Preface

This book is intended for beginners who must utilize finite element analysis (FEA) methods, but have not yet had a course in finite element theory. The emphasis is on the engineering reasons for conducting the sequence of stages necessary to complete a valid finite element analysis. For completeness, it has been necessary to select specific software to illustrate the various stages. Most commercial solid modeling and finite element analysis systems are very similar, and the overlap in their capabilities is probably 90% or more. Systems with more advanced or specialized abilities are usually more difficult to utilize, and have a significantly longer learning curve. In this case, the SolidWorks system (release 2010) has been selected due to its short learning curve and ability to execute the most commonly needed finite element analyses. The author wishes to thank the SolidWorks Corporation for permission to reproduce some of their online help file or demonstration figures for use in this text.

This book is based on my forty years of teaching finite element analysis, applying it in consulting applications and programming FEA. Historically, the typical initial users of FEA were often graduate level engineers well educated in the prerequisite knowledge. Most had completed courses covering statics, dynamics, free body diagrams, material properties, stress analysis, heat transfer, vibrations, etc. The slow computers of the time also required that they understand numerical analysis methods, and that they often programmed their own finite element systems. The good news is that, as implied by Moore's Law, today's computers have grown so powerful that one does not have to have the previously prerequisite knowledge to be able to easily build solid models of complex

geometries and then to apply all sorts of FEA to those models. That is also the bad news. Users no longer must have degrees in engineering (or applied mathematics) or even be exposed to the basic knowledge about materials and their stress or thermal responses. Indeed, systems like the SolidWorks software are currently being utilized by high school students in several regions.

Those realities mean that often what seems like computer aided design has become computer aided errors, or computer aided stupidity. To avoid such problems this book will hopefully identify the engineering reasons for selecting various capabilities, rather than just the sequence of icon picks that yield the pretty pictures that often hide misleading or erroneous results or assumptions. To support that educational process, the basic concepts or definitions of desirable prerequisite knowledge will be covered as needed. Having stated those goals, the reader of this text is strongly encouraged to complete a course in basic finite element theory. It can be dangerous to utilize tools when you do not understand their fundamental abilities and limitations.

Modern commercial finite element systems typically include millions of lines of source code. They are continuously being modified. Therefore, they are likely to contain some errors that could, on rare occasions, affect your analysis results. A good engineer always tries to check any analysis results. Thus, as space permits, I have also included typical examples of attempts to validate sample finite element analysis results.

J. Ed Akin, PhD, PE
Professor
Rice University
akin@rice.edu
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