



International Conference On Materials And Energy 2015, ICOMÉ 15, 19-22 May 2015, Tetouan, Morocco, and the International Conference On Materials And Energy 2016, ICOMÉ 16, 17-20 May 2016, La Rochelle, France

## Experimental assessment of the variability of concrete air permeability: repeatability, reproducibility and spatial variability

N. Issaadi\*; A. A. Hamami, R. Belarbi, A. Aït-Mokhtar

*University of La Rochelle-CNRS, LaSIE UMR 7356, Avenue Michel Crépeau 17042 La Rochelle Cedex 1, France*

---

### Abstract

To study the effect of spatial variability of some influential parameters on the durability of the building envelopes, some important information are required: the mean, the standard deviation and the spatial correlation of the studied fields defined by the correlation lengths. In this paper, the characterization of the concrete spatial variability was performed which included a significant number of test allowing the characterization of concrete air permeability. For this a concrete wall of 2 m of height, 1.20 m of width and 15 cm of thickness was manufactured in laboratory in which concrete specimens were periodically taken and tested. Firstly, results repeatability was performed. For these purpose, three tests per sample was carried out in order to assess the repeatability of the measurements. Secondly, the reproducibility of the measurements was carried out by testing two samples for each cored specimen.

Good repeatability of the intrinsic permeability measurements on each tested sample is recorded. Indeed, the standard deviation does not exceed  $0.67 \times 10^{-17} \text{ m}^2$ . Also, the concrete intrinsic permeability depends on the spatial location of the studied sample. It was found to be ranging between  $2.38 \times 10^{-17}$  and  $5.91 \times 10^{-17} \text{ m}^2$  with an average value equal to  $3.66 \times 10^{-17} \text{ m}^2$ .

The obtained results enable to quantify the spatial variability of concrete air permeability, particularly in terms of mean value and standard deviation. Also, it allowed highlighting the spatial correlation length of the studied fields and for probabilistic approaches regarding the prediction of the concrete durability.

© 2017 The Authors. Published by Elsevier Ltd.

Peer-review under responsibility of the scientific committee of ICOMÉ 2015 and ICOMÉ 2016.

*Keywords:* Concrete, air permeability, spatial variability, statistical function, correlation length

---

---

\* Corresponding author. Tel.: +33-155-178-034; fax: +33-155-178-001.

E-mail address: [nissaadi@cesi.fr](mailto:nissaadi@cesi.fr)

## 1. Introduction

The cementitious materials, which are nowadays the most used building material, have a very complex microstructure with heterogeneous shape leading to random mechanical and physical properties. These properties are affected by different phenomena that have chemical origin such as the cement hydration or physical such as the moisture, heat and aggressive species transfers. These latter can vary considerably depending on how the concrete is manufactured, cast and conditioned. This variability will affect the material behavior in general and, particularly, his behavior regarding the transfer phenomena.

Some works have highlighted the effect of the variability of some concrete parameters on its behavior. De Larrard [1] has studied the influence of this variability on leaching of concrete and its service life when it is used for manufacturing tunnels for radioactive waste storage. They showed the interest of considering this properties variability of cementitious materials.

The present work focuses on the study of the spatial variability of concrete air permeability. This will be used in probabilistic approaches for the prediction of hygrothermal behavior and durability. Trabelsi et al. [2] have studied the statistical variability of water vapor desorption isotherms. They showed their impact on the concrete drying and noticed a significant effect especially in the concrete cover. Dominguez-Minoz et al. [3] have studied the thermal conductivity of foams and noticed an important variability of this property. They compared other results provided by an inter-laboratories study on the hydric properties. They noticed a good reproducibility for some properties (porosity and density) when this reproducibility remains very poor for other properties such as the sorption isotherms and the resistance to the water vapor despite the used techniques are the same for the different laboratories. Feng et al. [4] studied the repeatability and the reproducibility of hydric properties of different materials. They concluded to a good repeatability for their results, nevertheless, the reproducibility was poor when comparing the results obtained by different laboratories. Indeed, significant differences are reported for the transport properties due to differences of the experimental procedures and analyses monitoring conditions, when comparing the results obtained by different laboratories [3, 5-7].

The study is conducted on a concrete wall. This wall was cored at different spatial locations in order to obtain different samples. The obtained samples were used for the characterization of air permeability of this concrete. A statistical distribution laws are proposed for the description of the variability of this property. Also, repeatability and reproducibility of the results are performed.

## 2. Experimental program

To study the effect of spatial variability of some influential parameters on the hygrothermal behavior of the building envelopes, some important information are required: the mean, the standard deviation and the spatial correlation of the studied fields defined by the correlation lengths. To obtain this data, an experimental concrete wall of 2 m of height, 1.20 m of width and 15 cm of thickness was manufactured in the laboratory in which samples were cored following six vertical lines. Two lines are dedicated to air permeability tests (diameter=65 mm, height=50 mm) (lines B and E in Fig. 1).



Fig. 1. Specimen position in the experimental concrete wall

Download English Version:

<https://daneshyari.com/en/article/7918166>

Download Persian Version:

<https://daneshyari.com/article/7918166>

[Daneshyari.com](https://daneshyari.com)