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PVP BASED VORONOI CELL FINITE ELEMENT METHOD FOR MECHANICAL ANALYSIS OF HETEROGENEOUS MATERIALS

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ABSTRACT

The Voronoi cell finite element method (VCFEM) is developed for the elastic-plastic analysis of heterogeneous Cosserat materials. The parametric variational principle (PVP) of the Cosserat theory is developed and the finite element formulations for the VCFEM are established. Compared with the conventional FEM, the newly developed method requires no tedious iterative procedures, and has no convergence problems. A smaller number of finite elements are needed for the discretization of heterogeneous materials with the model developed. The DOFs of the problem are reduced and the computational efficiency is improved. Based on the method developed, influence of microscopic heterogeneities on the overall mechanical responses of heterogeneous materials is studied. It is found that the volume fractions and the material properties of the inclusions have significant effect on the macromechanical responses of the heterogeneous materials. The characteristic length scale parameter has stronger influence on the macroscopic responses of RVE under shear load case than that under tensile case.

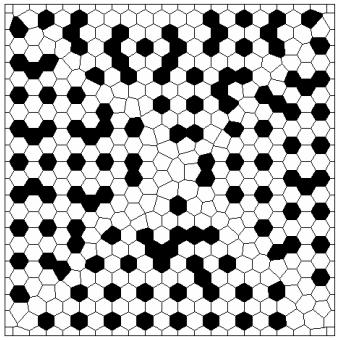

Fig. 1 Voronoi mesh of heterogeneous plate

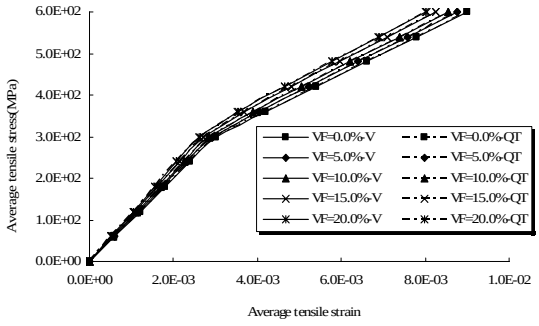

Fig. 2 Average stress-strain responses with stiff inclusions

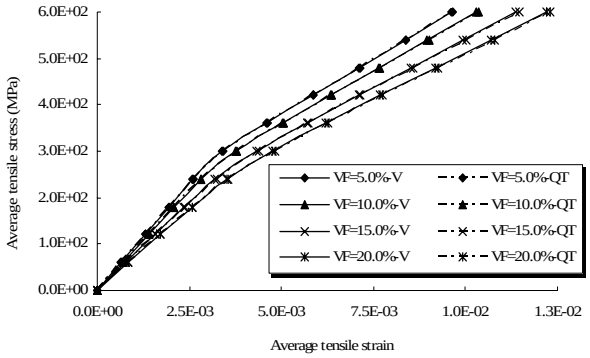

Fig. 3 Average stress-strain responses with soft inclusions

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