Nonlinear Analysis On Buckling And Postbuckling Of

Put a New Class of Structural Composites to Use Real Solutions for Predicting Load Initially designed as thermal barrier materials for aerospace applications and fusion reactors, functionally graded materials (FGMs) are now widely employed as structural components in extremely high-temperature environments. However, little information is commonly available that would allow engineers to predict the response of FGM plates and shells subjected to thermal and mechanical loads. Functionally Graded Materials: Nonlinear Analysis of Plates and Shells is the first book devoted to the geometrically nonlinear response of inhomogeneous isotropic and functionally graded plates and shells. Concerned that the high loads common to many structures may result in nonlinear load–deflection relationships due to large deformations, author Hui-Shen Shen has been conducting investigations since 2001, paying particular attention to the nonlinear response of these plates and shells to nonlinear bending, postbuckling and nonlinear vibration. Nearly all the solutions presented are the results of investigations conducted by the author and his collaborators. The rigor of these investigative procedures allows the results presented within these pages to stand as a benchmark against which the validity and accuracy of other numerical solutions may be measured

The object of the research reported herein was to develop a general mathematical model and solution methodologies for analyzing the structural response of thin, metallic shell structures under large transient, cyclic, or static thermomechanical loads. Among the system responses associated with these loads and conditions are thermal buckling, creep buckling, and ratcheting. Thus geometric and material nonlinearities (of high order) can be anticipated and must be considered in developing the mathematical model. The methodology is demonstrated through different problems of extension, shear, and of planar curved beams. Moreover, importance of the inclusion of large strain is clearly demonstrated, through the chosen applications. Simitses, George J. and Carlson, Robert L. and Riff, Richard Unspecified Center LOADS (FORCES); MATHEMATICAL MODELS; NONLINEAR EQUATIONS; STRUCTURAL ANALYSIS; THERMAL STRESSES; THIN WALLED SHELLS; TIME DEPENDENCE; CREEP BUCKLING; CURVED BEAMS; CYCLIC LOADS; FINITE DIFFERENCE THEORY; NONLINEARITY; STATIC LOADS; STRAIN DISTRIBUTION; THERMAL BUCKLING; THERMAL STABILITY; TRANSIENT LOADS...

This report is concerned with the broad problem of how to make effective use of nonlinear structural analysis in practical design, with emphasis on bridge structures. The report looks at several aspects of this broad problem. Some of these aspects are as follows: (1) The reasons for using structural analysis, and the differences between linear and nonlinear analysis; (2) Strength based versus damage based design; (3) Demand-capacity concepts for design, and decision making based on demand-capacity comparisons; (4) The importance of the behavior concept for the structure, and the value of capacity design; (5) Modeling for linear and nonlinear analysis; and (6) Unanswered questions about how to use nonlinear analysis effectively in design, and the steps we must take to develop answers.

A Topological Introduction to Nonlinear Analysis

A Method for the Geometrically Nonlinear Analysis of Compressively Loaded Prismatic Composite Structures

Nonlinear Analysis of Structures

Linear Buckling and Geometrically Nonlinear Analysis of Planar Plate-stiffener Type Structures by the Finite Element Method

A Two-Step Perturbation Method in Nonlinear Analysis of Beams, Plates and Shells

This book provides an in-depth treatment of the study of the stability of engineering structures. Contributions from internationally recognized leaders in the field ensure a wide coverage of engineering disciplines in which structural stability is of importance, in particular the experimental, analytical and numerical modelling of structural stability applied to aeronautical, civil and marine structures. This second volume in buckling and postbuckling structures builds on the first, and reports on the development of fast semi-analytical methods for the rapid characterization of postbuckling structures; optimization approaches for the design of stiffened composite panels, and a discourse on imperfection sensitivity. This book will be a particularly useful reference to professional engineers, graduate students and researchers interested in structural stability.

Engineering Analysis with SolidWorks Simulation 2012 goes beyond the standard software manual. Its unique approach concurrently introduces you to the SolidWorks Simulation 2012 software and the fundamentals of Finite Element Analysis (FEA) through hands-on exercises. A number of projects are presented using commonly used parts to illustrate the analysis features of SolidWorks Simulation. Each chapter is designed to build on the skills, experiences and understanding gained from the previous chapters. Topics covered: Linear static analysis of parts and assemblies Contact stress analysis Frequency (modal) analysis Buckling analysis Thermal analysis Drop test analysis Nonlinear analysis Dynamic analysis Random vibration analysis h and p adaptive solution methods Modeling techniques Implementation of FEA in the design process Management of FEA projects FEA terminology

Mechanical engineering, an engineering discipline born of the needs of the Industrial Revolution, is once again asked to do its substantial share in the call for industrial renewal. The general call is urgent as we face the profound issues of productivity and competitiveness that require engineering solutions, among others. The Mechanical Engineering Series is a new series, featuring graduate texts and research monographs, intended to address the need for information in contemporary areas of mechanical engineering. The series is conceived as a comprehensive one that will cover a broad range of concentrations important to mechanical engineering graduate education and research. We are fortunate to have a distinguished roster of consulting editors, each an expert in one of the areas of concentration. The names of the consult ing editors are listed on page vi. The areas of concentration are applied mechanics, biomechanics, computational mechanics, dynamic systems and control, energetics, mechanics of materials, processing, thermal science, and tribology. We are pleased to present Nonlinear Analysis of Thin-Walled Structures by James F. Doyle. Austin, Texas Frederick F. Ling Preface This book is concerned with the challenging subject of the nonlinear static, dynamic, and stability analyses of thin-walled structures. It carries on from where Static and Dynamic Analysis of Structures, published by Kluwer 1991, left off; that book concentrated on frames and linear analysis, while the present book is focused on plated structures, nonlinear analysis, and a greater emphasis on stability analysis.

Formulation of the Nonlinear Analysis of Shell-Like Structures, Subjected to Time-Dependent Mechanical and Thermal Loading

Buckling and Postbuckling Structures

Nonlinear Analysis of Plates and Shells

Application of Nonlinear Analysis to Structural Problems

Application of Variational Equation of Motion to the Nonlinear Analysis of Dynamic Buckling

This book is devoted to the discussion and studies of simple and efficient numerical procedures for large deflection and elasto-plastic analysis of steel frames under static and dynamic loading. In chapter 1, the basic fundamental behaviour and philosophy for design of structural steel is discussed, emphasising different modes of buckling and the inter-relationship between different types of analysis. In addition to this, different levels of refinement for non-linear analysis are described. An introduction is also given to the well-known P-&dgr; and P-&Dgr; effects. Chapter 2 presents the basic matrix method of analysis and gives several examples of linear analysis of semi-rigid pointed frames. It is evident from this that one must have a good understanding of first-order linear analysis before handling a second-order non-linear analysis. In chapter 3, the linearized bifurcation and second-order large deflection are compared and the detailed procedure for a second-order analysis based on the Newton-Raphson scheme is described. Chapter 4 introduces various solution schemes for tracing of post-buckling equilibrium paths and the Minimum Residual Displacement control method with arc-length load step control is employed for the post-buckling analysis of two and three dimensional structures. Chapter 5 addresses the non-linear behaviour and modelling of semi-rigid connections while several numerical functions for description of moment versus rotation curves of typical connection types are introduced. The scope of the work in chapter 6 covers semi-rigid connections and material yielding to the static analysis of steel frames. Chapter 7 studies the cyclic response of steel frames with semi-rigid joints and elastic material characteristics. In the last chapter the combined effects of semi-rigid connections and plastic hinges on steel frames under time-dependent loads are studied using a simple springs-in-series model. For computational effectiveness and efficiency, the concentrated plastic hinge concept is used throughout these studies.

Any nonlinear theories or finite elements have to be tested before they can be put into practice. Using the rigid body concept, this book provides simple rules for examining the validity of nonlinear theories and finite elements derived for structural members. The rules can be applied as well to testing the consistency of existing theories or computer analysis programs for nonlinear structures. Covers linear analysis and element quality test; nonlinear trusses and incremental constitutive laws; nonlinear analysis of planar frames; fundamentals of nonlinear theory of space frames; stiffness matrices for nonlinear analysis of space frames; theory and analysis on buckling of curved beams; and procedures for geometric nonlinear analysis. Provides numerous examples containing both analytical and numerical solutions. For mechanical, civil, and aerospace engineers.

Koiter's method for the asymptotic analysis of post-buckling behavior is reformulted in finite element notation for application to structures idealized by finite element models. Koiter's method is herein adapted to a general class of structures exhibiting the common snap-through (limit point) type of buckling. This is referred to as the Modified Structure method. It is accomplished by modification of the actual energy functional to create a hypothetical modified structure having a strictly linear pre-buckling path along which buckling must be of the bifurcation type. The analysis of the actual structure is then accomplished by application of Koiter's method through consideration of the actual structure as an imperfect version of the modified structure. The effects of pre-buckling nonlinearity are approximated asymptotically. The use of the Modified Structure method in conjunction with direct methods of nonlinear analysis is examined. A highly accurate finite element representation is employed in presenting a comprehensive numerical evaluation of the Modified Structure method of analysis on the basis of a number of planar frame problems.

Analysis of Geometrically Nonlinear Structures

Effects of Curvature on the Nonlinear Behaviour of Elastic Arches

Experimental, Analytical and Numerical Studies

An Integrated Finite Element Nonlinear Shell Analysis System with Interactive Computer Graphics

Concepts and Principles for the Application of Nonlinear Structural Analysis in Bridge Design

The importance of accounting for nonlinear effects in offshore structures has increased due to their higher utilization and extended service lives. This text addresses new methods for advanced analysis of offshore structures developed during the 1990s.

An integrated procedure has been proposed for applying the variational equation of motion to the analysis of nonlinear vibrations of solids. In this paper the procedure is extended to the analysis of nonlinear dynamic buckling. Example is given for a simply supported sandwich or homogeneous plate in plane-strain motion, one edge of which is fixed and the other subjected to a longitudinally oscillating displacement. Response curves for the parametrically excited, lateral vibration corresponding to the first instability region are *presented. Results show that the transverse shear effect cannot be neglected for the sandwich plate, as in the case of ordinary, nonlinear lateral vibration of the plate. The transverse shear effect is, however, negligible for the homogeneous plate (Timoshenko beam), at least for the first instability region. (Author).*

Simplified finite element methods for finite deformation, post-buckling analysis of large space trusses and space frames are presented. Arbitrarily large rigid translations and rigid rotations of each member are accounted for. Each 3-D truss member is assumed to withstand an axial force, while each 3-D frame member is assumed to withstand two bending moments, a twisting moment, and transverse and axial forces at each node. The influence of local (member) buckling on global instability is systematically examined. For both 3-D truss and frame members, explicit tangent stiffness matrices are derived. By 'explicit;' it is meant that no element-wise basis functions are assumed and that no element-wise numerical integrations are involved. These explicit tangent stiffness matrices are very simply evaluated at any point in the load deformation history of a space truss, or space frame, undergoing large deformations, as well as in the post-buckled region of behavior of these structures. An arc-length method is implemented to trace the post-buckling behavior of these large space structures. A large number of examples are included to: (1) bring out the economy as well as accuracy of the simplified method developed; (2) indicate the effectiveness of the present method in creating reduced-order models of large space structures; and (3) delineate the process whereby the overall behavior of the structure can be vastly improved by controlling the deformation of individual members through active or passive mechanisms. Keywords: Reduced order model; Simplified nonlinear analysis; Finite deformations; Finite rotations; Semi-tangential rotations; Exact tangent stiffness matrix; LSS (Large Space Structure) control; Arc-length method.

The Modified Structure method. Volume 1

Simplified Nonlinear Analysis of Large Space-trusses and Space-frames, Using Explicitly Derived Tangent Stiffnesses and Accounting for Local Buckling

Buckling and Postbuckling Structures II

Nonlinear Analysis and Post-buckling Response of Trusses

Engineering Analysis with SOLIDWORKS Simulation 2018

The capability to predict the nonlinear response of beams, plates and shells when subjected to thermal and mechanical loads is of prime interest to structural analysis. In fact, many structures are subjected to high load levels that may result in nonlinear load-deflection relationships due to large deformations. One of the important problems deserving special attention is the study of their nonlinear response to large deflection, postbuckling and nonlinear vibration. A two-step perturbation method is firstly proposed by Shen and Zhang (1988) for postbuckling analysis of isotropic plates. This approach gives parametrical analytical expressions of the variables in the postbuckling range and has been generalized to other plate postbuckling situations. This approach is then successfully used in solving many nonlinear bending, postbuckling, and nonlinear vibration problems of composite laminated plates and shells, in particular for some difficult tasks, for example, shear deformable plates with four free edges resting on elastic foundations, contact postbuckling of laminated plates and shells, nonlinear vibration of anisotropic cylindrical shells. This approach may be found its more extensive applications in nonlinear analysis of nano-scale structures. Concentrates on three types of nonlinear analyses: vibration, bending and postbuckling Presents not only the theoretical aspect of the techniques, but also engineering applications of the method A Two-Step Perturbation Method in Nonlinear Analysis of Beams, Plates and Shells is an original and unique technique devoted entirely to solve geometrically nonlinear problems of beams, plates and shells. It is ideal for academics, researchers and postgraduates in mechanical engineering, civil engineering and aeronautical engineering.

This book focuses on the nonlinear behaviour of thin-wall shells (single- and multilayered with delamination areas) under various uniform and non-uniform loadings. The dependence of critical (buckling) load upon load variability is revealed to be highly non-monotonous, showing minima when load variability is close to the eigenmode variabilities of solution branching points of the respective nonlinear boundary problem. A novel numerical approach is employed to analyze branching points and to build primary, secondary, and tertiary bifurcation paths of the nonlinear boundary problem for the case of uniform loading. The load levels of singular points belonging to the paths are considered to be critical load estimates for the case of non-uniform loadings.

The hydraulic buckling instability of the involute fuel plates and hydraulic coolant channels in the Advanced Neutron Source (ANS) uranium fission reactor is analyzed nonlinearly using the commercial ABAQUS finite element computer program for the fuel plates in conjunction with a user-written element for the two-dimensional fluid flow in the coolant channels. This methodology has been used for several purposes, including determination of the effect of the aluminum-clad plate plastic behavior and the effect of three-dimensional plate temperature distributions on hydraulic buckling. The present report concentrates on a study of the effect of hydraulic channel imperfections on buckling. The specific form of imperfection considered is an error in fluid channel thickness that is uniform within any one channel but that varies from one channel to the next. The calculated bifurcation (linear buckling) coolant velocity is about 45 m/s, whereas the present design coolant velocity is 25 m/s. At the design velocity, the calculated fluid-induced plate deflection due to the imperfection is somewhat less in magnitude and opposite in direction from the imperfection itself.

Linear and Nonlinear Structural Mechanics
Nonlinear Behaviour and Stability of Thin-Walled Shells
Theory & Analysis of Nonlinear Framed Structures
Nonlinear Analysis of Post-buckling Dynamics and Higher Order Instabilities of Flexible Structures
Nonlinear Analysis of the Buckling and Vibration of a Rotating Elasticum. No. 1992/16

State-of-the-art nonlinear computational analysis of shells, nonlinearities due to large deformations and nonlinear material behavior, alternative shell element formulations, algorithms and implementational aspects, composite and sandwich shells, local and global instabilities, optimization of shell structures and concepts of shape finding methods of free from shells. Furthermore, algorithms for the treatment of the nonlinear stability behavior of shell structures (including bifurcation and snap-through buckling) are presented in the book.

Many of today's low-rise building structures consist of thin-walled metal members that form Metal Building Frames (MBFs). Members associated with MBFs typically involve tapered webs. Although use of web-tapered members for MBFs are driven by economical efficiency, understanding on how these type of members respond under seismic loading is limited. Design of web-tapered members generally is governed by lateral-torsional buckling (LTB) and local buckling. To better understand the seismic response of MBFs that buckle, use of numerical methods that can simulate buckling and post-buckling behavior are desirable. Since it is not inefficient to use elements such as shells or solids for extensive seismic analyses, development of a one-dimensional beam-column element is researched and incorporated to the software OpenSees in order to capture warping and non-prismatic effects. In addition to monotonic correlations, six full-scale web-tapered members cyclically tested at UCSD were analyzed using this proposed beam-column element. Parametric studies associated with these analyses were also performed and included variation of axial loads, initial imperfections, and residual stresses. Based on the predicted analyses, events of initial LTB were captured reasonably well. However, it was observed that the proposed element is limited in its capabilities by events of local buckling. Because of local buckling limitation, attempt to expand the proposed element by introducing combined flange-web displacements was pursued. Although formulation of the updated element was successfully implemented, issues associated with initiating local buckling were observed during preliminary verification. Further development of incorporating initial displacements to the flanges is thus required.

Nonlinear Analysis of Structures presents a complete evaluation of the nonlinear static and dynamic behavior of beams, rods, plates, trusses, frames, mechanisms, stiffened structures, sandwich plates, and shells. These elements are important components in a wide variety of structures and vehicles such as spacecraft and missiles, underwater vessels and structures, and modern housing. Today's engineers and designers must understand these elements and their behavior when they are subjected to various types of loads. Coverage includes the various types of nonlinearities, stress-strain relations and the development of nonlinear governing equations derived from nonlinear elastic theory. This complete guide includes both mathematical treatment and real-world applications, with a wealth of problems and examples to support the text. Special topics include a useful and informative chapter on nonlinear analysis of composite structures, and another on recent developments in symbolic computation. Designed for both self-study and classroom instruction, Nonlinear Analysis of Structures is also an authoritative reference for practicing engineers and scientists. One of the world's leaders in the study of nonlinear structural analysis, Professor Sathyamoorthy has made significant research contributions to the field of nonlinear mechanics for twenty-seven years. His foremost contribution to date has been the development of a unique transverse shear deformation theory for plates undergoing large amplitude vibrations and the examination of multiple mode solutions for plates. In addition to his notable research, Professor Sathyamoorthy has also developed and taught courses in the field at universities in India, Canada, and the United States.

The Effects of Initial Imperfections on the Buckling of Composite Cylindrical Shells

Nonlinear Analysis of Plates

Nonlinear Analysis of Shells by Finite Elements

Web-Tapered Steel Beam-Column Elements for Nonlinear Analysis with Cyclic Loading

Mat-report

The availability of computers has, in real terms, moved forward the practice of structural engineering. Where it was once enough to have any analysis given a complex configuration, the profession today is much more demanding. How engineers should be more demanding is the subject of this book. In terms of the theory of structures, the importance of geometric nonlinearities is explained by the theorem which states that "In the presence of prestress, geometric nonlinearities are of the same order of magnitude as linear elastic effects in structures. " This theorem implies that in most cases (in all cases of incremental analysis) geometric nonlinearities should be considered. And it is well known that problems of buckling, cable nets, fabric structures, ... REQUIRE the inclusion of geometric nonlinearities. What is offered in the book which follows is a unified approach (for both discrete and continuous systems) to geometric nonlinearities which incidentally does not require a discussion of large strain. What makes this all work is perturbation theory. Let the equations of equilibrium for a system be written as where P represents the applied loads, F represents the member forces or stresses, and N represents the operator which describes system equilibrium.

The results of an experimental and analytical study of the effects of initial imperfections on the buckling response of thin unstiffened graphite-epoxy cylindrical shells with and without a cutout, and with three different shell-wall laminates, are presented. Results that identify the individual and combined effects of traditional initial geometric shell-wall imperfections, and nontraditional shell-wall thickness variations, shell-end geometric imperfections, and variations in loads applied to the ends of the shells on the shell

buckling and nonlinear responses, are included. The shells have been analyzed with a robust nonlinear finite-element analysis code for shells that accurately accounts for these effects on the buckling and nonlinear responses of the shells. The analysis results generally correlate well with the experimental results. The nonlinear analysis results are also compared with the results from a traditional linear bifurcation buckling analysis that is commonly used for shell design. The results suggest that the nonlinear analysis procedure can be used for determining accurate, high-fidelity, design knockdown factors for shell buckling and collapse. A discussion of how this high-fidelity nonlinear analysis procedure can be used to form the basis for a shell analysis and design approach that addresses some of the critical shell-buckling design criteria and design considerations for composite shell structures is included.

Engineering Analysis with SOLIDWORKS Simulation 2018 goes beyond the standard software manual. Its unique approach concurrently introduces you to the SOLIDWORKS Simulation 2018 software and the fundamentals of Finite Element Analysis (FEA) through hands-on exercises. A number of projects are presented using commonly used parts to illustrate the analysis features of SOLIDWORKS Simulation. Each chapter is designed to build on the skills, experiences and understanding gained from the previous chapters.

A Nonlinear Analysis of the Buckling of Circular Cylinders Subjected to Axial Compression and Internal Pressure

Non-Linear Static and Cyclic Analysis of Steel Frames with Semi-Rigid Connections

Computerized buckling analysis of shells

Linear buckling and geometric nonlinear analysis of arbitrary plane frames for microcomputers

Nonlinear Analysis of Structures (1997)

Provides an in-depth treatment of the study of the stability of engineering structures. This book is useful for professional engineers, graduate students and researchers interested in structural stability.

"The book is highly recommended as a text for an introductory course in nonlinear analysis and bifurcation theory... reading is fluid and very pleasant... style is informal but far from being imprecise." -review of the first edition. New to this edition: additional applications of the theory and techniques, as well as several new proofs. This book is ideal for self-study for mathematicians and students interested in geometric and algebraic topology, functional analysis, differential equations, and applied mathematics.

A method was developed for the geometrically nonlinear analysis of the static response of thin-walled stiffened composite structures loaded in uniaxial or biaxial compression. The method is applicable to arbitrary prismatic configurations composed of linked plate strips, such as stiffened panels and thin-walled columns. The longitudinal ends of the structure are assumed to be simply supported, and geometric shape imperfections can be modeled. The method can predict the nonlinear phenomena of postbuckling strength and imperfection sensitivity which are exhibited by some buckling-dominated structures. The method is computer-based and is semi-analytic in nature, making it computationally economical in comparison to finite element methods. The method uses a perturbation approach based on the use of a series of buckling mode shapes to represent displacement contributions associated with nonlinear response. Displacement contributions which are of second order in the model amplitudes are incorported in addition to the buckling mode shapes. The principle of virtual work is applied using a finite basis of buckling modes, and terms through the third order in the model amplitudes are retained. A set of cubic nonlinear algebraic equations are obtained, from which approximate equilibrium solutions are determined. Buckling mode shapes for the general class of structure are obtained using the VIPASA analysis code within the PASCO stiffened-panel design code. Thus, subject to some additional restrictions in loading and plate anisotropy, structures which can be modeled with respect to buckling behavior by VIPASA can be analyzed with respect to nonlinear response using the new method. Results obtained using the method are compared with both experimental and analytical results in the literature. The configurations investigated include several different unstiffened and blade-stiffening panel configurations, featuring both homogeneous, isotropic materials, and laminated composite materi...

Engineering Analysis with SolidWorks Simulation 2012

Nonlinear Analysis of Hydraulic Buckling Instability of ANS Involute Fuel Plates

Engineering Analysis with SolidWorks Simulation 2013

Nonlinear Analysis of Offshore Structures

Statics, Dynamics, and Stability

Arches are structures which combine the bending member function of transmitting transverse forces with the compression member function of transmitting axial forces. The axial deformations of an arch affect its deformed curvatures, giving rise to some high order curvature terms. These terms are not usually considered in the conventional nonlinear analysis of elastic arches, and their effects have not been investigated adequately. This paper develops a new curved finite element model for the nonlinear analysis of elastic arches which includes the effects of the high order terms in the deformed curvatures, and investigates the effects of these terms on the in-plane nonlinear behaviour of elastic arches. The use of deformed curvatures with these high order terms can describe the deformations of arches more accurately. Numerical examples demonstrate that the model is efficient, effective and accurate and that the effects of the high order curvature terms on the in-plane nonlinear behaviour of arches are significant in some cases. The nonlinear buckling and postbuckling behaviours of elastic pinended arches subjected to uniformly distributed radial loads are investigated numerically using the model. It is found that the existence of a linear bifurcation buckling load is not a sufficient condition for linear bifurcation buckling to occur; that the effects of prebuckling deformations on the buckling of shallow arches are significant; and that the nonlinear buckling loads may be much lower than the linear buckling loads.

This report describes the work performed by Lockheed Palo Alto Research Labora tory, Palo Alto, California 94304. The work was sponsored by Air Force Office of Scientific Research, Bolling AFB, Washington, D. C. under Grant F49620-77-C-0l22 and by the Flight Dynamics Laboratory, Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio under Contract F3361S-76-C-31OS. The work was completed under Task 2307NI, "Basic Research in Behavior of Metallic and Composite Components of Airframe Structures". The work was admini stered by Lt. Col. J. D. Morgan (AFOSR) and Dr. N. S. Khot (AFWAL/FIBRA). The contract work was performed between October 1977 and December 1980. The technical report was released by the Author in December 1981. Preface Many structures are assembled from parts which are thin. For example, a stiffened plate or cylindrical panel is composed of a sheet the thickness of which is small com pared to its length, breadth, and stiffener- spacing, and stiffeners the thickness of which is small compared to their _ heights and lengths. These assembled structures, loaded in compression, can buckle overall, that is sheet and stiffeners can collapse together in a general instability mode; the sheet can buckle locally between stiffeners; the stiffeners can cripple; and a variety of complex buckling interactions can occur involving local and overall deformations of both sheet and stiffeners. More complex, built-up structures can buckle in more complex and subtle ways.

Engineering Analysis with SolidWorks Simulation 2013 goes beyond the standard software manual. Its unique approach concurrently introduces you to the SolidWorks Simulation 2013 software and the fundamentals of Finite Element Analysis (FEA) through hands-on exercises. A number of projects are presented using commonly used parts to illustrate the analysis features of SolidWorks Simulation. Each chapter is designed to build on the skills, experiences and understanding gained from the previous chapters. Topics covered: Linear static analysis of parts and assemblies Contact stress analysis Frequency (modal) analysis Buckling analysis Thermal analysis Drop test analysis Nonlinear analysis Dynamic analysis Random vibration analysis h and p adaptive solution methods Modeling techniques Implementation of FEA in the design process Management of FEA projects FEA terminology

A Koiter-type Method for Finite Element Analysis of Nonlinear Structural Behavior

Presented at the 4th National Congress on Pressure Vessel and Piping Technology, Portland, Oregon, June 19-24, 1983

Nonlinear Analysis of the Buckling and Vibration of a Rotating Elasticum

Nonlinear Analysis of Thin-Walled Structures

Nonlinear Analysis of Shell Structures

* Explains the physical meaning of linear and nonlinear structural mechanics. * Shows how to perform nonlinear structural analysis. * Points out important nonlinear structural dynamics behaviors. * Provides ready-to-use governing equations.

Functionally Graded Materials