Pergamon

Cement and Concrete Research, Vol. 27, No. 5, pp. 799-800, 1997

0008-8846/97 $17.00 + .00

PII S0008-8846(97)00022-7

BOOK REVIEW

"DAMAGE MECHANICS" - North-Holland Series in Applied Mathematics and Mechanics Vol. 41. Dusan Krajcinovic. Elsevier Science B.V. April 1996, 772.p. ISBN 0-444-82349-2

Damage mechanics is a discipline which is used to quantify the effect of a diffuse set of microcracks and other micro defects, distributed over most of the material volume, has on the macroscopic response and, eventually, specimen failure. In contrast to the problems within the domain of the fracture mechanics none of these microcrack is dominant.

This book is structured in a manner which emphasizes the stochastic and microscopic aspects of the problem which must be carefully addressed to be able to formulate a rational continuum model and set the conditions under which such model is possible. In considering this the author used his own research experience and consulted a large volume of literature in many physics, materials science and mechanics journals. The resulted book is therefore comprehensive and up-to-date.

The book focuses on the deformation process which empasize the nucleation, growth and interaction of a large ensamble of crack-like micro defects which are randomly distributed over a large part of the volume of the specimen. One of the basic premises of the book is that the nonlinearity of the stress-strain (force displacement) curves observed on the macro-scale in the course of the deformation process reflects the micro defect induced degradation of the specimen stiffness. The rate, mode and pattern of the material degradation depends in an essential manner on the random topology and morphology of the solid microstructure.

Microcracks will be defined as flat defects with an atomically sharp tip. They will be modeled by a surface which is not penetrated by the interatomic bonds, i.e. as a pair of mating surfaces which do not adhere to each other. An internal surface will be, therefore, referred to as a microcrack if it: (a) can support a discontinuity in at least one component of the displacement vector, (b) has an atomically sharp tip and (c) is commensurable in size to the micro texture (size of grain facet, distance between two adjacent fibers, etc.).

Damage is a continuum concept which is intuitively related to the microcracks. It is measured by the cumulative effect which these microcracks and other micro defects have on the macroscopic response. A solid will be said to be damaged only if the micro defects impair its ability to transmit the loads and resist the environmental influences. The damage may become a cause, or lead to, the fracture but is, by no means, synonymous with it.

The book covers *statistical, micromechanical and continuum models*. The chapter on *statistical models* presents failure criteria, parallel bar model, lattices, strength of diluted networks, brittle to quasi-brittle transition, experimental results and application of discrete models. In case of *micromechanical models,* thermodynamical considerations, relation between average stress and strain fields, effective properties of a solid which contains a single penny shaped crack, effective properties of a damaged elastic solid: dilute concentration limit, effective properties of a damaged elastic solid: elastic percolation limit, effective properties of a damaged elastic solid: cross-over regime and process models are discussed.

Considering *continuum models* microcrack distribution, damage variable, scalar models, rate theory of brittle deformation processes, brittle-ductile deformation processes - a finite strain rate theory and failure modes are summarized.

The book is intended for people who are doing or plan to do research in the brittle deformation of materials with microstructure and could also serve as a textbook for a graduate course.

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