Coupled Heat and Moisture Transport in Masonry

Tomáš Krejčí, Jaroslav Kruis, Michal Šejnoha, Tomáš Koudelka
Czech Technical University in Prague
krejci@cml.fsv.cvut.cz, jk@cml.fsv.cvut.cz, sejnom@.fsv.cvut.cz,
koudelka@cml.fsv.cvut.cz

Abstract

Numerical modelling of coupled heat and moisture transport in masonry by the finite element method leads to huge number of degrees of freedom. It is caused mainly by an effort to create suitable finite element mesh in mortar between stones and in its vicinity in order to capture correct temperature and moisture distribution. Such problems with too many degrees of freedom are hardly solvable on single processor computers. One of possible solutions of the mentioned difficulties is an application of a multi-scale approach. This paper presents hybrid parallel method based on multi-scale analysis. In the hybrid method, each macro-scopic integration point or each finite element is connected with a certain meso-scopic problem represented by an appropriate periodic unit cell. The solution of a meso-scale problem then provides effective parameters needed on the macro-scale. Such an analysis is suitable for parallel computing because the meso-scale problems can be distributed among many processors and the amount of transferred data is small. In this regard, the master-slave strategy can be efficiently exploited. Two-scale approach with a macro-scale problem dealing with the structure and a meso-scale problem describing the type of masonry has been introduced in [1] and [2]. This formulation corresponds to the first order homogenization, where only the function value and the gradient of the macro-level function is used on the meso-level.

References

1. J. Sýkora and M. Šejnoha and J. Šejnoha. Homogenization of coupled heat and moisture transport in masonry structures including interfaces. Applied Mathematics and Computation (2011) http://dx.doi.org/10.1016/j.amc.2011.02.050.
2. J. Sýkora and J. Vorel and T. Krejčí and M. Šejnoha and J. Šejnoha. Analysis of coupled heat and moisture transfer in masonry structures. Materials and Structures, 42(8), (2009) 1153-1167.