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Soggetti	Mechanics, Applied Mathematics - Data processing Building materials Ceramic materials Engineering Mechanics Computational Science and Engineering Structural Materials Ceramics
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Nota di contenuto	Introduction -- Composite materials uses -- The use of composite materials in the automobile industry -- The use of composite materials in the Aeronautic industry -- Composite materials in the naval industry -- The use of composite materials in Civil Engineering -- Composites properties -- Classification of composite materials -- Classification by the topology -- Classification by their components -- Structural Classification -- Mechanical Anisotropy -- Introduction -- Generalities on the anisotropic formulation -- Yield function and plastic potential for isotropic materials -- General explicit definition of the isotropic yield criterion in the referential configuration -- General explicit definition of the orthotropic yield criterion in the referential configuration -- General implicit definition of the orthotropic criterion in the referential configuration -- Stresses space transformation -- Strain space transformation -- General definition of the stress space

transformation tensor -- Numerical calculation of the adjusting tensor matrix form -- Mises-Hill orthotropic criterion verification by the space mapping theory -- Anisotropy in the updated configuration -- Transformation of the stresses space -- Transformation of the strain space -- Plastic flow rule. Internal variables evolution law -- Referential Configuration -- Updated Configuration -- Definition of the dissipation in the isotropic fictitious space. Unicity of the dissipation -- Referential configuration -- Updated configuration -- Tangent constitutive equation -- Referential Configuration -- Spatial Configuration -- Mixing Theory -- Introduction -- Classic Mixing Theory -- Free energy expression -- Classical theory modification. Serial-Parallel Model -- The generalized mixing theory -- Large strains classic mixing theory -- Closure or compatibility equation -- Free energy function -- The constitutive equation -- Generalized mixing theory formulated in large strains -- Constitutive equation -- Mixing theory modification for short length reinforcement -- Fiber axial stress distribution -- Tangent stress distribution in the interface -- Short fibers constitutive model -- Composite constitutive equation -- Free energy for short reinforced composite materials -- Fiber mechanical properties in the Mixing Theory – Linear behavior in small strains -- Comparative example. “Micromodel” vs. “Mixing Theory” with anisotropy in large strains -- Behavior simulation of asphalt mixtures -- Introduction -- Problem motivation and description -- Materials parameterization. Simplified granulometry and properties correction by aspect relation -- Numerical Simulation -- Fiber-Matrix Displacement (FMD)-Debonding -- Introduction -- Stresses distribution along the reinforced fiber -- Cracks and fibers interaction -- Constitutive models for composite materials with "FMD" -- A procedure proposed for “FMD” -- The constitutive model modification. Procedure for the fiber–matrix displacement phenomenon (FMD) -- Expression of the elastoplastic constitutive model of the reinforcement -- Yield condition -- Plastic flow rule -- "Total" and "Updated" Lagrangian Formulation -- Implementation of the mixing and anisotropy theory in the FEM context -- "FMD" Phenomenon: Micro model and Mixing Theory with anisotropy -- Homogenization Theory -- Introduction and state of the art -- Average Methods -- The asymptotic expansion theory -- Extension of the “Average Method” and the “Asymptotic Expansion Method” to the nonlinear problem -- Other homogenization-related subjects -- Homogenization Theory based on “Local Periodicity” -- Introduction -- Periodic structure concepts -- Variables Local periodicity -- Strains tensor homogenization -- The homogenized stress and the equilibrium equation -- Elastic problem basis at micro-macro scales -- Basis of the inelastic problem at micro-macro scales -- The elastic constitutive tensor determination for composite materials -- Quasi-tangent inelastic constitutive tensor determination for the composite materials. Analytical determination -- Micro-Macro structural coupling -- Local effects influence -- Test examples of the “Homogenization Theory of Local Periodicity” -- Transversal behavior of a reinforced long fibers matrix –Simple tensile test -- Thick cylinder subjected to internal pressure -- Masonry homogenized, treated as a composite -- Masonry-Homogenized Composite -- Introduction and background -- Masonry properties -- Masonry behavior under uniaxial compression -- Masonry behavior under uniaxial tension -- Biaxial behavior -- Post-peak masonry behavior. Softening -- Different methods for masonry calculation -- Constitutive model based on a particular case of the homogenization concept -- Constitutive model -- Formulation checkout -- Non-Linear Buckling of Reinforced Composites -- Introduction -- Problem description and state-of-the-art -- Euler

critical load -- Rosen model -- Micro-mechanical models -- Mechanical damage models -- Model of stiffness-loss due to buckling in long-fibers composites reinforced -- Introduction -- Fiber model general definition -- Definition of the stiffness-loss variable due to buckling -- Main characteristics of the model -- Energy dissipation -- Test example.

Sommario/riassunto

An original mechanical formulation to treat nonlinear orthotropic behavior of composite materials is presented in this book. It also examines different formulations that allow us to evaluate the behavior of composite materials through the composition of its components, obtaining a new composite material. Also two multiple scale homogenization methods are given, one based on the analytical study of the cells (Ad-hoc homogenization), and other one, more general based on the finite element procedure applied on the macro scale (upper-scale) and in the micro scale (sub-scale). A very general formulation to simulate the mechanical behavior for traditional composite structures (plywood, reinforced concrete, masonry, etc.), as well as the new composite materials reinforced with long and short fibers, nanotubes, etc., are also shown in this work. Typical phenomena occurring in composite materials are also described in this work, including fiber-matrix debounding, local buckling of fibers and its coupling with the overall buckling of the structure. Finally, several numerical examples that evaluates the qualities and capabilities of the general model formulated are offered in this book. This book is intended for graduate engineering students who want to expand their knowledge of composite structures behavior.