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Measurement of apparent thermal conductivity of wet porous building materials by a periodic method

Détermination de la conductivité thermique apparente des matériaux de construction poreux et mouillés par une méthode périodique

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Foreword

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The committee responsible for this document is ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

Introduction

Most building materials, with the exception of glass and metals, are porous and, thus, absorb moisture due to condensation, rain and water uptake from the ground. The absorbed moisture may damage the materials through, e.g. rotting or frost damage and, thus, may cause their performance to deteriorate. In particular, an increase in the moisture content of insulation material causes a reduction of its thermal resistance, which must be avoided as much as possible to preserve its performance. However, infiltration of rain water into a brick wall or joints of tiles and uptake of ground water into the foundation (footing) are very difficult to avoid. Therefore, it is important to understand the changes in the thermal properties (thermal conductivity and heat capacity) of porous materials due to changes in their moisture content.

ISO 10051 specifies a steady-state method for measuring the thermal conductivity of a moist building material. In the steady-state method, a nonuniform distribution of moisture content in the test piece is inevitable, since the imposed temperature gradient causes moisture transfer. The nonuniform moisture distribution makes it difficult to define which moisture content the measured thermal conductivity corresponds to. ISO 10051 categorizes the moisture distribution in the test piece into several types and estimates the thermal conductivity corresponding to each type.

Since theoretical and experimental research has recently been performed concerning heat and moisture transfer in porous materials (see References [5], [7], [8], [9] and [10]), along with measurements and the construction of a database of hygrothermal properties (see Reference [6]), hygrothermal behaviour can now be predicted with reasonable accuracy.

This International Standard describes a transient method for measuring the thermal conductivity of a wet porous building material and a method of evaluating the measurement uncertainty, on the basis of both theoretical developments for heat and mass transfer and the constructed database of hygrothermal properties. The evaluation of the measurement uncertainty makes possible a simple and, thus, practical method for measuring thermal conductivity.

NOTE Thermal conductivity is one of the necessary hygrothermal properties. Since heat transfer and mass transfer in porous material interact with each other, an exact value of the thermal conductivity must be given in order to examine the validity of the theoretical models. Thus, precisely speaking, the above-mentioned theoretical models have not been validated, and the construction of the model and the measurements of the hygrothermal properties must be carried out in parallel. Nonetheless, it seems reasonable to expect that measurement of the thermal conductivity with an allowable accuracy is possible using a suitable measuring method. This is the basis for the present document.