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Comparative analysis of influence selected geometrical parameters on stress concentration in the surrounding of inclusion

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Abstract

In this paper we are focused on influence of selected geometrical characteristics as are: inscribed circle diameter, circumscribed circle diameter, eccentricity, ovality and radius of curvature of inclusion on stress concentration around these defects modelling using by FEM. This task was solved as plane stress. From this point of view there are monitored and evaluated there factors: maximum value of stress along the loading, across the loading, shear stress and equivalent stresses. There will be also presented algorithms for automatic generation of models that make possible to practice statistical data processing.

Keywords: stress concentration, geometrical model, finite element methods, inclusion

1. Introduction

Calculations on the strength of structures are primarily based on the theory of elasticity. If the yield stress is exceeded plastic deformation occurs, more complex theory of plasticity has to be used [5]. The macroscopic elastic behaviour of an isotropic is characterized by three elastic constants, the elastic modulus or Young's modulus E, shear modulus G and Poisson's ratio μ [7]. The well-known relation between the constants is:

$$E = 2G(1+\mu), \tag{1}$$

In the structure, geometrical notches such as holes cannot be avoided. The notches are causing an inhomogeneous stress distribution, see fig. 1, with a stress concentration at the root of the notch [1] and [4]. The theoretical stress concentration factor K_t is defined as a ratio between peek stress at the root of the notch and the nominal stress witch would be present if a stress concentration does not occur, i.e.

$$K_t = \frac{\sigma_{peak}}{\sigma_{no\min al}}, \tag{2}$$

The severity of the stress concentration depends on the geometry of the notch configuration, generally referred to as the shape of the notch. The term *notch* is defined as a geometric discontinuity that may be introduced either by design, such as hole, or by the manufacturing process in the form of material and fabrication defect such as inclusion, weld defects, casting defects or machining marks [3]. For a component with a surface notch, the maximum elastic notch stress σ^e can be determined by the product of a nominal stress σ and the elastic stress concentration factor K_t, i.e.

$$\sigma^e = \sigma \cdot K_t, \tag{3}$$

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