An adaptive domain decomposition approach for modeling failure in unreinforced masonry using the finite element method

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ABSTRACT

Masonry is, despite its age, still a relevant research topic in structural mechanics. On one hand there is a lot of interest in the conservation of our cultural heritage buildings of which a big portion is constructed using masonry. On the other hand it is still one of the most popular building materials, making understanding its behavior crucial to ensure both safety and price efficiency.

This composite material is highly heterogeneous, due to its different material properties of brick and mortar. This combination causes a highly complex and non-linear behavior for the composite material making efficient and accurate modeling solutions, especially in failure, difficult.

An underexplored solution for the efficiency problem in masonry is domain decomposition[1, 2] in which one separates the material into regions of higher and lower resolution. In high resolution areas the constituent materials are modeled separately, while elsewhere one models a homogenized material[3] thus lowering computational costs. This method has been successfully applied in other construction engineering fields[4, 5]. Despite the heterogeneous nature of masonry, this homogenization can be highly accurate due to the periodicity inherent in the material. Improving run-time refinement criteria[6] based on the material nonlinearities together with the corresponding refinement process is crucial and part of the investigation.

A new finite element based program making use of adaptive domain decomposition is developed in the present research, in combination with other state of the art modeling methods, to create an efficient and accurate modeling framework which will permit efficient research on failure in large-scale masonry structures.

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