Building and Environment 46 (2011) 1115–1124

Contents lists available at ScienceDirect

Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

Average permeability measurements for an individual dwelling in Romania

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ARTICLE INFO

Article history:
Received 5 August 2010
Received in revised form
25 October 2010
Accepted 19 November 2010
Available online 27 November 2010

Keywords:
Average permeability
Air leaks
Permeability law
Apartment building

ABSTRACT

The air permeability represents that feature of the building playing a major role in both the building energy performance and the indoor environment quality, therefore its prediction is very important. The statistical prediction models which are used today on a very large scale present large errors. The experimental measurements correct this deficit, but they are impossible to be carried out for large apartment building due to technical concerns. In this study we propose an intermediate approach "the prediction of average permeability as a weighted mean of the different measured permeabilities characteristic to the different types of joinery". The article presents the mathematical models and the adapted experimental protocol for four different parameters that describes the permeability. The experimental work was carried out for an apartment placed at the ground level of a two storey house in Romania. The proposed approach presents smaller errors: 5% for the overall leakage airflow and 15% for the average permeability. The study presents interesting data being among the first permeability measurements in Romania. The originality of the study is also given by the proposed model which is oriented towards large dimensions blocks of apartments.

1. Introduction

The air permeability of a building represents an important characteristic of the building which is significantly influencing the quality of the indoor environment: the heating load, the strategies of the ventilation system, the degree of the indoor air pollution [1–3], the indoor acoustic comfort [4] and last but not least the energy performance of the building [5]. Therefore predicting the airtightness is very important for both the design and the rehabilitation stages of a building.

Today in Romania, there are many large residential apartment blocks (over 5000 m^2, over 70 apartments) built in 60's–90's found in the thermal rehabilitation state. These buildings are characterized simultaneously by both old and leaky joinery for some apartments and modern and tight joinery for other apartments, thus the permeability is not distributed uniformly over the entire façade. Moreover, the action of the wind upon the façade is also different according its direction and to the building height [6]; the same building may be divided into different shielding classes [7]. Both phenomena are translated through leakage airflows which are variable over the entire façade. In the actual context of thermal rehabilitation of buildings in order to reduce energy consumptions, it appears a major need to predict the permeability and the leakage airflow for this kind of buildings with variable permeability of their façades.

The air change rate through their façades might be evaluated using predictive models determined from experimental data bases. In the specific literature there are several data bases for many countries such as: United States [8], Greece [9], Finland [10], Spain [11], France [12,13], Italy [14], Australia [15], Canada [16] being extensively used to deduce mathematical models for the infiltrated air change rate for different types of buildings.

Air infiltration models can be classified into two major categories: single-zone models such as Lawrence Berkeley Laboratory (LBL) model [17,18] or AIM-2 model [19] and multi-zone models such as COMIS [20] and CONTAM [21]. Single-zone models predict the air infiltration rate for a whole building represented as a single and well-mixed zone. Single-zone models present the advantage of being fast and simple to use. Multi-zone models allow the division of a building into a number of distinct pressure regions. With more user inputs and computation time required, multi-zone models can provide detailed results about the leakage rates through all leakage paths.

Previous studies [22] present a mean error for the single-zone LBL model of 26–46%, reaching up to 159%. The AIM-2 single-zone model [23] presents errors around 19%, reaching up to 87%. Similarly, high errors are obtained for multi-zone models for the real building case [24]. Multi-zone models are very sensitive to user data introduction and model choice, and users easily make modeling errors

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doi:10.1016/j.buildenv.2010.11.012