FINITE ELEMENT **ANALYSIS IN** MANUFACTURING ENGINEERING

A PC-BASED APPROACH

EDWARD R. CHAMPION, Jr.

Finite Element Analysis in Manufacturing Engineering

Edward R. Champion, Jr.





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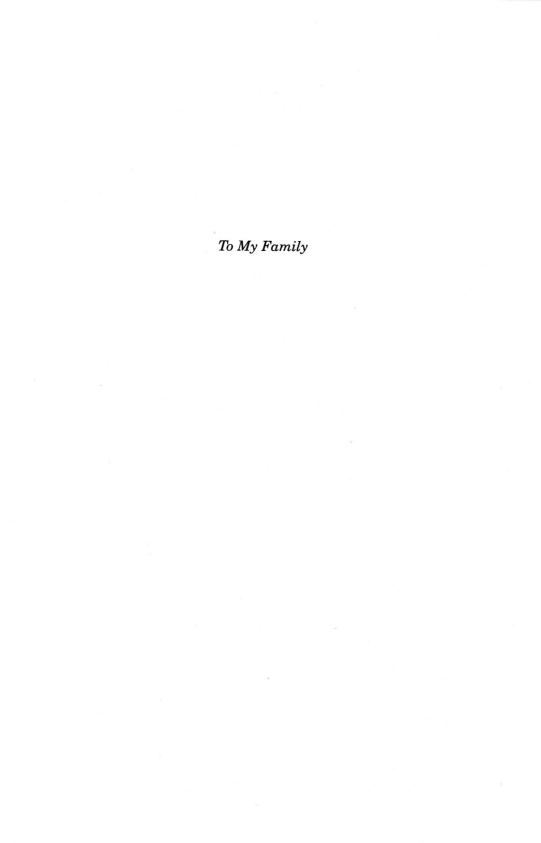
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Preface

This book is intended to be a basic guide for the manufacturing engineer who wants exposure to the use of Finite Element Analysis (FEA) in a small to medium size manufacturing facility where either personnel or hardware (or both) resources are limited. No previous exposure to FEA is assumed. Moreover, this book is applicable to students in the science and engineering fields who wish to obtain a concise introduction to the subject of applied FEA, and who wish to learn how to apply this analysis technique to their particular situation.

In keeping with this theme, the reader will find the text directed toward helping the user solve general classes of engineering problems with FEA on personal computers. The types of problems that may be solved on personal computers are primarily limited by memory, hard disk space, and overall throughput of the system. Problems that previously involved cumbersome or intractable solutions can now be analyzed and solved if the engineer owns or has access to a personal computer and the proper software.

There are advantages and disadvantages in using a personal computer for finite element analysis. Certainly a motivating factor that has fostered the popularity of the PC/FEA combination has been the relatively low cost of this type of analysis. However, there are often restrictions on problem size coupled with long execution times.

With the newer and faster processors that continually

come to market, the availability of massive amounts of storage, and software refinements in algorithms and code that allow the fastest possible execution and minimize space requirements, rather complex problems can be handled. These types of problems range from linear analysis to fluid flow to highly nonlinear analysis.

All problems run in this book, with the exception of one in Chap. 9 that used ANSYS, were executed with the program SuperSAP (ALGOR Interactive Systems, Inc., 260 Alpha Drive, Pittsburgh, PA 15238, 412-967-2700. In addition, all problems were run using an 80386 25 MHz personal computer.

Chapter 1 addresses some of the basic requirements for finite element analysis and what to look for when considering using this tool.

The remainder of the text is divided into the following chapters:

Chapter 2 covers the practical aspects of hardware requirements plus recommendations for upgrades to your existing computer systems. Discussions in this chapter range from the basic PC unit and upgrades to the basic unit to get the most performance possible within a given budget.

Chapter 3 looks at the fundamental aspects of finite element analysis such as setting up problems and element types. There is discussion on selecting proper mesh sizes, elements, etc.

Chapter 4 gives an introduction to the ALGOR Interactive Systems, Inc. finite element program and explains how to use the program with sample verification problems and a detailed example, both from an FEA standpoint and a conventional solution.

Chapter 5 covers the finite element methodology in somewhat more detail and presents a FORTRAN program for calculation of two-dimensional heat transfer.

Chapter 6 offers real-world applications of FEA in a manufacturing environment with applications to tools, molds, and dies.

Chapter 7 illustrates finite element analysis uses in the automotive industry.

Chapter 8 presents a unique view of using FEA in a musical product modification.

Chapter 9 examines finite element analysis as used in some applications in a military environment.

Chapter 10 looks at a more commercial side as it examines applications to in-home medical products.

Chapter 11 applies the finite element concept to situations within the utility industry.

The Reference section contains useful references to common finite element texts and should serve as a stepping stone to further reading on the subject.

All references to specific trade names are copyrighted by the respective companies.

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ABOUT THE AUTHOR

Edward R. Champion, Jr., Ph.D., is a consultant and registered Professional Engineer in the areas of fluid/heat transfer analysis and structural analysis for a wide variety of commercial and military applications. This interest in the application of numerical methods to solve many types of problems has led to the development of several PC-based analysis programs for both industry and business. Dr. Champion is the author/co-author of several books (including Finite Element Analysis and Numerical Analysis) and articles (covering subjects such as fabric combustion phenomena and waste heat transfer). He is a member of the ASME.

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