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MODELLING THE MECHANICAL RESPONSE OF ADOBE COMPONENTS UNDER UNIAXIAL LOADINGS

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This paper presents a constitutive relationship to describe the uniaxial response in statics of brick and mortar samples of Adobe. This defines a traditional masonry whose components are made of soil mixture reinforced with fibres. Only recently Adobe has started attracting scientific attention, primarily as a consequence of the dramatic failures these structures have suffered in regions prone to earthquakes due to dynamic loadings. Furthermore, it possesses eco-friendly material properties which are attractive features for western countries forced to reduce the environmental impact of modern building industry. Nevertheless, the mechanical properties of Adobe are still largely neglected, especially with regards to the influence of soil mixture components. The study of the structural performance of masonry starts from the assessment of the material performance of its components. Thus, an extensive characterization campaign was organized and performed by Delft University of Technology and the Military Engineering Laboratory of the Netherlands, in order to characterize the material properties of Adobe components. Three types of bricks and one type of mortar, made with different mixture components proportions, were subjected to granulometry, moisture content, density tests and uniaxial compressive and three point bending tests. Predictive formulations for compressive and tensile strength and deformation values have been proposed by the authors [1]. These relations include the dependency of mixture components and moisture contents. In this paper, constitutive laws are developed for Adobe in pure compression and tension according to the experimental results. In compression, the force-displacement curves were interpolated according to several existing constitutive laws and the model originally developed by Priestley for concrete masonry elements was finally selected as best fitting. Despite the differences in terms of mechanical parameters, the analytical assessment revealed that the experimental force-displacement graphs of all the different types of bricks could be interpolated using the same model with the same calibrating values. Furthermore, the uniaxial response in tension was derived according to an inverse approach. A numerical model recently developed and calibrated with respect to the compressive and bending tests was used to simulate uniaxial tensile tests [2]. Also in this case, a common trend among types was observed. The results of the constitutive modelling frames components of Adobe within the class of quasi brittle (geo)materials, with particular reference to concrete-like materials. This paper presents the experimental results of the tested samples and the related analytical and numerical modelling.

REFERENCES

[1] T. Li Piani, D. Krabbenborg, J. Weerheijm, L. Koene, L. Sluys, *The Mechanical Performance of Traditional Adobe Masonry Components: An experimental-analytical characterization of soil bricks and mud mortar* (submitted), 2018.

[2] T. Li Piani, J. Weerheijm, L. Koene, L. Sluys, *The Adobe Delta Damage Model*, Proc. EURO-C 2018: Computational Modelling of Concrete and Concrete Structures, Bad Hofgastein, Austria, 26th Feb. 1st Mar., 2018.