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Estimate of the solution of a problem of a plane crack of normal rupture in a material with power strengthening. (Russian. English summary) Zbl 0598.73104

Izv. Akad. Nauk Arm. SSR, Mekh. 37, No. 4, 31-43 (1984).

We consider the problem of normal rupture of a plane crack in an incompressible solid medium. We suppose that $\sigma'_{ij} = A\epsilon_i^{\mu-1}\epsilon_{ij}$, where σ'_{ij} is the deviator of stresses, ϵ_{ij} is the deformation tensor in the case of nonlinear elasticity or the rate of deformation tensor in the case of a steady creep, and ϵ_i is the deformation intensity in the case of nonlinear elasticity or the deformation rate intensity in the case of steady creep. The approximate equations obtained by using Arutyunyan's principle of summing up generalized displacements are employed. Isoperimetric inequalities for some integral characteristics of the solution transformed in the case of a linearly elastic medium into inequalities for energy and volume of the crack are proved. A relation between displacements within the crack edge and stresses on its prolongation is established. The generalization of Irwin's formula is obtained. Evaluations of the minimum stress concentration factor along the crack outline on the top and the maximum one on the bottom are given.

MSC:

74R05 Brittle damage
74S30 Other numerical methods in solid mechanics (MSC2010)
74B20 Nonlinear elasticity

Keywords:

normal rupture; plane crack; incompressible solid medium; steady creep; approximate equations; Arutyunyan's principle of summing up generalized displacements; Isoperimetric inequalities; generalization of Irwin's formula; minimum stress concentration factor