On static hierarchical models of thermo-electro-magneto-elastic bars

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In this paper thermo-electro-magneto-elastic bar with variable rectangular cross-section, which may vanish on the butt ends, consisting of several inhomogeneous anisotropic layers is considered. A hierarchy of one-dimensional models of the bar is constructed using variational formulation of the boundary value problem in curvilinear coordinates corresponding to static linear three-dimensional model [1] of multilayer thermo-electro-magneto-elastic solid, when along certain parts of the boundary with positive area mechanical displacement, electric and magnetic potentials and temperature vanish, while on the remaining parts of the boundary densities of surface force, and components of electric displacement, magnetic induction and heat flux along the outward normal vector of the boundary are given, and on the interface surfaces between layers the rigid contact conditions are fulfilled. In order to construct one-dimensional models of thermo-electro-magneto-elastic bar spectral approximation method is used that is a generalization of dimensional reduction method suggested by I. Vekua [2] in the classical linear theory of elasticity for plates with variable thickness. Applying variational approach a hierarchy of static one-dimensional models is constructed and the existence, uniqueness and continuous dependence on the given data of solutions of corresponding boundary value problems in suitable weighted Sobolev spaces is investigated. Moreover, it is proved that the sequence of vector-functions of three variables restored from the solutions of the constructed one-dimensional problems converges to the solution of the original three-dimensional problem in the corresponding spaces and under additional conditions the rate of convergence is estimated.

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References

[1] G. Avalishvili, M. Avalishvili, W.H. Müller, Investigation of the three-dimensional boundary value problem for thermoelastic piezoelectric solids, Bull. of TICMI, **21** (2017), № 2, 65-79.
[2] I.N. Vekua, On a way of calculating prismatic shells, Proceedings of A. Razmadze Institute of Mathematics of the Georgian Academy of Sciences, **21** (1955), 191-259 (in Russian).