<<连续损伤力学及其数值分析应用>>

图书基本信息

书名：<<连续损伤力学及其数值分析应用>>

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前言

The progress of failure in metals, under various loading conditions, is as-sumed to involve the degradation of a structure due to nucleation and growthof defects, such as microvoids and microcracks, and their coalescence intomacrocracks. This process, generically termed damage, was first used to pre-dict material failure and rupture in-service in an elevated condition. Althoughdamage mechanics provides a measure of material degradation on a microme-chanics scale, the damage variables are introduced to reflect average materialdegradation on a macromechanics scale and thus continuum damage mechan-ics （CDM） was developed. In the micro-cracking of materials under differentstress conditions, damage is regarded as the progressive degradation. This ma-terial degradation is reflected in the non-linear behaviour of the structures.Non-linear analysis based on CDM provides conservative and realistic results.Since the pioneering work of Kachanov in 1958, continuum damage mechan-ics has been widely accepted to describe progressive failure due to materialdegradation. The reason for its popularity is as much the intrinsic simplic-ity and versatility of the approach, as well as its consistency based on thetheory of the thermodynamics of irreversible processes. When the crack pro-files are not known a priori, the continuum damage mechanics approaches arecomputationally very attractive. CDM is a very applicable and rapidly de-veloping discipline. Now many papers are published and several internationalconferences, e.g., IUTAM-Symposia or EUROMECH-Colloquia, take place.Furthermore, a special International Journal of Damage Mechanics stressesthe importance of this branch of solid mechanics.

内容概要

The theoretical framework of continuum damage mechanics presented in this book is based on the thermodynamic theory of energy and material dissipation, and is described by employing a group of internal state variables as a set of fundamental formulations of constitutive equations of damaged materials, development equations of the damaged state, and evolution equations of micro-structures. According to concepts of damage-dissipation of the material state and effective evolution of material properties, all these advanced equations, which take damage aspects into account, are developed and modified from the traditional general failure models, because they are more easily applied and verified in a very wide range of engineering practices by experimental tests, either macroscopically or microscopically.The most practical applications of the theory developed in this book are presented in different engineering topics analyzed by a specified numerical method. Some essential programs of the continuum damage mechanics are listed in the appendices.

作者简介

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书籍目录

1 Introduction2 Review of Damage Mechanics3 Basis of Isotropic Damage Mechanics4 Isotropic Elasto-Plastic Damage Mechanics5 Basis of Anisotropic Damage Mechanics6 Brittle Damage Mechanics of Rock Mass7 Anisotropic Elasto-plastic Damage Mechanics8 Theory of Visco-elasto-plastic Damage Mechanics9 Dynamic Damage Problems of Damaged MaterialsIndex

章节摘录

插图：Costin and Stone [2-196], using the elastic stress intensity factor for penny-shaped micro-cracks, presented a constitutive equation based on energy func-tion in a manner similar to that of Krajcinovic and Fonseka [2-39].A proper form of the stiffness matrix for anisotropic damaged materialswas proposed by Chaboche [2-38], in which the fourth order tensor reflects thefluctuations of the displacement field within the unit cell. Horii and Nemat-Nasser [2-223] deduced similar forms of the stress-strain relations. In orderto develop the constitutive relationship for anisotropic damage it may benecessary to introduce either a fourth order stiffness tensor [2-38, 2-66] or adyadic product of four axial stiffness vectors [2-224] for the symmetrization.An unified constitutive relation for brittle damage and fatigue damagemodels was presented in [2-39, 2-46, 2-183]. In the case of brittle damage, adamage-surface in the strain space was introduced into the brittle law. In thecase of fatigue damage, this damage-surface was substituted into the fatiguelaw based on the concepts of Lubiliner's loading-unloading irreversibility [2-183, 2-215, 2-42, 2-44]. However, a bounding surface and possibly an endurancedomain was also contained in this model. The expressions presented in [2-44] imply that the flux of damage is dependent on the energy dissipationonly. Therefore, the normality principle is not valid, for example when frictionbecomes an important mode of energy dissipation.Dragon [2-227, 2-110] applied continuum damage mechanics to quasi-brittle materials to study the plastic-brittle damage behavior of rock and con-crete materials based on a continuum model. Halm, [2-228] and Ilankambanand Krajcinovic [2-224] presented a modular damage model for quasi-brittlesolids to study the interaction between initial and damage induced anisotropy.In Article [2-229], Govindjee et al. developed an anisotropic quasi-brittle dam-age model for numerical simulation of brittle damage in concrete structures.Lu et al. [2-225] have studied damage waves in elastic-brittle materials andsolved a one dimension wave propagation problem theoretically. Alternatively,Zhang and Mai [2-226] studied the concept of a damage wave and provided asimplified theory of damage waves propagation in elastic-brittle materials.

编辑推荐

This book presents a systematic development of the theory of Continuum Damage Mechanics and its numerical engineering applications with a unified form of mathematical formulations in anisotropic and isotropic damage models. The areas studied in this book are （1） Review of damage mechanics； （2） Basis of isotropic damage mechanics； （3） Brittle damage mechanics of rock mass； （4） Theory of isotropic elasto-plastic damage mechanics； （5） Basis of anisotropic damage mechanics； （6） Theory of anisotropic elasto-plastic damage mechanics； （7） Theory of elasto-visco-plastic damage mechanics； （8） Dynamics of damage problems； （9） Fatigue damage of dynamic structures； （10） Micro-damage mechanics； （11） Random damage mechanics； （12） Numerical method in continuum damage mechanics； （13） Application of damage mechanics to problems coupled with multiphase medium.