Lesson learnt and new protocol for the Durabilit'air 2 project: onsite measurements

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FOREWORD

This work is part of two French research projects “Durabilit'air1” (2016-2019) and “Durabilit'air2” (2021-2024), that aim at improving our knowledge on the variation of buildings envelope airtightness through onsite measurement and accelerated ageing in laboratory-controlled conditions.
The content presented in this paper is based on two publications in past AIVC conferences (Moujalled et al., 2019, 2018) and a research paper (Moujalled et al., 2021) about the mid-term and long-term changes in building airtightness through on-site measurements in low-energy houses.

KEYWORDS

Airtightness, durability, on-site measurements, experimental protocol

1 FINDINGS FROM DURABILIT’AIR1 PROJECT

During the first project “Durabilit’air 1”, we have conducted two filed measurement campaigns on two samples of new low-energy houses: a mid-term sample (MT) composed of 30 new houses and a long-term (LT) sample composed of 31 houses built during the last 10 years. The main objectives were to quantify and qualify changes in building airtightness on different time scales, and to identify factors that may explain the variations observed.
A special measurement protocol, based on ISO 9972 (airtightness measurement) but with some additional requirements, was defined after a detailed literature review. It also includes a detailed qualitative leakage detection and questionnaire for occupants. For the MT campaign, the 30 houses of the MT sample were measured once per year over a 3-year period. Besides, five buildings of this sample were measured twice per year in order to investigate the impact of seasonal variations. For the LT campaign, the 31 houses of the LT sample were measured once. For the MT campaign, it was observed that air permeability increases slightly during the first year (a mean increase of 18%), and then stabilizes during the second and third years. We did not observe any significant seasonal variation. For the long-term campaign, air permeability showed a similar increase to that of the mid-term campaign after 3–10 years (a mean increase of 20%). However, we have observed that building airtightness deteriorated significantly in some houses while in others it stabilised or even improved. One reason would be the environmental conditions (hygrothermal, dustiness) during the installation of the airtightness barrier during the construction phase, which the literature review identified as a factor that could impact the durability of the airtightness.

In addition, the results showed an overall increase in the number of leakages detected for all houses, but this increase was not always correlated with the change in air permeability measurements. Results pointed to three factors that could explain the deterioration of airtightness: the number of levels, the type of roof and the type of building material and air-barrier.

2 EXPERIMENTAL PROTOCOL DEFINED FOR DURABILIT'AIR2 PROJECT (ON GOING PROJET)

The first study showed that the evolution of the mid and long-term changes in air permeability of low-energy houses occurs mainly in the first few years after construction is completed. However, the reasons for the deterioration of airtightness during the first years are still poorly understood.

As part of the ongoing project "Durabilit'air 2", we will conduct a new onsite measurement campaign on a small sample of houses (12 houses). Each house will be thoroughly monitored during the construction phase (checking implementation of materials including the creation of the air barrier, hygrothermal and dustiness measurements…) to one year after the building is completed with airtightness measurements. The main objectives are to better understand the evolution of the airtightness of the building and to identify the possible factors of its deterioration during the first few years of the building.

We will set up a new experimental protocol adapted to the needs of this study integrating the two phases of construction and operation of buildings.

During the construction phase, the protocol should allow the collect of the information about implementation of materials including the air barrier and the conditions of its implementation. Six visits are planned at key stages of house construction (Table 1) depending on the interventions of the different craftsmen.

Table 1: Visits at key stages of house construction

Visit number	Key stages of house construction
1	Completion of the structural works
2	Installation of the joinery
3	1st work of electricians, heating engineers, plumbers…
4	Work of drywall installer (installation of plasterboard)
5	2nd work of electricians, heating engineers, plumbers…
6	Completion of the finishing work

The references of the products used will be collected and the installation conditions will be documented. In addition, we will monitor the air temperature and relative humidity on site and characterize the condition of the wall surfaces receiving the sealants (dust). The method of dust characterization is currently being developed.

During the operation phase, after the commissioning measurement of the air permeability of the building upon completion (reference measurement), the air permeability will be measured six times every two months: at 1, 3, 5, 7, 9, 12 months of the building reception. During each test, a detailed qualitative leakage detection will be done in order to track changes in leakage distribution over the duration of the measurement campaigns. In addition, questionnaires will be used to know in detail the modifications made by occupants on the building envelope.

3 ACKNOWLEDGEMENTS

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4 REFERENCES

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