Influence of the external pressure tap position on the airtightness test result

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KEYWORDS

airtightness, blower door, measurement uncertainty, repeatability, wind

1 PURPUSE OF THE WORK

Due to the wind induced pressure, different results may be obtained if the inside-outside pressure difference is measured across different locations on the building envelope, i.e. if the external pressure tap of a differential pressure sensor measuring this pressure difference is placed in different positions. Therefore, the position of the external pressure tap may influence an airtightness test result as well. As the wind induced pressure is linked with the wind speed, it can be expected that the influence of the external pressure tap position on the airtightness test result would be amplified with increasing wind speed. The aim of this full-scale experiment is to quantify the variability of the airtightness test results obtained under repeatability conditions with different external pressure tap positions in function of the wind speed. The motivation is a better understanding of the real influence of the wind allowing a better estimation of the measurement uncertainty as well as possible improvement of the measurement technique.

2 METHOD

The airtightness of a single-family house was tested 9 times according to EN ISO 9972. During each test, the wind speed and the air flow rate through the measuring device fan were recorded simultaneously with 4 different inside-outside pressure differences.

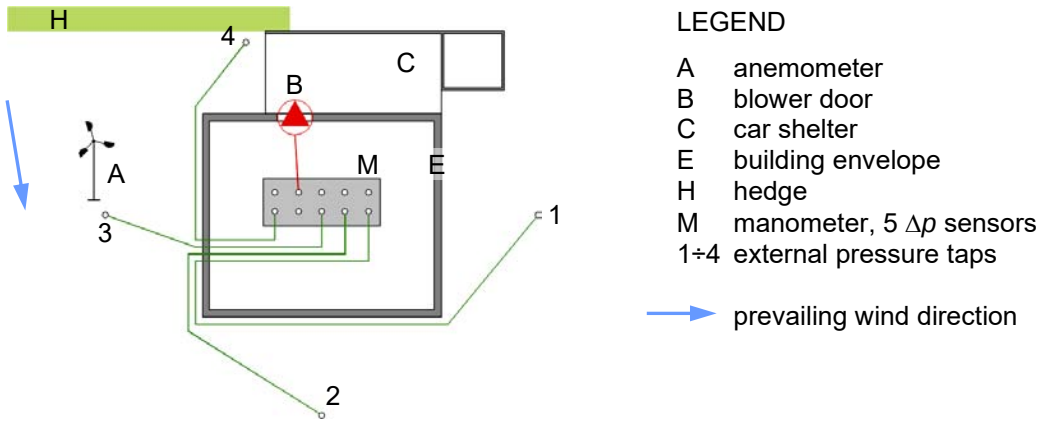

Figure 1: The experimental set-up, schematic plan view

The external pressure taps of the 4 pressure sensors measuring the inside-outside pressure differences were placed in different positions around the building while the internal pressure taps were in the same position inside the building (see Fig. 1). The external pressure taps were placed at the ground level, approx. 5 ÷ 8 m from the facades. The end of each pressure tap was equipped with a T-piece. For each test, 5 values of the air flow rate q_{50} [m^3/h] were calculated out of the 4 measured inside-outside pressure differences respectively and out of their average value (calculated).

3 RESULTS

Unfortunately, during all the 9 tests, the wind conditions were rather similar. The variability of the q_{50} values resulting from the same test and corresponding to the 4 different positions of the external pressure tap is very low (see Fig. 2). Apart from the test 09, the range of the 4 q_{50} values resulting from one test does not exceed 5.2 m^3/h. Despite expectations, the variability of the results decreases with the wind speed. Regardless the position of the external pressure tap, very high coefficients of determination r^2 were obtained. In general, higher r^2 values were obtained if the inside-outside pressure difference was calculated as average of the readings corresponding to the 4 positions of the external pressure tap.

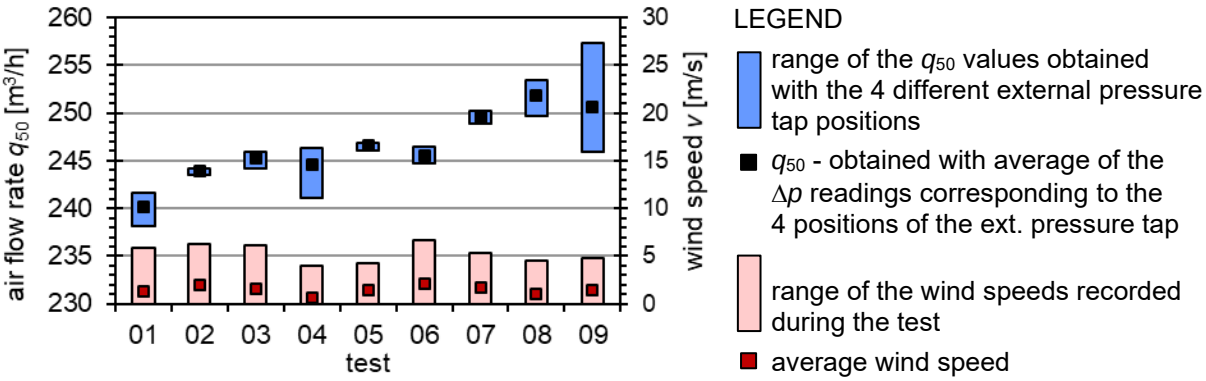

Figure 2: Overview of the results (q_{50} is the average of pressurization and depressurization test results)

4 DISCUSSION AND CONCLUSIONS

Under the wind conditions similar to this study, the external pressure tap position seems not to impede the repeatability. The statistical tests according to the ISO 5725-6 standard proved that the variability of the 4 q_{50} obtained with the 4 different external pressure tap positions within the same test fit well an interval which can be expected with regard to the repeatability of the measurement method (the repeatability was determined in another stand-alone experiment). The low wind speeds and some technical measures (T-pieces, longer periods of record, distance of the pressure taps from facades) may explain the low variability of the q_{50} values and high r^2 values obtained. So, such measures seem to effectively improve the measurement accuracy.

Owing to the small differences between the average wind speed recorded during the individual tests, the correlation found between the variability of the q_{50} and the wind speed is questionable. The results do not allow quantification of the measurement uncertainty due to the wind. A more extensive experiment in more variable wind conditions is needed for this purpose.

The averaging of the readings from the 4 external pressure taps proved to be good strategy for ensuring high r^2 value as required by EN ISO 9972 and hence for reducing the measurement uncertainty due to the wind.