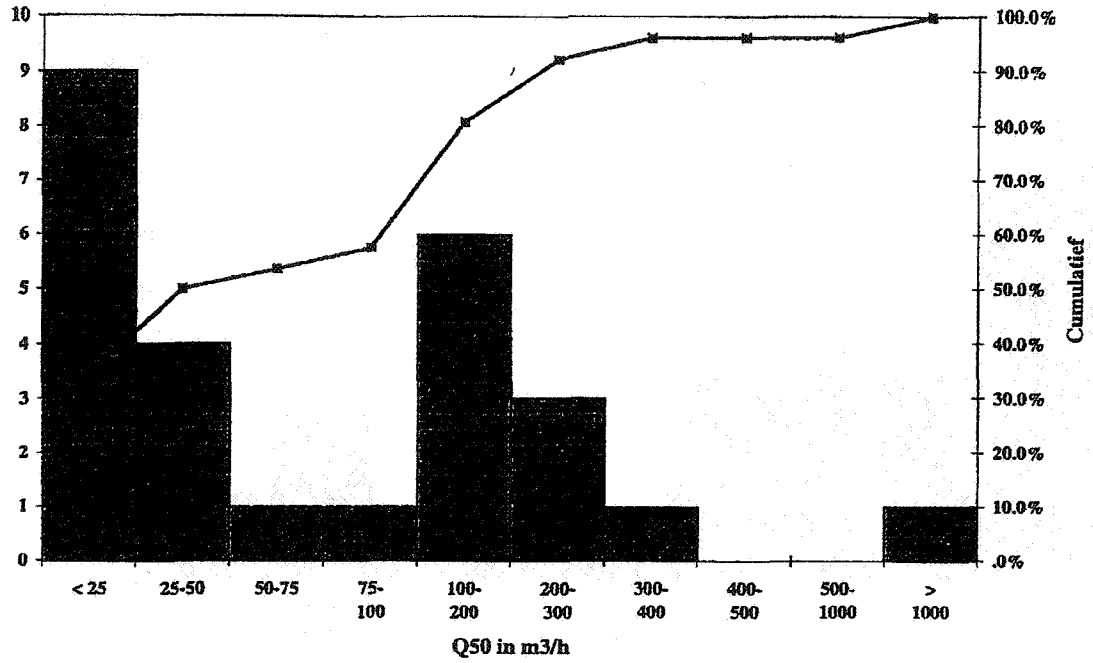

figure 4 : measured Q_{50}-values of bathrooms (vertical axis : number of bathrooms)

3. Visual estimation of the airtightness

One of the objectives of the SENVIVV study in relation to building airtightness is evaluating to what extent the airtightness can be estimated by visual means.

3.1 Approach

During the inspection visit, all visible leakages are registered. For each identified leakage, a leakage rate Q_{50} is associated. For this, a standard list is used. The following typical leakages are considered :

1. walls, floors and ceilings
2. connections between walls/floors/ceilings
3. joints in frames of windows and doors
4. connections between windows and walls
5. large openings and other leakages

The beginning of the list is given in table 1.

Walls in brickwork, concrete blocks,... : plastered	1
Brickwork not plastered nor painted	3
Concrete blocks not plastered nor painted	6
Gypsum board (joints plastered)	1
Gypsum board (joints not plastered)	3/10/(20)
Sandwich panels, joint finished	1.5
Sandwich panels, open joint	3/10/(20)
.....	...

table 1 : Part of list used for visual estimation of leakages

3.2 Results

The results of the comparison between the visual estimation and the measured values is given in figure 5 : comparison between measured and estimated Q50-values.

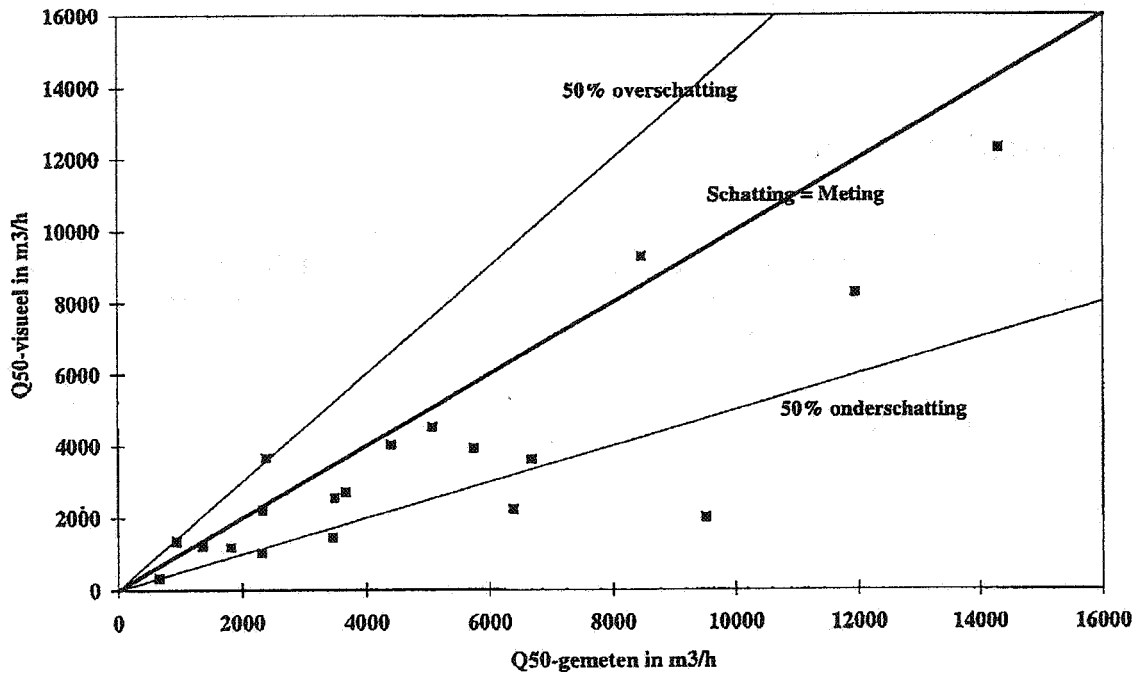

figure 5 : comparison between measured and estimated Q50-values

(horizontal axis: measured vertical axis : estimated)

The following observations can be made :

- The estimated Q50-value by the visual method is rarely above the measured value (only 3 times), in most cases is there an underestimation.
- In only 1 case is the estimation more than 50% above the measured value;
- In 4 cases is the estimation less than 50% of the measured value.
- The results seem to indicate that the visual method allows a quite realistic estimation of the minimum leakage level.

4. Conclusions

1. The airtightness of recent Belgian dwellings is not at all very good. One explanation is the fact that the owners of many dwellings take care of the finishing of certain parts of the dwelling.
2. For the Belgian context, the visual estimation of the leakage rate seems to allow a first order estimation of the minimum leakage rate of the dwelling.
3. Even in new dwellings constructed after 1990, the presence of purpose provided ventilation supply and exhaust devices is seldom. This is mainly due to the fact that there is not yet a legislation in the Flemish Region imposing such provisions.

5. Acknowledgements

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