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Keynote Lectures

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By asymptotic integration of the equations of three-dimensional problems of the theory of elasticity and electroelasticity are derived recurrence formulas for the determination of the components of the stress tensor, the displacement vector and the electric potential of a two-layer plate of infinite longitudinal dimensions with a circular hole. One layer of plate is an electrically conductive with zero ohmic resistance and the other one is piezoceramic and the polarized along the thickness. Examined cases when on the faces of the plate electric potential together with the conditions of the first and mixed boundary value problems of the theory of elasticity are given. Dispersion equations of the resonant frequencies of oscillation are obtained. Part of the resonant frequencies of the plate is calculated.

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An approximated analytical solution of axisymmetric contact problems for a soft elastic layer inhomogeneous by depth

Analytical solutions for contact problems involving elastic homogeneous layer were obtained in [1-4]. Their applicability was restricted to the cases of a thick layer [1, 2], a thin layer [3], and a layer which thickness is comparable to width of a punch [4].

Due to wide use of functionally graded materials and coatings in industry, contact problems for media having varying with depth elastic properties are of particular interest. Recent results in such problems are obtained mostly in sight of special assumptions on the form of elastic properties variation (linear, power law, exponential, and so on), which allows one to use exact analytical solutions for corresponding differential equations [5-7]. Coatings with arbitrary variation of elastic properties by depth were considered by Y.-S. Wang et al. [8] and S.M. Aizikovich et al. [9-12].

Usually substrate is assumed to be undeformable when a soft elastic layer is considered [1-7]. But even the toughest materials have elastic properties, for example, Young's modulus of the diamond is 1000 GPa. Young's modulus of soft metals (Al, Cu, Pb, Ag, and others) varies from 16 to 125 GPa, Young's modulus of polymers (plexiglas, polystyrene, polyvinylchloride) – from 1 to 4 GPa. So the ratio of the Young's moduli of the layer and the elastic substrate usually is equal to 10–100 and in rare cases can be up to 1000 and greater.

In this paper we consider elastic layer inhomogeneous by depth, which is located on an undeformable substrate which elastic modulus differs more than 10 times from that one of the layer. Approximated analytical solutions for the torsion and the indentation problems for a rigid flat circular punch are constructed. Effect of the hardness of the substrate and the inhomogeneity of the layer on characteristics of the contact interaction was studied.

Numerous experimental studies show that under the attack of irradiation mechanical characteristics of metallic alloys undergo significant changes, caused particularly by the aging processes. The following effects are observed: low temperature and high temperature creep and creep fracture, irradiation aging and embrittlement. Numerical experimental results are received on creep, aging and creep fracture. Here one can see the significant increase of the creep rate. The time to fracture decreases many times depending on temperature and irradiation dose. In world literature these effects are investigated well in the context of physical material science. At the same time not enough attention is paid to describe the effects integrally by the mechanic of materials methods in the framework of mechanical parameters. In the presentation these methods are applied to formulate the creep equation and creep fracture criterion, based on the energy conservation law. The theoretical curves of creep and long time strength for different values of irradiation dose are constructed and compared with the corresponding experimental results.

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analysis of a standard model used in the problems of applied acoustics, when boundary surfaces are replaced by planar faces of the inscribed or circumscribed polyhedra.

The stability of non-conservative rod systems is investigated, considering the different types of friction.The destabilization effects due to friction are established.

problem of optimal stabilization of the mathematical pendulum at lower equilibrium position in case of small oscillations has been formulated. The problem has been solved by using Lyapunov – Bellman method. An optimal Lyapunov function and an optimal control action have been constructed.