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STRESS CONCENTRATION NEAR SHARP AND ROUNDED V-SHAPED NOTCHES IN TWO-DIMENSIONAL BODIES

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Fracture mechanics includes the analysis of stress and strain fields of solids in the vicinity of the stress concentrators: cracks and V-notches. At present, only the methods of stress analysis and fracture criteria for cracked bodies are most completed. In the case of bodies with V-notches these methods are at the early stage of development. This remark refers to both sharp V-notches, in which, in compliance with the linear theory of the elasticity, stresses rise to infinity, as well as blunt V-notches the vertices of which are rounded with small radii of curvature. At the vertices of such notches even the moderate level of loading causes the stress concentration which significantly exceeds the strength of material.

This paper presents the application of the method of unified approach to the problems of stress concentration in the vicinity of sharp and rounded vertices of V-notches for two-dimensional bodies subjected to complex loads.

The essence of the method of unified approach is to calculate the streses at the vertex of V-notch (rounded with small radii of curvature) and then to perform a limit transition to sharp notch. This limit transition is possible due to the relationships between stress concentration coeffcients at the vertex of rounded notch and the stress intensity factors at the vertex of the corresponding sharp notch. These relationships have been previously established for the symmetric deformation state around the notch tip (mode I) [2], and the effectiveness of the proposed method has been demonstrated [3]. It was also proved that the value of maximum stress at the V-notch vertex affects not only the radius of curvature of the notch vertex and the opening angle of the notch, but also the shape of the notch in the neighborhood of the vertex.

Recently [4, 5], the authors have developed similar relationships binding stress concentration coefficients and stress intensity factors for notches in antisymmetrical (mode II) and antiplane states (mode III). These relationships have the form of compact approximation

formulas convenient in engineering applications [6]. Moreover, these relationships could be treated as asymptotic for problems of finite bodies with notches rounded with small radius of curvature.

In the paper the solution to the problem of stress concentration at the vertex of rectangular opening in the isotropic half-plane subjected to tensile load is presented. For the wide range of geometrical parameters the stress concentration factors for rounded notches and stress intensity factors for sharp V-notches were calculated. The solutions of elastostatics problems for domains with rounded V-shaped notches were obtained by singular integral equation method [1]. Thanks to the excellent precision of the method, the stress concentration factors for notches rounded with small curvature radii were calculated, and then the limit transition to sharp notches was performed.

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