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EFFECTIVE PROPERTIES OF PARTICULATE COMPOSITES WITH INHOMOGENEOUS INTERPHASES

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The modeling of inhomogeneous interphases in random particulate composites will be discussed. In our model the interphases are represented by layers of springs whose stiffness parameters change across interphase surface. This causes the effective properties of the composite to become anisotropic (in our case orthotropic). To capture the effects of inhomogeneous interphase on the overall properties of the composite two ideas proposed with the author's participation are utilized. One is the Method of Conditional Moments (MCM), a statistical homogenization technique developed in the past to analyze the effective properties of random composites without interphases [1]. The other is the recent notion of energy equivalent inhomogeneity (EEI) [2], which replaces the particles of the composite and their interphases with homogeneous perfectly bonded particles whose properties are energetically determined in terms of the properties of the particles and properties of their interphases. It is based on Hill's energy equivalence principle. The idea of the EEI allows methods devised to describe composites without interphases, such as MCM, to analyze problems with interphases. In addition, the notion of EEI permits to account for interphases with spatially varying properties, a feature could be critical from the point of view of their damage. The key feature associated with the combination of these two ideas is that it allows to evaluate closed-form formulas for the components of the effective stiffness tensor of random particulate composites accounting surface varying interphase. The approach will be illustrated by numerical examples. They will concern composites with spherical particles with spatially varying properties. Comparisons with the existing numerical and experimental results will be described and the relative merits of the proposed approach will be discussed in this context.

REFERENCES

[1] L. Nazarenko, H. Stolarski, L. Khoroshun and H. Altenbach, Effective thermo-elastic properties of random composites with orthotropic components and aligned ellipsoidal inhomogeneities. *Int. J. Solids & Struct.,***136-137**, pp. 220-240, 2018.

[2] L. Nazarenko and H. Stolarski, Energy-based definition of equivalent inhomogeneity for various interphase models and analysis of effective properties of particulate composites. *Comp. Part B.,* **94**, pp. 82–94, 2016.