Enhanced micromechanical formulation for capturing permanent strain in lime materials

Sina Sayadi[1*], Cristina De Nardi [1], Tony Jefferson[1], Iulia Mihai [1]

[1] Cardiff University sayadimoghadams@cardiff.ac.uk

Abstract

Since pre-historic time, lime-based mortars have been widely used in constructions and interest in designing new compositions for retrofitting operations has grown considerably in recent years. Much of the work undertaken on lime-based mortars have been experimental in nature but there has also been some numerical research aimed at producing computational models for these materials. Whilst considerable progress has been made on models that simulate certain aspects of stress-strain behaviour of lime mortars in compression, there remain some key behavioural characteristics that current models do not represent well, which includes the simulation of the strain-softening portion. In the present study, a refined micromechanical formulation is used to derive the 3D constitutive material formulation of this material under different loading scenarios. Under compression load, damaged particles would be interlock in the open crack which causes the residual strain during unloading processes. A new approach is followed to express this mechanism mathematically and implementable to the current micromechanical formulation. The proposed model was validated by comparing the outputs with experimental data sets that align with the simulated scenario. The results show that the new continuum micromechanical damage model could capture the permanent strain of lime mortar and uses a few physical parameters as input compared to the phenomenological approaches. The experiments and their simulation contribute to discuss on the complexities of existing masonry structures, in which the progression of damage in each material phase must be accounted for.

Keywords: *Micromechanics, Constitutive equation, Lime-based mortar*