Boundary Integral Method in the Theory of Bone Porothermoelasticity

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The concept of porous media is used in many areas of applied science (e.g., biology, biophysics, biomechanics) and engineering. The double porosity model would consider the bone fluid pressures in the vascular porosity and lacunar-canalicular porosity. A porothermoelastic approach for double porosity materials combines the theory of heat conduction with poroelastic constitutive equations, coupling the temperature field with the stresses and the pore and fissure fluid pressures.

This paper concerns with the quasi-static coupled linear theory of bone porothermoelasticity for materials with double porosity and some basic results of the classical theory of thermoelasticity are generalized. The system of equations of this theory is based on the equilibrium equations, conservation of fluid mass, the effective stress concept, Darcy's law for material with double porosity and Fourier law of heat conduction. The fundamental solution of the system of governing equations is constructed by means of elementary functions and its basic properties are established. The Green's formulas in the considered theory are obtained. The formulas of Somigliana type integral representations of regular vector and regular (classical) solutions are presented. The uniqueness theorems for classical solutions of the internal and external boundary value problems are proved. The single-layer, double-layer and volume potentials are constructed and their basic properties are established. Finally, the existence theorems for classical solutions of the boundary value problems are proved by means of the boundary integral method and the theory of singular integral equations.