

books on finite element analysis

Books on Finite Element Analysis: Your Guide to Mastering FEA

Introduction:

Are you ready to unlock the power of Finite Element Analysis (FEA)? This comprehensive guide dives deep into the best books on finite element analysis, providing you with a curated list to help you master this crucial engineering and scientific tool. Whether you're a seasoned professional looking to expand your knowledge or a student taking your first steps into the world of FEA, this post will equip you with the resources you need to succeed. We'll explore various books catering to different skill levels and specific applications, offering detailed reviews and insights to help you choose the perfect learning companion. Get ready to delve into the fascinating world of FEA!

Understanding Finite Element Analysis (FEA): A Quick Overview

Finite Element Analysis is a powerful numerical technique used to solve complex engineering and scientific problems. By breaking down a complex system into smaller, simpler elements, FEA allows us to approximate solutions to equations governing physical phenomena like stress, strain, heat transfer, fluid flow, and electromagnetism. It's widely used across various industries, including aerospace, automotive, civil engineering, biomedical engineering, and manufacturing. Understanding FEA is crucial for engineers and scientists seeking to design, analyze, and optimize products and systems.

Choosing the Right Book on Finite Element Analysis: Key Considerations

Selecting the ideal FEA textbook depends on your current knowledge level, specific area of interest, and learning style. Here's what to consider:

Your Background: Are you a beginner with little to no prior knowledge of FEA? Or do you have a strong foundation in engineering mathematics and numerical methods?

Software Focus: Do you want a book focused on a specific FEA software package like ANSYS, ABAQUS, or COMSOL? Or are you looking for a more general introduction to the underlying principles?

Application Area: Are you interested in structural analysis, heat transfer, fluid dynamics, or a combination thereof?

Mathematical Depth: Some books delve deeply into the mathematical formulations, while others prioritize practical application and interpretation of results.

Top Books on Finite Element Analysis: A Curated Selection

We've compiled a list of highly-regarded books, categorized for ease of selection:

1. For Beginners:

Title: Introduction to Finite Element Analysis (Beginner-Friendly Edition) (Hypothetical Title)

Author: Jane Doe (Hypothetical Author)

Content Outline:

Introduction to FEA concepts and applications.

Basic concepts of stress, strain, and elasticity.

1D, 2D, and 3D element formulations.

Simple examples and exercises.

Introduction to FEA software (e.g., a brief overview of various packages).

Conclusion and further learning resources.

1. Intermediate to Advanced Level:

Title: Finite Element Procedures (Advanced Edition) (Hypothetical Title)

Author: John Smith (Hypothetical Author)

Content Outline:

Advanced element formulations (e.g., higher-order elements, isoparametric elements).

Non-linear finite element analysis (e.g., plasticity, large deformations).

Finite element methods for heat transfer and fluid dynamics.

Advanced numerical techniques (e.g., iterative solvers, adaptive meshing).

Applications in specific engineering fields (e.g., aerospace, automotive).

Case studies and advanced exercises.

Conclusion and advanced topics.

1. Software-Specific:

Title: Mastering ANSYS for Finite Element Analysis (Hypothetical Title)

Author: Robert Brown (Hypothetical Author)

Content Outline:

Introduction to ANSYS software and interface.

Preprocessing: geometry creation, meshing, material properties definition.

Solving: applying loads and boundary conditions.

Postprocessing: visualizing and interpreting results.

Advanced ANSYS features and techniques.

Practical case studies using ANSYS.

Conclusion and advanced resources.

Detailed Explanation of Book Content Outlines

1. Introduction to Finite Element Analysis (Beginner-Friendly Edition): This hypothetical book would start with a gentle introduction to FEA concepts, explaining what it is, why it's useful, and its limitations. It would then cover fundamental concepts like stress, strain, and elasticity using clear, non-intimidating language. The book would progress through simple element formulations (1D, 2D, 3D), illustrated with step-by-step examples and accompanying exercises to reinforce learning. A brief overview of popular FEA software packages would provide students with a launching point for further exploration. Finally, the conclusion would guide students towards further resources for continued learning.

1. Finite Element Procedures (Advanced Edition): This hypothetical book would target readers with a solid understanding of FEA fundamentals. It would delve deeper into advanced element formulations, exploring higher-order elements and isoparametric elements. It would introduce non-linear FEA, covering topics like plasticity and large deformations. Significant sections would be dedicated to heat transfer and fluid dynamics applications of FEA. The book would include advanced numerical techniques such as iterative solvers and adaptive meshing. The inclusion of real-world case studies from diverse engineering fields (aerospace, automotive) would make the concepts more relatable and practical. The book would culminate in a discussion of even more advanced topics and future directions in FEA research.

1. Mastering ANSYS for Finite Element Analysis: This hypothetical book focuses solely on ANSYS software. It would begin by introducing the software's interface and workflow. The book would then cover the essential preprocessing steps, including geometry creation, mesh generation, and material property definition. Solving techniques, involving applying loads and boundary conditions, would be thoroughly discussed. Post-processing, crucial for interpreting results and drawing conclusions, would be explained in detail. The book would also cover advanced ANSYS features and provide multiple practical case studies to give readers hands-on experience using the software. The conclusion would suggest further resources for advanced learning within the ANSYS environment.

Frequently Asked Questions (FAQs)

1. What is the best book for learning FEA as a complete beginner? The ideal book depends on your learning style but a beginner-friendly text focusing on fundamental concepts and using simple examples is best.
2. Are there books that cover FEA for specific software packages? Yes, many books focus on specific software like ANSYS, ABAQUS, or COMSOL.

3. What mathematical background is required to understand FEA books? A solid foundation in calculus, linear algebra, and differential equations is generally recommended.
4. How can I choose a book that aligns with my specific application area? Look for books that explicitly mention your area of interest (structural, thermal, fluid dynamics) in the description.
5. What is the difference between linear and nonlinear FEA? Linear FEA assumes a linear relationship between load and response, while nonlinear FEA handles cases where this relationship is not linear.
6. Are there any free online resources to supplement FEA books? Yes, numerous online courses, tutorials, and documentation are available.
7. Can I learn FEA solely through books, or do I need hands-on experience? Hands-on experience through software applications is crucial to mastering FEA.
8. What are some common challenges faced when learning FEA? Understanding the underlying mathematical concepts and interpreting the software results can be challenging.
9. Where can I find reviews of different FEA books? Online book retailers like Amazon and Goodreads often have user reviews that can be helpful.

Related Articles:

1. Introduction to Finite Element Method: A basic overview of the FEA method and its applications.
2. Finite Element Analysis Software Comparison: A comparison of popular FEA software packages.
3. Nonlinear Finite Element Analysis Techniques: An in-depth look at advanced nonlinear FEA methods.
4. Meshing Techniques in Finite Element Analysis: A guide to effective mesh generation for FEA.
5. Finite Element Analysis for Heat Transfer: A focused study of FEA applications in thermal analysis.
6. Finite Element Analysis for Fluid Dynamics: An exploration of FEA in the context of fluid flow simulations.
7. Practical Applications of Finite Element Analysis in Civil Engineering: Real-world examples of FEA in civil engineering projects.

8. Advanced Topics in Finite Element Analysis: A discussion of cutting-edge research and development in FEA.
9. Troubleshooting Common Errors in Finite Element Analysis: A guide to resolving common issues encountered during FEA simulations.

books on finite element analysis: *Practical Finite Element Analysis* Nitin S. Gokhale, 2008

Highlights of the book: Discussion about all the fields of Computer Aided Engineering, Finite Element Analysis Sharing of worldwide experience by more than 10 working professionals Emphasis on Practical usage and minimum mathematics Simple language, more than 1000 colour images International quality printing on specially imported paper Why this book has been written ... FEA is gaining popularity day by day & is a sought after dream career for mechanical engineers. Enthusiastic engineers and managers who want to refresh or update the knowledge on FEA are encountered with volume of published books. Often professionals realize that they are not in touch with theoretical concepts as being pre-requisite and find it too mathematical and Hi-Fi. Many a times these books just end up being decoration in their book shelves ... All the authors of this book are from IITs & IISc and after joining the industry realized gap between university education and the practical FEA. Over the years they learned it via interaction with experts from international community, sharing experience with each other and hard route of trial & error method. The basic aim of this book is to share the knowledge & practices used in the industry with experienced and in particular beginners so as to reduce the learning curve & avoid reinvention of the cycle. Emphasis is on simple language, practical usage, minimum mathematics & no pre-requisites. All basic concepts of engineering are included as & where it is required. It is hoped that this book would be helpful to beginners, experienced users, managers, group leaders and as additional reading material for university courses.

books on finite element analysis: *TEXTBOOK OF FINITE ELEMENT ANALYSIS* P.

SESHU, 2003-01-01 Designed for a one-semester course in Finite Element Method, this compact and well-organized text presents FEM as a tool to find approximate solutions to differential equations. This provides the student a better perspective on the technique and its wide range of applications. This approach reflects the current trend as the present-day applications range from structures to biomechanics to electromagnetics, unlike in conventional texts that view FEM primarily as an extension of matrix methods of structural analysis. After an introduction and a review of mathematical preliminaries, the book gives a detailed discussion on FEM as a technique for solving differential equations and variational formulation of FEM. This is followed by a lucid presentation of one-dimensional and two-dimensional finite elements and finite element formulation for dynamics. The book concludes with some case studies that focus on industrial problems and Appendices that include mini-project topics based on near-real-life problems. Postgraduate/Senior undergraduate students of civil, mechanical and aeronautical engineering will find this text extremely useful; it will also appeal to the practising engineers and the teaching community.

books on finite element analysis: *Introduction to Finite Element Analysis and Design* Nam-Ho

Kim, Bhavani V. Sankar, Ashok V. Kumar, 2018-05-24 Introduces the basic concepts of FEM in an easy-to-use format so that students and professionals can use the method efficiently and interpret results properly Finite element method (FEM) is a powerful tool for solving engineering problems both in solid structural mechanics and fluid mechanics. This book presents all of the theoretical aspects of FEM that students of engineering will need. It eliminates overlong math equations in favour of basic concepts, and reviews of the mathematics and mechanics of materials in order to illustrate the concepts of FEM. It introduces these concepts by including examples using six

different commercial programs online. The all-new, second edition of Introduction to Finite Element Analysis and Design provides many more exercise problems than the first edition. It includes a significant amount of material in modelling issues by using several practical examples from engineering applications. The book features new coverage of buckling of beams and frames and extends heat transfer analyses from 1D (in the previous edition) to 2D. It also covers 3D solid element and its application, as well as 2D. Additionally, readers will find an increase in coverage of finite element analysis of dynamic problems. There is also a companion website with examples that are concurrent with the most recent version of the commercial programs. Offers elaborate explanations of basic finite element procedures Delivers clear explanations of the capabilities and limitations of finite element analysis Includes application examples and tutorials for commercial finite element software, such as MATLAB, ANSYS, ABAQUS and NASTRAN Provides numerous examples and exercise problems Comes with a complete solution manual and results of several engineering design projects Introduction to Finite Element Analysis and Design, 2nd Edition is an excellent text for junior and senior level undergraduate students and beginning graduate students in mechanical, civil, aerospace, biomedical engineering, industrial engineering and engineering mechanics.

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books on finite element analysis: Fundamentals of Finite Element Analysis Ioannis Koutromanos, 2018-02-12 An introductory textbook covering the fundamentals of linear finite element analysis (FEA) This book constitutes the first volume in a two-volume set that introduces readers to the theoretical foundations and the implementation of the finite element method (FEM). The first volume focuses on the use of the method for linear problems. A general procedure is presented for the finite element analysis (FEA) of a physical problem, where the goal is to specify the values of a field function. First, the strong form of the problem (governing differential equations and boundary conditions) is formulated. Subsequently, a weak form of the governing equations is established. Finally, a finite element approximation is introduced, transforming the weak form into a system of equations where the only unknowns are nodal values of the field function. The procedure is applied to one-dimensional elasticity and heat conduction, multi-dimensional steady-state scalar field problems (heat conduction, chemical diffusion, flow in porous media), multi-dimensional

elasticity and structural mechanics (beams/shells), as well as time-dependent (dynamic) scalar field problems, elastodynamics and structural dynamics. Important concepts for finite element computations, such as isoparametric elements for multi-dimensional analysis and Gaussian quadrature for numerical evaluation of integrals, are presented and explained. Practical aspects of FEA and advanced topics, such as reduced integration procedures, mixed finite elements and verification and validation of the FEM are also discussed. Provides detailed derivations of finite element equations for a variety of problems. Incorporates quantitative examples on one-dimensional and multi-dimensional FEA. Provides an overview of multi-dimensional linear elasticity (definition of stress and strain tensors, coordinate transformation rules, stress-strain relation and material symmetry) before presenting the pertinent FEA procedures. Discusses practical and advanced aspects of FEA, such as treatment of constraints, locking, reduced integration, hourglass control, and multi-field (mixed) formulations. Includes chapters on transient (step-by-step) solution schemes for time-dependent scalar field problems and elastodynamics/structural dynamics. Contains a chapter dedicated to verification and validation for the FEM and another chapter dedicated to solution of linear systems of equations and to introductory notions of parallel computing. Includes appendices with a review of matrix algebra and overview of matrix analysis of discrete systems. Accompanied by a website hosting an open-source finite element program for linear elasticity and heat conduction, together with a user tutorial. Fundamentals of Finite Element Analysis: Linear Finite Element Analysis is an ideal text for undergraduate and graduate students in civil, aerospace and mechanical engineering, finite element software vendors, as well as practicing engineers and anybody with an interest in linear finite element analysis.

books on finite element analysis: Finite Element Analysis Barna Szabó, Ivo Babuška, 2021-05-20 Finite Element Analysis An updated and comprehensive review of the theoretical foundation of the finite element method The revised and updated second edition of Finite Element Analysis: Method, Verification, and Validation offers a comprehensive review of the theoretical foundations of the finite element method and highlights the fundamentals of solution verification, validation, and uncertainty quantification. Written by noted experts on the topic, the book covers the theoretical fundamentals as well as the algorithmic structure of the finite element method. The text contains numerous examples and helpful exercises that clearly illustrate the techniques and procedures needed for accurate estimation of the quantities of interest. In addition, the authors describe the technical requirements for the formulation and application of design rules. Designed as an accessible resource, the book has a companion website that contains a solutions manual, PowerPoint slides for instructors, and a link to finite element software. This important text: Offers a comprehensive review of the theoretical foundations of the finite element method Puts the focus on the fundamentals of solution verification, validation, and uncertainty quantification Presents the techniques and procedures of quality assurance in numerical solutions of mathematical problems Contains numerous examples and exercises Written for students in mechanical and civil engineering, analysts seeking professional certification, and applied mathematicians, Finite Element Analysis: Method, Verification, and Validation, Second Edition includes the tools, concepts, techniques, and procedures that help with an understanding of finite element analysis.

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books on finite element analysis: Essentials of the Finite Element Method Dimitrios G Pavlou, 2015-07-14 Fundamental coverage, analytic mathematics, and up-to-date software applications are hard to find in a single text on the finite element method (FEM). Dimitrios Pavlou's Essentials of the Finite Element Method: For Structural and Mechanical Engineers makes the search easier by providing a comprehensive but concise text for those new to FEM, or just in need of a refresher on the essentials. Essentials of the Finite Element Method explains the basics of FEM, then relates these basics to a number of practical engineering applications. Specific topics covered include linear spring elements, bar elements, trusses, beams and frames, heat transfer, and structural dynamics. Throughout the text, readers are shown step-by-step detailed analyses for finite element equations development. The text also demonstrates how FEM is programmed, with examples in MATLAB, CALFEM, and ANSYS allowing readers to learn how to develop their own computer code. Suitable for everyone from first-time BSc/MSc students to practicing mechanical/structural engineers, Essentials of the Finite Element Method presents a complete reference text for the modern engineer. - Provides complete and unified coverage of the fundamentals of finite element analysis - Covers stiffness matrices for widely used elements in mechanical and civil engineering practice - Offers detailed and integrated solutions of engineering examples and computer algorithms in ANSYS, CALFEM, and MATLAB

books on finite element analysis: An Introduction to the Mathematical Theory of Finite Elements J. T. Oden, J. N. Reddy, 2012-05-23 This introduction to the theory of Sobolev spaces and Hilbert space methods in partial differential equations is geared toward readers of modest

mathematical backgrounds. It offers coherent, accessible demonstrations of the use of these techniques in developing the foundations of the theory of finite element approximations. J. T. Oden is Director of the Institute for Computational Engineering & Sciences (ICES) at the University of Texas at Austin, and J. N. Reddy is a Professor of Engineering at Texas A&M University. They developed this essentially self-contained text from their seminars and courses for students with diverse educational backgrounds. Their effective presentation begins with introductory accounts of the theory of distributions, Sobolev spaces, intermediate spaces and duality, the theory of elliptic equations, and variational boundary value problems. The second half of the text explores the theory of finite element interpolation, finite element methods for elliptic equations, and finite element methods for initial boundary value problems. Detailed proofs of the major theorems appear throughout the text, in addition to numerous examples.

books on finite element analysis: *Nonlinear Finite Elements for Continua and Structures* Ted Belytschko, Wing Kam Liu, Brian Moran, Khalil Elkhodary, 2014-01-07 *Nonlinear Finite Elements for Continua and Structures* This updated and expanded edition of the bestselling textbook provides a comprehensive introduction to the methods and theory of nonlinear finite element analysis. New material provides a concise introduction to some of the cutting-edge methods that have evolved in recent years in the field of nonlinear finite element modeling, and includes the eXtended Finite Element Method (XFEM), multiresolution continuum theory for multiscale microstructures, and dislocation- density-based crystalline plasticity. *Nonlinear Finite Elements for Continua and Structures, Second Edition* focuses on the formulation and solution of discrete equations for various classes of problems that are of principal interest in applications to solid and structural mechanics. Topics covered include the discretization by finite elements of continua in one dimension and in multi-dimensions; the formulation of constitutive equations for nonlinear materials and large deformations; procedures for the solution of the discrete equations, including considerations of both numerical and multiscale physical instabilities; and the treatment of structural and contact-impact problems. Key features: Presents a detailed and rigorous treatment of nonlinear solid mechanics and how it can be implemented in finite element analysis Covers many of the material laws used in today's software and research Introduces advanced topics in nonlinear finite element modelling of continua Introduction of multiresolution continuum theory and XFEM Accompanied by a website hosting a solution manual and MATLAB® and FORTRAN code *Nonlinear Finite Elements for Continua and Structures, Second Edition* is a must-have textbook for graduate students in mechanical engineering, civil engineering, applied mathematics, engineering mechanics, and materials science, and is also an excellent source of information for researchers and practitioners.

books on finite element analysis: *Applied Finite Element Analysis* Larry J. Segerlind, 1976 An introductory textbook for senior/graduate courses in finite element analysis taught in all engineering departments. Covers the basic concepts of the finite element method and their application to the analysis of plane structures and two-dimensional continuum problems in heat transfer, irrotational fluid flow, and elasticity. This revised edition includes a reorganization of topics and an increase in the number of homework problems. The emphasis on numerical illustrations make topics clear without heavy use of sophisticated mathematics.

books on finite element analysis: *Finite Element Procedures* Klaus-Jürgen Bathe, 1996 **BASIC APPROACH:** Comprehensive -- this text explores the full range of finite element methods used in engineering practice for actual applications in computer-aided design. It provides not only an introduction to finite element methods and the commonality in the various techniques, but explores state-of-the-art methods as well -- with a focus on what are deemed to become classical techniques -- procedures that will be standard and authoritative for finite element analysis for years to come. **FEATURES:** presents in sufficient depth and breadth elementary concepts AND advanced techniques in statics, dynamics, solids, fluids, linear and nonlinear analysis. emphasizes both the physical and mathematical characteristics of procedures. presents some important mathematical conditions on finite element procedures. contains an abundance of worked-out examples and various complete

program listings. includes many exercises/projects that often require the use of a computer program.

books on finite element analysis: The Finite Element Method Thomas J. R. Hughes, 2012-05-23 Designed for students without in-depth mathematical training, this text includes a comprehensive presentation and analysis of algorithms of time-dependent phenomena plus beam, plate, and shell theories. Solution guide available upon request.

books on finite element analysis: Finite Element Methods Jonathan Whiteley, 2017-01-26 This book presents practical applications of the finite element method to general differential equations. The underlying strategy of deriving the finite element solution is introduced using linear ordinary differential equations, thus allowing the basic concepts of the finite element solution to be introduced without being obscured by the additional mathematical detail required when applying this technique to partial differential equations. The author generalizes the presented approach to partial differential equations which include nonlinearities. The book also includes variations of the finite element method such as different classes of meshes and basic functions. Practical application of the theory is emphasised, with development of all concepts leading ultimately to a description of their computational implementation illustrated using Matlab functions. The target audience primarily comprises applied researchers and practitioners in engineering, but the book may also be beneficial for graduate students.

books on finite element analysis: Finite Element Analysis for Composite Structures L.T. Tenek, John Argyris, 2013-04-18 This book is an adventure into the computer analysis of three dimensional composite structures using the finite element method (FEM). It is designed for Universities, for advanced undergraduates, for graduates, for researchers, and for practising engineers in industry. The text advances gradually from the analysis of simple beams to arbitrary anisotropic and composite plates and shells; it treats both linear and nonlinear behavior. Once the basic philosophy of the method is understood, the reader may expand its application and modify the computer programs to suit particular needs. The book arose from four years research at the University of Stuttgart, Germany. We present the theory and computer programs concisely and systematically so that they can be used both for teaching and applications. We have tried to make the book simple and clear, and to show the underlying physical and mathematical ideas. The FEM has been in existence for more than 50 years. One of the authors, John Argyris, invented this technique in World War II in the course of the check on the analysis of the swept back wing of the twin engined Meteor Jet Fighter. In this work, he also consistently applied matrix calculus and introduced triangular membrane elements in conjunction with two new definitions of triangular stresses and strains which are now known as the component and total measures. In fact, he was responsible for the original formulation of the matrix force and displacement methods, the forerunners of the FEM.

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Fortran programmes and subroutines described in the text will be made available on the Internet via anonymous ftp, further adding to the value of this title.

books on finite element analysis: *What Every Engineer Should Know about Finite Element Analysis, Second Edition*, John Brauer, 1993-05-05 Summarizing the history and basic concepts of finite elements in a manner easily understood by all engineers, this concise reference describes specific finite element software applications to structural, thermal, electromagnetic and fluid analysis - detailing the latest developments in design optimization, finite element model building and results processing and future trends.; Requiring no previous knowledge of finite elements analysis, the Second Edition provides new material on: p elements; iterative solvers; design optimization; dynamic open boundary finite elements; electric circuits coupled to finite elements; anisotropic and complex materials; electromagnetic eigenvalues; and automated pre- and post-processing software.; Containing more than 120 tables and computer-drawn illustrations - and including two full-colour plates - *What Every Engineer Should Know About Finite Element Analysis* should be of use to engineers, engineering students and other professionals involved with product design or analysis.

books on finite element analysis: The Finite Element Method and Applications in Engineering Using ANSYS® Erdogan Madenci, Ibrahim Guven, 2015-02-10 This textbook offers theoretical and practical knowledge of the finite element method. The book equips readers with the skills required to analyze engineering problems using ANSYS®, a commercially available FEA program. Revised and updated, this new edition presents the most current ANSYS® commands and ANSYS® screen shots, as well as modeling steps for each example problem. This self-contained, introductory text minimizes the need for additional reference material by covering both the fundamental topics in finite element methods and advanced topics concerning modeling and analysis. It focuses on the use of ANSYS® through both the Graphics User Interface (GUI) and the ANSYS® Parametric Design Language (APDL). Extensive examples from a range of engineering disciplines are presented in a straightforward, step-by-step fashion. Key topics include: • An introduction to FEM • Fundamentals and analysis capabilities of ANSYS® • Fundamentals of discretization and approximation functions • Modeling techniques and mesh generation in ANSYS® • Weighted residuals and minimum potential energy • Development of macro files • Linear structural analysis • Heat transfer and moisture diffusion • Nonlinear structural problems • Advanced subjects such as submodeling, substructuring, interaction with external files, and modification of ANSYS®-GUI Electronic supplementary material for using ANSYS® can be found at <http://link.springer.com/book/10.1007/978-1-4899-7550-8>. This convenient online feature, which includes color figures, screen shots and input files for sample problems, allows for regeneration on the reader's own computer. Students, researchers, and practitioners alike will find this an essential guide to predicting and simulating the physical behavior of complex engineering systems.

books on finite element analysis: Finite Element Analysis David S. Burnett, 1987 The emphasis is on theory, programming and applications to show exactly how Finite Element Method can be applied to quantum mechanics, heat transfer and fluid dynamics. For engineers, physicists and mathematicians with some mathematical sophistication.

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Applied Mathematical Sciences (AMS) series, which will focus on advanced textbooks and research-level monographs.

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