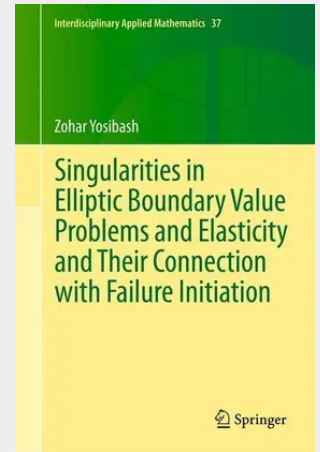


Singularities in Elliptic Boundary Value Problems and Elasticity and Their Connection with Failure Initiation

This introductory and self-contained book gathers as much explicit mathematical results on the linear-elastic and heat-conduction solutions in the neighborhood of singular points in two-dimensional domains, and singular edges and vertices in three-dimensional domains. These are presented in an engineering terminology for practical usage. The author treats the mathematical formulations from an engineering viewpoint and presents high-order finite-element methods for the computation of singular solutions in isotropic and anisotropic materials, and multi-material interfaces. The proper interpretation of the results in engineering practice is advocated, so that the computed data can be correlated to experimental observations. The book is divided into fourteen chapters, each containing several sections. Most of it (the first nine Chapters) addresses two-dimensional domains, where only singular points exist. The solution in a vicinity of these points admits an asymptotic expansion composed of eigenpairs and associated generalized flux/stress intensity factors (GFIFs/GSIFs), which are being computed analytically when possible or by finite element methods otherwise. Singular points associated with weakly coupled thermoelasticity in the vicinity of singularities are also addressed and thermal GSIFs are computed. The computed data is important in engineering practice for predicting failure initiation in brittle material on a daily basis. Several failure laws for two-dimensional domains with V-notches are presented and their validity is examined by comparison to experimental observations. A sufficient simple and reliable condition for predicting failure initiation (crack formation) in micron level electronic devices, involving singular points, is still a topic of active research and interest, and is addressed herein. Explicit singular solutions in the vicinity of vertices and edges in three-dimensional domains are provided in the remaining five chapters. New methods for the computation of generalized edge flux/stress intensity functions along singular edges are presented and demonstrated by several example problems from the field of fracture mechanics; including anisotropic domains and bimaterial interfaces. Circular edges are also presented and the author concludes with some remarks on open questions. This well illustrated book will appeal to both applied mathematicians and engineers working in the field of fracture mechanics and singularities.

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165,84 €

154,99 € (zzgl. MwSt.)

Lieferfrist: bis zu 10 Tage

Artikelnummer: 9781489995100

Medium: Buch

ISBN: 978-1-4899-9510-0

Verlag: Springer

Erscheinungstermin: 03.03.2014

Sprache(n): Englisch

Auflage: Erscheinungsjahr 2014

Serie: Interdisciplinary Applied Mathematics

Produktform: Kartoniert

Gewicht: 727 g

Seiten: 462

Format (B x H): 155 x 235 mm

