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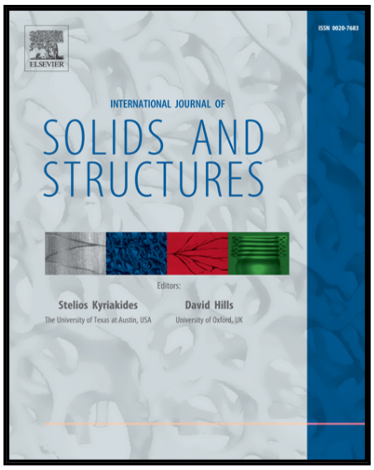

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Hydro-mechanical network modelling of particulate composites

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Abstract

Differential shrinkage in particulate quasi-brittle materials causes microcracking which reduces durability in these materials by increasing their mass transport properties. A hydro-mechanical three-dimensional periodic network approach was used to investigate the influence of particle and specimen size on the specimen permeability. The particulate quasi-brittle materials studied here consist of stiff elastic particles, and a softer matrix and interfacial transition zones between matrix and particles exhibiting nonlinear material responses. An incrementally applied uniform eigenstrain, along with a damage-plasticity constitutive model, are used to describe the shrinkage and cracking processes of the matrix and interfacial transition zones. The results showed that increasing particle diameter at constant volume fraction increases the crack widths and, therefore, permeability, which confirms previously obtained 2D modelling results. Furthermore, it was demonstrated that specimen thickness has, in comparison to the influence of particle size, a small influence on permeability increase due to microcracking.