A RIGOROUS DERIVATION OF THE INTERFACE CONDITIONS IN LINEAR POROELASTIC COMPOSITES

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The modeling of complex structures obtained by joining simpler elements with highly contrasted geometric and/or material characteristics represents a source of a variety of problems of practical importance in all fields of engineering. In the present work we undertake a rigorous derivation of the interface conditions between two poroelastic solids separated by a thin poroelastic interphase layer by means of an asymptotic analysis, following the approach by [1, 2, 3, 4]. The goal of the present work is to identify the interface limit models of a linear poroelastic composite constituted by a thin poroelastic layer surrounded by two poroelastic bodies. The mechanical behavior is described by the quasi-static Biot equations of linear poroelasticity. By defining a small parameter $\varepsilon$, associated with the thickness and the constitutive properties of the middle layer, we perform an asymptotic analysis by letting $\varepsilon$ tend to zero. We analyze different situations by varying the stiffness ratios between the middle layer and the adherents. This parametric analysis draws the attention to three significant cases: namely, the soft poroelastic interphase, where the material coefficients of the intermediate domain have order of magnitude $\varepsilon$ with respect to those of the surrounding bodies; the hard poroelastic interface, where the constitutive parameters have the same order of magnitude; finally, the rigid poroelastic interface, where the rigidities have order of magnitude $\frac{1}{\varepsilon}$. We characterize the limit transmission problem at order zero, the first corrector term of the asymptotic expansion, giving a more precise approximation of the actual mechanical behavior, and we identify the ad hoc transmission conditions at the interface between the two neighbouring bodies in terms of the jump of stresses, displacements and pressure.

REFERENCES


