CFD modelling of fan pressurization method in buildings – The impact of dynamic wind on airtightness tests

Dimitrios Kraniotis, Arnab Chaudhuri

Oslo Metropolitan University
P.O.box: St. Olav plass 4
0130 Oslo, Norway

SUMMARY

Building airtightness tests have become very common in several countries, either to comply with minimum requirements of regulations or programs, or to justify input values in calculation methods. This raises increasing concerns for the reliability of those tests. Despite the extensive debates about how the building pressurization test standard ISO 9972 should address sources of uncertainties, no change has been implemented. According to the current standard, the zero-flow pressure shall not exceed 5 Pa for the test to be valid. Consequently, in moderately windy conditions, it may be impossible to perform a pressurization test in accordance with the standard, even using precautions with a careful uncertainty analysis. This study investigates numerically, with the use of a commercial CFD code, the impact of unsteady wind on fan pressurization tests. Two test houses, built in cross-laminated-timber (CLT), are modelled and used as case study. Various leakage location, fan placement and wind profiles are used as input in a set of Scenarios.

KEYWORDS

air infiltration; unsteady wind; fan pressurization method; airtightness test; computational fluid dynamics (CFD)

1 INTRODUCTION

Numerical methods have been extensively used in air infiltration and natural ventilation studies. The value of such methods is high in particular when unsteady phenomena are under investigation, i.e. turbulent wind. Computational fluid dynamics codes can provide detailed information about pressure distribution around building envelope and air exchange in transient analysis.

2 METHODOLOGY

A commercial CFD code is used in this study, which includes both steady state and transient analysis. For the steady state, the focus is set on the impact of various wind speeds on airtightness tests, while for the transient analysis turbulent wind is under investigation. In all cases, a wind profile has been defined in the inlet of computational domain.
Two test houses located at the site of the meteorological station of Ås are used as case study. The houses are insulated and built in cross-laminated-timber (CLT). For the detail description of wind profile, historic data about surface roughness and wind speed at 10 m have been collected and used.
In addition, various scenarios of fan exposure, i.e. windward, leeward, side as well as leakage location in building envelope have been employed. Regarding the latter, controlled leakage paths exist in the building envelope of both houses, providing the opportunity to investigate different airtightness levels.
The results from CFD will be validated experimentally in the near future.