

Mechanics of Composite Materials with MATLAB

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Mechanics of Composite Materials with MATLAB

With 86 Figures and a CD ROM

 Springer

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Library of Congress Control Number: 2005920509

ISBN-10 3-540-24353-4 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-24353-3 Springer Berlin Heidelberg New York

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springeronline.com

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Printed in The Netherlands

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Typesetting: by the authors and TechBooks using a Springer L^AT_EX macro package
Cover design: deblik, Berlin

Printed on acid-free paper SPIN: 11015482 89/3141/jl 5 4 3 2 1 0

Dedicated with Love to CHRISTINA, ELENA, and ANDREW
George Z. Voyiadjis

Dedicated with Love to My Family
Peter I. Kattan

Preface

This is a book for people who love mechanics of composite materials and MATLAB*. We will use the popular computer package MATLAB as a matrix calculator for doing the numerical calculations needed in mechanics of composite materials. In particular, the steps of the mechanical calculations will be emphasized in this book. The reader will not find ready-made MATLAB programs for use as black boxes. Instead step-by-step solutions of composite material mechanics problems are examined in detail using MATLAB. All the problems in the book assume linear elastic behavior in structural mechanics. The emphasis is not on mass computations or programming, but rather on learning the composite material mechanics computations and understanding of the underlying concepts.

The basic aspects of the mechanics of fiber-reinforced composite materials are covered in this book. This includes lamina analysis in both the local and global coordinate systems, laminate analysis, and failure theories of a lamina. In the last two chapters of the book, we present a glimpse into two especially advanced topics in this subject, namely, homogenization of composite materials, and damage mechanics of composite materials. The authors have deliberately left out the two topics of laminated plates and stability of composites as they feel these two topics are a little bit advanced for the scope of this book. In addition, each of these topics deserves a separate volume for its study and there are some books dedicated to these two topics. Each chapter starts with a summary of the basic equations. This is followed by the MATLAB functions which are specific to the chapter. Then, a number of examples is solved demonstrating both the theory and numerical computations. The examples are of two types: the first type is theoretical and involves derivations and proofs of various equations, while the other type is MATLAB-based and involves using MATLAB in the calculations. A total of 44 special MATLAB functions for composite material mechanics are provided as M-files on the accompanying CD-ROM to be used in the examples and solution of the

* MATLAB is a registered trademark of the MathWorks, Inc.

problems. These MATLAB functions are specifically written by the authors to be used with this book. These functions have been tested successfully with MATLAB versions 6.0 and 6.2. They should work with other later or previous versions. Each chapter also ends with a number of problems to be used as practice for students.

The book is written primarily for students studying mechanics of composite materials for the first time. The book is self-contained and can be used as a textbook for an introductory course on mechanics of composite materials. Since the computations of composite materials usually involve matrices and matrix manipulations, it is only natural that students use a matrix-based software package like MATLAB to do the calculations. In fact the word MATLAB stands for MATrix LABoratory.

The main features of this book are listed as follows:

1. The book is divided into twelve chapters that are well defined and correlated. Each chapter is written in a way to be consistent with the other chapters.
2. The book includes a short tutorial on using MATLAB in Chap. 1.
3. The CD-ROM that accompanies the book includes 44 MATLAB functions (M-files) that are specifically written by the authors to be used with this book. These functions comprise what may be called the MATLAB Composite Material Mechanics Toolbox. It is used mainly for problems in structural mechanics. The provided MATLAB functions are designed to be simple and easy to use.
4. The book stresses the interactive use of MATLAB. The MATLAB examples are solved in an interactive manner in the form of interactive sessions with MATLAB. No ready-made subroutines are provided to be used as black boxes. These latter ones are available in other books and on the internet.
5. Some of the examples show in detail the derivations and proofs of various basic equations in the study of the mechanics of composite materials. The derivations of the remaining equations are left to some of the problems.
6. Solutions to most of the problems are included in a special section at the end of the book. These solutions are detailed especially for the first six chapters.

The authors wish to thank the editors at Springer-Verlag (especially Dr. Thomas Ditzinger) for their cooperation and assistance during the writing of this book. Special thanks are also given to our family members without their support and encouragement this book would not have been possible. The second author would also like to acknowledge the financial support of the Center for Computation and Technology headed by Edward Seidel at Louisiana State University.

Louisiana State University
February 2005

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