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Stress and Strain Fields in a Plate of Stress State Dependent Material Properties

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The paper analyzes the properties of the constitutive relations proposed to describe the behavior of materials whose deformation diagrams depend on the type of external forces. In this case, various forms of nonlinearity arise, related to the dependence of the properties of materials on the type of the stressed state, the nonlinearity of the deformation diagrams, and the relationship between the shear and volume deformation processes. The influence of these forms of nonlinearity on the distribution of stresses and strains in a circular plate under different boundary conditions is investigated. The stress and strain fields were calculated for structural graphite and they are compared with the results of calculations for a classical physically nonlinear material whose properties are invariant to the form of external forces. The conditions imposed on the parameters of material functions that ensure the uniqueness of the solution of boundary value problems are established.

Key words: nonlinear theory of elasticity, constitutive relations, stress state parameter, susceptibility of properties to the type of external forces.

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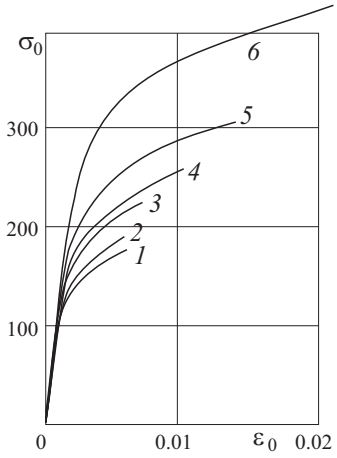

Fig. 1. Equivalent deformation diagrams of cast iron 15-32: *1* — uniaxial tension; *3* — pure shear; *6* — uniaxial compression; *2, 4, 5* — proportional loading with parameter $\xi = 0.232, -0.064, -0.126$

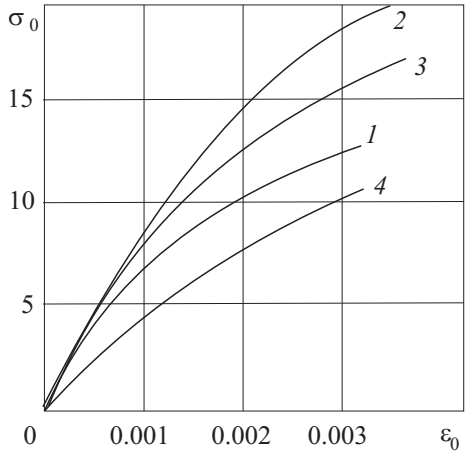

Fig. 2. Equivalent strain diagrams of structural graphite APB: *1* — uniaxial tension; *2* — uniaxial compression; *3* — shear; *4* — proportional biaxial tension

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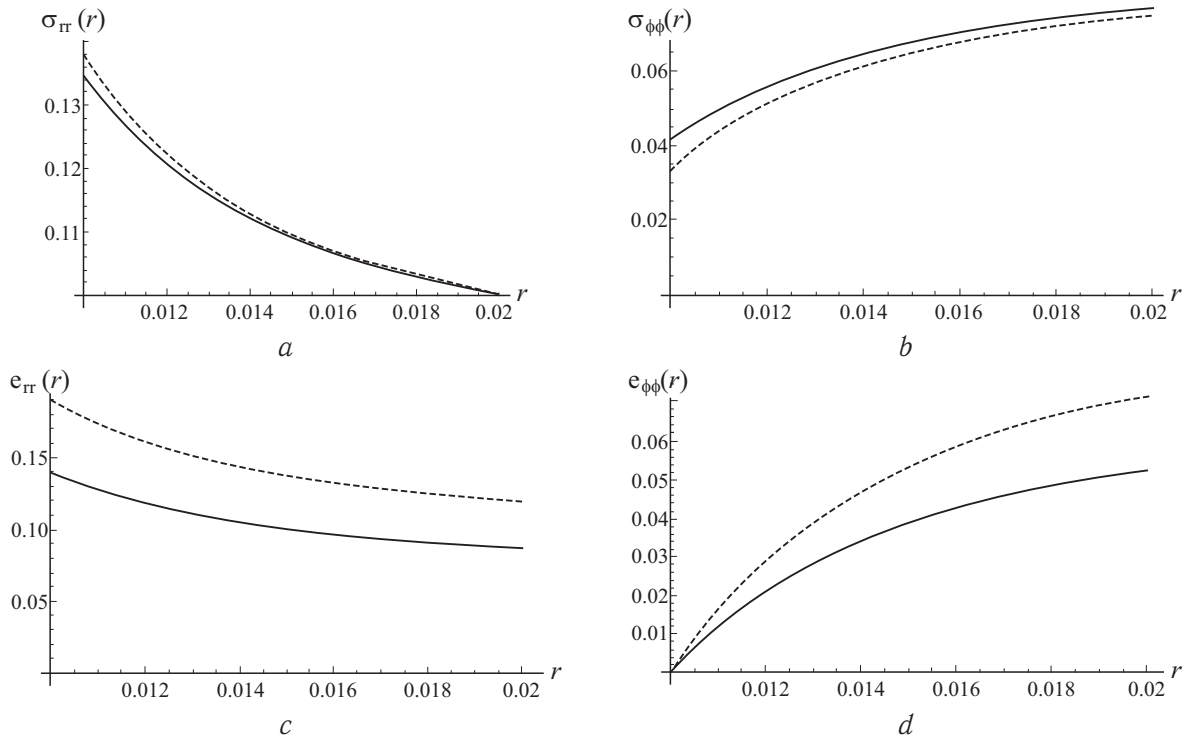

Fig. 3. The distributions of stresses and strains in the plate ($C = 0.45$ dotted line, $C = 0$ solid line): *a* — radial stress; *b* — circumferential stress; *c* — radial deformations; *d* — circumferential deformations

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