Homogenization of Masonry and Heterogeneous Materials on PC Clusters

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Abstract

There are two major approaches for numerical modeling of masonry with the help of FEM. The first possibility is to use a very fine mesh which takes into account the composition of the material and the second one is based on a homogenization method. The decision which approach should be used is difficult because both possibilities lead to a very large number of arithmetic operations and they are very time consuming and therefore execution on parallel computers may be a suitable option. This contribution presents a processor farming method in connection with a multi-scale analysis. In this method, each macroscopic integration point or each finite element is connected with a certain meso- scopic problem represented by an appropriate representative volume element (RVE). The solution of a mesoscale problem provides then effective parameters needed on the macro-scale. Such an analysis is suitable for parallel computing because the mesoscale problems can be distributed among many processors. The method differs from classical parallel computing methods which come out from the domain decomposition. The macro-problem is assigned to the master processor while the solution of homogenization procedure ([1] and [2]) at the meso-level is carried out on slave processors. At each time step the current temperature, moisture and mechanical fields together with the increments of their gradients at a given macroscopic integration point are passed to the slave processor (imposed onto the associated periodic cell), which, upon completing the small-scale analysis, sends the homogenized data on mesoscale (effective conductivities, averaged storage terms, fluxes, forces etc.) back to the master processor. The application of the processor farming method to a real-world masonry structure is illustrated by a numerical example.

References

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