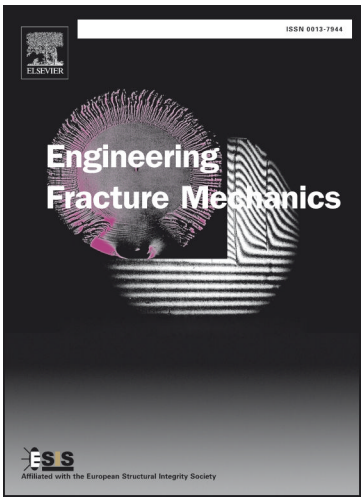

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PII: S0013-7944(18)30249-2
DOI: https://doi.org/10.1016/j.engfracmech.2018.07.006
Reference: EFM 6072

To appear in: *Engineering Fracture Mechanics*

Revised Date: 1 July 2018
Accepted Date: 4 July 2018

Please cite this article as: Boumakis, I., Luzio, G.D., Marcon, M., Vorel, J., Wan-Wendner, R., Discrete element framework for modeling tertiary creep of concrete in tension and compression, *Engineering Fracture Mechanics* (2018), doi: https://doi.org/10.1016/j.engfracmech.2018.07.006

Discrete element framework for modeling tertiary creep of concrete in tension and compression

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Abstract

In this contribution, a computational framework for the analysis of tertiary concrete creep is presented, combining a discrete element framework with linear visco-elasticity and rate-dependency of damage. The Lattice Discrete Particle Model (LDPM) serves as constitutive model. Aging visco-elasticity is implemented based on the Micro-Prestress-Solidification (MPS) theory, linking the mechanical response to the underlying physical and chemical processes of hydration, heat transfer and moisture transport through a multi-physics approach. The numerical framework is calibrated on literature data, which include tensile and compressive creep tests, and tests at various loading rates. Afterwards, the framework is validated on time-to-failure tests, both for flexure and compression. It is shown that the numerical framework is capable of predicting the time-dependent evolution of concrete creep deformations in the primary, secondary but also tertiary domains, including very accurate estimates of times to failure. Finally, a predictive numerical study on the time-to-failure response is presented for load levels that are difficult to test experimentally, showing a deviation from the simple linear trend that is commonly assumed. Ultimately,

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