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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.

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Either ordinary concretes with polymer additives are used in practice, either materials in which polymer is considered to be the unique binder. The choice of polymer is defined by the sphere of use of concrete and character of possible influences.

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*To a problem of vibrations of adjoining semi-infinite plates on a surface of elastic medium*

The problem of vibrations of the coating consisting of two half-planes, bordering along a straight line on an elastic foundation is discussed.

Dynamic problems of the elasticity theory for plates on deformable foundation have applications in construction, engineering, materials science and other fields. In seismology, the interaction of lithospheric structures as contacting deformable plates placed on an elastic foundation can also be studied in terms of the theory of mixed problems of elasticity.

Two-dimensional elastic plates with the average thickness parameters are considered as components of coatings. The infinite crack passes on the border between the plates. Contact between the coating and the substrate is ideal, an elastic medium containing no defects treated as substrate. Applying the differential factorization method systems of integral equations concerning the stresses between the coating and the foundation are constructed. Solutions of received integral equation's systems are obtained with integral factorization method of Wiener–Hopf. Difficulties caused by the polynomial growth of the elements of kernel's symbols are overcome by moving a differential operator outside. The unknown functions included in the solutions are determined from the given boundary conditions for the plates.

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