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Analytical and Numerical Solutions of Two-dimensional Problems of Asymmetric Elasticity Theory

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Models of mechanics of deformable bodies in which medium deformation can be described both by the displacement vector and by the rotation vector are currently available in the literature. Classical works devoted by asymmetric elasticity theory argue that these theories are capable of providing best agreement between theoretical and experimental data at high gradient stresses. However these models have not found wide application due to the absence of the reliable data on material constants of the asymmetric elasticity theory. Moreover no information exists regarding the experiments testifying that the couple effects are present in solids subjected to deformation.

One of the criteria for estimation of the applicability of the asymmetric elasticity theory is the availability of problems solved in the framework of this theory, which makes possible the corresponding experimental realization.

In this work new analytical solutions to the following problems of asymmetric elasticity theory are presented: torsion and deformation of a rigid ring in elasticity region, unilateral extension of a plate with a circular hole (Kirsh problem), shear deformation of elastic infinite plane layer [1].

To enlarge the number of the aforementioned problems the finite element method algorithm has been developed for solving two-dimensional problems of asymmetric elasticity theory. Numerical solutions are found for several problems in which couple effects manifest themselves more "dramatic" than in the problems with realized analytical solutions, for example, the problem of unilateral extension of a plate with several circular holes.

The algorithm of sensitivity analysis method is proposed to use for estimate an influence of mechanical characteristic values on stress-strain state.

The analysis of several problems has been carried out on the basis of the obtained analytical solutions by the finite element algorithm applying sensitivity analysis techniques with the purpose to reveal the cases where the couple behavior of elastic media is more pronounced. Summarizing theoretical results we propose experimental procedures for identification of material constants of the asymmetric elasticity theory.

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References

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