Influence of the spatial variability of joints and bricks characteristics on the elastic properties of masonry

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ABSTRACT

In historical masonry building a topic of major concern is the reliable characterization of the mechanical properties of constituents. The main difficulties are, indeed, related to their marked inhomogeneity, anisotropy and local variability due both to handcrafted construction methods, often based on rules of thumbs, and to possible occurring local damaging phenomena.
Experimental results [1,2], referred either to single constituents or to the overall composite material, have shown non negligible spatial variations of constitutive variables, i.e. Young modulus, tensile and compressive strength among others, also in case of new masonry structures. When historical masonries are considered, such variability is a fortiori expected, especially with respect to the mechanical characteristics of bed and head mortar joints, very sensitive to ageing processes. The overall response of masonry walls is, in turn, strongly affected by the characteristics of single constituents both in terms of elastic properties and strength. In addition, a not negligible issue in this framework is the inherent uncertainty in the results of diagnostic tests on existing masonries.
We are, thus, interested in studying the influence of spatial variability of mechanical properties of constituents on the overall response of masonry panels. To this aim, we combine well-established computational homogenization techniques with a properly conceived stochastic procedure. We focus on regular masonries, made of bricks and mortar joints, where the mechanical properties of both bed and head joints vary according to a fixed probability distribution and correlation function. The mechanical response, in terms of overall elastic stiffness, is investigated as the statistical parameters (mean, variance and correlation length) vary, in order to better modeling the masonry behavior and taking into account the variability experimentally observed. Some preliminary results confirm the relevance of the considered issue and the marked effects that the spatial variability of the mechanical properties of constituents may have on the overall response.

REFERENCES

[1] Schueremans, L., and Van Gemert D. *Predicting masonry properties from component properties using probabilistic techniques*. Proceedings of the STRUMAS V, The Fifth International Symposium on Computer Methods in Structural Masonry. 2001.

[2] Zavalis, R., Jonaitis, B. and Lourenco P.B., *Analysis of bed joint influence on masonry modulus of elasticity*, Proceedings of the 9 th International Masonry Conference in Guimarães, 2014.