Homogenized Elastic Model for In-Plane Analysis of Masonry Walls Retrofitted by Steel Fiber Reinforced Mortar Coating

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Abstract

Unreinforced Masonry has been one of the most used construction materials worldwide and is still in use in many parts of Europe. However, it is well known that the low tensile resistance makes these structures vulnerable to both in plane and out of plane seismic actions. For this reason, many research studies are devoted to develop and improve retrofitting techniques for enhancing the seismic behavior of masonry buildings. Among these, an innovative retrofitting technology consists of steel fiber reinforced mortar (SFRM). The literature about this topic regards mainly experimental tests (see [1-2]). On the contrary, the modelling of SFRM and of its interaction with masonry structures is rather lacking.
In this work, a homogenization procedure (inspired by [3]) is used to derive simple closed-form expressions for "equivalent" linear elastic constants of masonry walls retrofitted by SFRM, solicited in their plane. The method mainly consists of modeling the behavior of an elementary cell using suitable designed assemblies of in-parallel springs. Thereafter, an equivalent homogenized orthotropic material is defined, the elementary cell of which has the same stiffness as the assembly. The stresses of the masonry and SFRM components are also evaluated analytically once the average stress acting on the homogeneous medium is determined. The accuracy of the theoretical results is assessed by means of comparisons with finite element (FE). Finally, static and dynamic FE analyses are carried out on sample retrofitted masonry walls, with the aim of comparing the non-homogeneous and homogeneous models. The latter is found to describe both the local and global behavior of masonry walls to a satisfactory extent.

References

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