A new constitutive model for asphalt concrete materials in a mesoscale approach

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Abstract

The mechanical behaviour of asphalts strictly depends on its internal structure, namely the location of bitumen and aggregate, together with voids. Therefore, a correct mechanical prediction of creep is achieved through a correct evaluation of the stress concentration among the inclusions and the voids within the domain of interest [1]. For this reason, the mechanical behaviour at medium-to-long-term of asphalt is studied in a 3D mesoscale approach, by explicitly modelling the composite material as a cluster of aggregates (the coarse fraction is considered, for computational reasons) and bitumen surrounding them (see Fig. 1). The random disposition of inclusions satisfies a given grading curve and a known volume fraction [2].

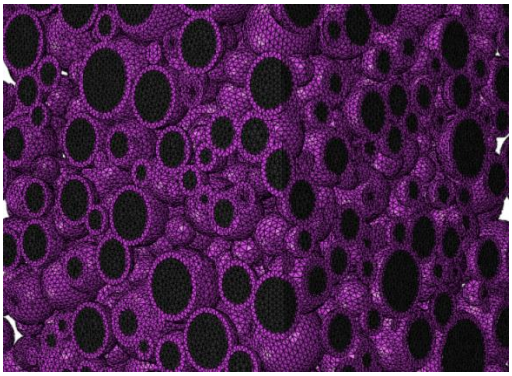

Fig.1 – A possible mesoscale representation using ellipsoidal inclusions.

In agreement with recent viscoelastic formulation [3, 4] a new visco-elasto-plastic constitutive model has been developed, where the viscoelasticity is accounted for via a fractional formulation, i.e. through a parabolic-dashpot-based mechanical representation. The subsequent non-integer order differential model is treated with the Grünwald definition of fractional derivatives. Long term effects have been carried out under different monotonic and cyclic load conditions, based on some relevant experimental tests. The model itself accounts for a better understanding of the inclusions interaction within asphalt under different compressive external loads.

References

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