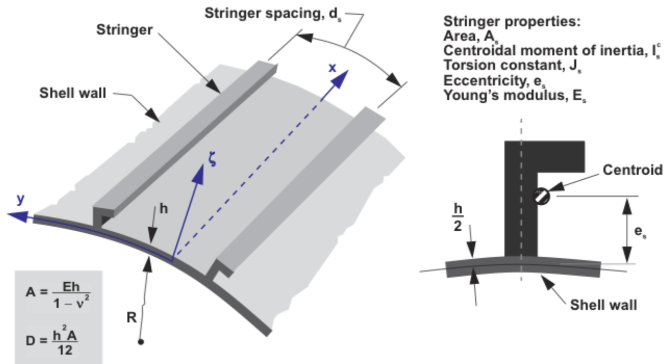
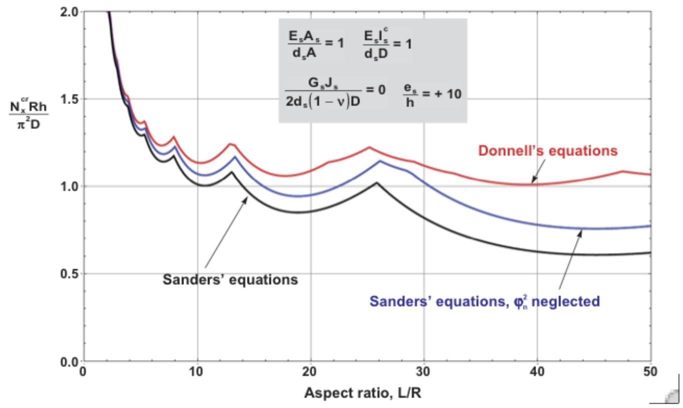
Dr. Michael P. Nemeth





From: M. P. Nemeth, "Buckling analysis for stiffened anisotropic circular cylinders based on Sanders' nonlinear shell theory", NASA/TM-2014-218176, March 2014

Mike Nemeth (2006)

Mike Nemeth (1992)

See:
http://www.journalogy.net/Author/12755564/michael-p-nemeth
http://archive.org/search.php?query=creator%3A%22Nemeth%2C%20Michael%20P%22
http://en.scientificcommons.org/michael_p_nemeth
http://openlibrary.org/authors/OL4654291A/Michael_P._Nemeth

NASA Langley Research Center, Hampton, Virginia

Selected Publications:
For an important review of NASA design recommendations relating to shell stability, see the file, **1998nasa.pdf**, by Michael P. Nemeth and James H. Starnes, Jr.:
Michael P. Nemeth and James H. Starnes, Jr. (NASA Langley Research Center, Hampton, Virginia, USA), **"The NASA Monographs on Shell Stability Design Recommendations, A review and suggested improvements"**, NASA/TP-1998-206290, January, 1998
ABSTRACT: A summary of the existing NASA design criteria monographs for the design of buckling-resistant thin-shell structures is presented. Subsequent improvements in the analysis for nonlinear shell response are reviewed, and current issues in shell stability analysis are discussed. Examples of nonlinear shell responses that are not included in the existing shell design monographs are presented, and an approach for including reliability-based analysis procedures in the shell design process is discussed. Suggestions for conducting future shell experiments are presented, and proposed improvements to the NASA shell design criteria monographs are discussed.

Nemeth, M. P., "Importance of Anisotropy on Buckling of Compression-Loaded Symmetric Composite Plates," AIAA Journal, Vol. 24, No. 11, Nov. 1986, pp. 1831-1835.

Nemeth, M. P., "Buckling and Postbuckling Behavior of Square Compression-Loaded Graphite-Epoxy Plates With Circular Cut- outs," NASA Technical Paper 3007, August 1990.

Nemeth, M. P., "Buckling and Postbuckling Behavior of Compression-Loaded Isotropic Plates With Cutouts," NASA Technical Paper 3024, September 1990.

Michael P. Nemeth, "Nondimensional parameters and equations for buckling of symmetrically laminated thin elastic shallow shells", NASA Technical Memorandum 104060, March, 1991

Nemeth, M. P. (1992). Buckling behavior of long symmetrically laminated plates subjected to compresion, shear, and inplane bending loads. AIAA Paper 92-2286-CP, Proceedings of 33rd AIAA Structures, Structural Dynamics, and Materials Conference, Part 2, pp. 274-282.

Nemeth, M. P., "Buckling Behavior of Long Symmetrically Laminated Plates Subjected to Combined Loadings," NASA TP-3195, 1992.

M.P. Nemeth (Structural Mechanics Division, NASA Langley Research Center, Hampton, VA, 23681-0001), "Nondimensional parameters and equations for buckling of anisotropic shallow shells", J. Appl. Mech., Vol. 61, September 1994, pp. 664-669
ABSTRACT: A procedure for deriving nondimensional parameters and equations for bifurcation buckling of

anisotropic shallow shells subjected to combined loads is presented. First, the Donnell-Mushtari-Vlasov equations governing buckling of symmetrically laminated doubly curved thin elastic shallow shells are presented. Then, the rationale used to perform the nondimensionalization of the buckling equations is presented, and fundamental parameters are identified that represent measures of the shell orthotropy and anisotropy. In addition, nondimensional curvature parameters are identified that are analogues of the well-known Batdorf Z parameter for isotropic shells, and analogues of Donnell's and Batdorf's shell buckling equations are presented. Selected results are presented for shear buckling of balanced symmetric laminated shells that illustrate the usefulness of the nondimensional parameters.

Nemeth, M. P., "Buckling Behavior of Long Anisotropic Plates Subjected to Combined Loads," NASA TP-3568, 1995.

M. Nemeth, Buckling and postbuckling behaviour of laminated composite plates with a cut-out, in: G. Turvey, I. Marshall (Eds.), Buckling and Postbuckling of Composite Plates, 1st Edition, Chapman and Hall, London Glasgow Weinheim, 1995, pp. 260–298.

Michael P. Nemeth (Langley Research Center, Hampton, Virginia), "Buckling Behavior of Long Symmetrically Laminated Plates Subjected to Shear and Linearly Varying Axial Edge Loads", NASA Technical Paper 3659, July 1997
ABSTRACT: A parametric study of the buckling behavior of infinitely long symmetrically laminated anisotropic plates that are subjected to linearly varying edge loads, uniform shear loads, or combinations of these loads is presented. The study focuses on the effects of the shape of linearly varying edge load distribution, plate orthotropy, and plate flexural anisotropy on plate buckling behavior. In addition, the study examines the interaction of linearly varying edge loads and uniform shear loads with plate flexural anisotropy and orthotropy. Results obtained by using a special purpose non-dimensional analysis that is well suited for parametric studies of clamped and simply supported plates are presented for [±theta]s thin graphite-epoxy laminates that are representative of spacecraft structural components. Also, numerous generic buckling-design charts are presented for a wide range of nondimensional parameters that are applicable to a broad class of laminate constructions. These charts show explicitly the effects of flexural orthotropy and flexural anisotropy on plate buckling behavior for linearly varying edge loads, uniform shear loads, or combinations of these loads. The most important finding of the present study is that specially orthotropic and flexurally anisotropic plates that are subjected to an axial edge load distribution that is tension dominated can support shear loads that are larger in magnitude than the shear buckling load.

Nemeth, Michael P.; Britt, Vicki O.; Collins, Timothy J.; and Starnes, James H., Jr.: Nonlinear Analysis of the Space Shuttle Superlightweight External Fuel Tank. NASA TP-3616, 1996.

Michael P. Nemeth, Vicki O. Britt, Timothy J. Collins, and James H. Starnes, Jr. (Langley Research Center Hampton, Virginia), "Nonlinear Analysis of the Space Shuttle Superlightweight External Fuel Tank", NASA Technical Paper 3616, December, 1996. (Also see Journal of Spacecraft and Rockets, Vol. 36, No.6, November-December, 1999, pp. 788-803)
ABSTRACT: Results of buckling and nonlinear analyses of the Space Shuttle external tank superlightweight liquid-oxygen (LO2) tank are presented. Modeling details and results are presented for two prelaunch loading conditions and for two full-scale structural tests that were conducted on the original external tank. The results illustrate three distinctly different types of nonlinear response for thin-walled shells subjected to combined mechanical and thermal loads. The nonlinear response phenomena consist of bifurcation-type buckling, short-

wavelength nonlinear bending, and nonlinear collapse associated with a limit point. For each case, the results show that accurate predictions of nonlinear behavior generally require a large-scale, high-fidelity finite-element model. Results are also presented that show that a fluid-filled launch-vehicle shell can be highly sensitive to initial geometric imperfections. In addition, results presented for two full-scale structural tests of the original standard-weight external tank suggest that the finite-element modeling approach used in the present study is sufficient for representing the nonlinear behavior of the superlight-weight LO2 tank.

Nemeth, M.P. 1997. Buckling behavior of long symmetrically laminated plates subjected to shear and linearly varying axial edge loads, TP 3659: NASA.

Knight, Norman F, Jr and Nemeth, Michael P (editors), “Stability Analysis of Plates and Shells”, NASA no. 19980019011. In: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference
ABSTRACT: This special publication contains the papers presented at the special sessions honoring Dr. Manuel Stein during the 38th AIAA /ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference held in Kissimmee, Florida, Apdl 7-10, 1997. This volume, and the SDM special sessions, are dedicated to the memory of Dr. Manuel Stein, a major pioneer in structural mechanics, plate and shell buckling, and composite structures. Many of the papers presented are the work of Manny's colleagues and co-workers and are a result, directly or indirectly, of his influence. Dr. Stein earned his Ph.D. in Engineering Mechanics from Virginia Polytechnic Institute and State University in 1958. He worked in the Structural Mechanics Branch at the NASA Langley Research Center from 1943 until 1989. Following his retirement, Dr. Stein continued his involvement with NASA as a Distinguished Research Associate.

Richard D. Young, Michael P. Nemeth, Timothy J. Collins, and James H. Starnes, Jr. (NASA Langley Research Center Hampton, Virginia 23681-0001), “Nonlinear Analysis of the Space Shuttle Superlightweight LO2 Tank: Part I - Behavior under Booster Ascent Loads”, AIAA 39th Structures, Structural Dynamics and Materials Conference, AIAA-98-1838, 1998
ABSTRACT: Results of linear bifurcation and nonlinear analyses of the Space Shuttle superlightweight (SLWT) external liquid-oxygen (LO2) tank for an important early booster ascent loading condition are presented. These results for thin-walled linear elastic shells that are subjected to combined mechanical and thermal loads illustrate an important type of response mode that may be encountered in the design of other liquid-fuel launch vehicles. Linear bifurcation analyses are presented that predict several nearly equal eigenvalues that correspond to local buckling modes in the forward ogive section of the LO2 tank. In contrast, the nonlinear response phenomenon is shown to consist of short-wavelength bending deformations in the forward ogive and barrel sections of the LO2 tank that grow in amplitude in a stable manner with increasing load. Imperfection sensitivity analyses are presented that show that the presence of several nearly equal eigenvalues does not lead to a premature general instability mode for the forward ogive section. For the linear bifurcation and nonlinear analyses, the results show that accurate predictions of the response of the shell generally require a large-scale, high-fidelity finite-element model. Results are also presented that show that the SLWT LO2 tank can support loads in excess of approximately 2.6 times the values of the operational loads considered.

Arbocz, J., Starnes, J. H., and Nemeth, M. P., A Hierarchical Approach to Buckling Load Calculations, AIAA Paper No. 99-1232, April 1999.

Young, R. D., Nemeth, M. P., Collins, T. J., and Starnes, J. H., Jr.,"Nonlinear Behavior of Space Shuttle Super-lightweight Liquid-Oxygen Tank Under Booster Ascent Loads," Journal of Spacecraft and Rockets, Vol. 36, No.6, November-December, 1999, pp. 820-827.

Nemeth, M. P., Young, R. D., Collins, T. J., and Starnes, J. H., Jr., "Effects of Welding-Induced Imperfections on Behavior of Space Shuttle Superlightweight Liquid-Oxygen Tank," Journal of Spacecraft and Rockets, Vol. 36, No.6, November-December, 1999, pp. 812-819.

Nemeth, M. P., Young, R. D., Collins, T. J., and Starnes, J. H., Jr., "Nonlinear Behavior of Space Shuttle Superlightweight Liquid-Oxygen Tank Under End-of-Flight Loads," Journal of Spacecraft and Rockets, Vol. 36, No.6, November-December, 1999, pp. 828-835.

Árbocz, J., Starnes, J. H., Hr., and Nemeth, M. P., "On the Accuracy of Probabilistic Buckling Load Predictions,"
Proceedings of the 41st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Atlanta, GA. AIAA Paper No. 2000-1236, 2000.

Starnes, J. H., Jr., Hilburger, M. W., and Nemeth, M. P., The Effect of Initial Imperfections on the Buckling of Composite Cylindrical Shells, in Composite Structures: Theory and Practice, ASTM STP 1383, P. Grant and C. Q. Rousseau (editors), American Society for Testing Materials, West Conshohocken, PA, 2000, pp. 529-550.

Librescu, L., Nemeth, M. P., Starnes, J. H., Jr., and Lin, W., "Nonlinear Response of Flat and Curved Panels Subjected to Thermomechanical Loads," Journal of Thermal Stresses, Vol. 23, 2000, pp. 549-582.

Mark W. Hilburger, Michael P. Nemeth and James H. Starnes, Jr. (NASA Langley Research Center, Hampton, Virginia), "Effective Widths of Compression-Loaded Plates with a Cutout", NASA/TP-2000-210538, October 2000
ABSTRACT: Results from a study of the effects of cutouts and laminate construction on the prebuckling and initial postbuckling stiffnesses, and the effective widths of compression-loaded laminated-composite and aluminum square plates are presented. An effective-width concept is derived for plates with and without cutouts, and experimental and nonlinear finite-element analysis results are presented. Behavioral trends are compared for seven plate families and for cutout-diameter-to-plate-width ratios up to 0.66. A general compact design curve that can be used to present and compare the effective widths for a wide range of laminate constructions is also presented. A discussion of how the results can be used and extended to include certain types of damage, cracks, and other structural discontinuities or details is given. Several behavioral trends are described that initially appear to be nonintuitive. The results demonstrate a complex interaction between cutout size and plate orthotropy that affects the axial stiffness and effective width of a plate subjected to compression loads.

Michael P. Nemeth and Stanley S. Smeltzer, III (Langley Research Center, Hampton, Virginia), "Bending Boundary Layers in Laminated- Composite Circular Cylindrical Shells", NASA/TP-2000-210549, November 2000
ABSTRACT: An analytical, parametric study of the attenuation of bending boundary layers or edge effects in balanced and unbalanced, symmetrically and unsymmetrically laminated thin cylindrical shells is presented for nine contemporary material systems. The analysis is based on the linear Sanders-Koiter shell equations and specializations to the Love-Kirchhoff shell equations and Donnell's equations are included. Two nondimensional parameters are identified that characterize and quantify the effects of laminate orthotropy and laminate anisotropy on the bending boundary-layer decay length in a very general and encompassing manner. A

substantial number of structural design technology results are presented for a wide range of laminated-composite cylinders. For all laminate constructions considered, the results show that the differences between results that were obtained with the Sanders-Koiter shell equations, the Love-Kirchhoff shell equations, and Donnell's equations are negligible. The results also show that the effect of anisotropy in the form of coupling between pure bending and twisting has a negligible effect on the size of the bending boundary-layer decay length of the balanced, symmetrically laminated cylinders considered. Moreover, the results show that coupling between the various types of shell anisotropies has a negligible effect on the calculation of the bending boundary-layer decay length in most cases. The results also show that, in some cases, neglecting the shell anisotropy results in underestimating the bending boundary-layer decay length and, in other cases, results in an overestimation. An example problem is included in an appendix that demonstrates how to perform the calculations that were used to generate the results of the present study.

Starnes, J. H., Jr., Hilburger, M. W., and Nemeth, M. P., "The Effects of Initial Imperfections on the Buckling of Composite Shells," Composite Structures: Theory and Practice, ASTM STP 1383, P. Grant and C. Q. Rousseau, Eds., American Society for Testing and Materials, 2000, pp. 529-550.

Hilburger, M. W. (1 and 3), Britt, V. O. (2), and Nemeth, M. P. (3)
(1) National Research Council, Washington, DC 20418, USA
(2) Gulf Stream Aerospace Corp., Savannah, GA 31402-2206, USA
(3) NASA Langley Research Center, MS 190, Hampton, VA 23681-0001, USA,
email: m.w.hilburger@larc.nasa.gov
"Buckling Behavior of Compression-Loaded Quasi-Isotropic Curved Panels With a Circular Cutout," International Journal of Solids and Structures, Vol. 38, 2001, pp. 1495-1522,
doi:10.1016/S0020-7683(00)00114-1
ABSTRACT: Results from a numerical and experimental study of the response of compression-loaded quasi-isotropic curved panels with a centrally located circular cutout are presented. The numerical results were obtained by using a geometrically nonlinear finite element analysis code. The effects of cutout size, panel curvature and initial geometric imperfections on the overall response of compression-loaded panels are described. In addition, results are presented from a numerical parametric study that indicate the effects of elastic circumferential edge restraints on the prebuckling and buckling response of a selected panel and these numerical results are compared to experimentally measured results. These restraints are used to identify the effects of circumferential edge restraints that are introduced by the test fixture that was used in the present study. It is shown that circumferential edge restraints can introduce substantial nonlinear prebuckling deformations into shallow compression-loaded curved panels that can result in a significant increase in buckling load.

Nemeth, M. P., Young, R. D., Collins, T. J., and Starnes, J. H., Jr., "Effects of Initial Geometric Imperfections on the Nonlinear Response of the Space Shuttle Superlightweight Liquid-Oxygen Tank," International Journal of Non-Linear Mechanics, Vol. 37, No.4-5, June, 2002, pp. 723-744.

Harik, V. M. ; Gates, T. S. ; Nemeth, M. P., "Applicability of the Continuum-shell Theories to the Mechanics of Carbon Nanotubes", Institute For Computer Applications In Science And Engineering Hampton VA, Accession Number : ADA401873, Handle / proxy Url http://handle.dtic.mil/100.2/ADA401873. , April 2002
ABSTRACT: Validity of the assumptions relating the applicability of continuum shell theories to the global mechanical behavior of carbon nanotubes is examined. The present study focuses on providing a basis that can be used to qualitatively assess the appropriateness of continuum-shell models for nanotubes. To address the

effect of nanotube structure on their deformation, all nanotube geometries are divided into four major classes that require distinct models. Criteria for the applicability of continuum models are presented. The key parameters that control the buckling strains and deformation modes of these classes of nanotubes are determined. In an analogy with continuum mechanics, mechanical laws of geometric similitude are presented. A parametric map is constructed for a variety of nanotube geometries as a guide for the applicability of different models. The continuum assumptions made in representing a nanotube as a homogeneous thin shell are analyzed to identify possible limitations of applying shell theories and using their bifurcation-buckling equations at the nano-scale.

Nemeth, M. P., Young, R. D., Collins, T. J., and Starnes, J. H., Jr. (NASA Langley Research Center, Hampton, VA 23681-2199, USA), "Effects of Initial Geometric Imperfections on the Nonlinear Response of the Space Shuttle Superlightweight Liquid-Oxygen Tank," International Journal of Non-Linear Mechanics, Vol. 37, No.4-5, June, 2002, pp. 723-744, Special Issue: Stability and Vibration in Thin-Walled Structures, doi:10.1016/S0020-7462(01)00095-6
ABSTRACT: The results of an analytical study of the elastic buckling and non-linear behavior of the liquid-oxygen tank for the new Space Shuttle superlightweight external fuel tank are presented. Selected results that illustrate three distinctly different types of non-linear response phenomena for thin-walled shells which are subjected to combined mechanical and thermal loads are presented. These response phenomena consist of a bifurcation-type buckling response, a short-wavelength non-linear bending response, and a non-linear collapse or “snap-through” response associated with a limit point. The effects of initial geometric imperfections on the response characteristics are emphasized. The results illustrate that the buckling and non-linear response of a geometrically imperfect shell structure subjected to complex loading conditions may not be adequately characterized by an elastic linear bifurcation buckling analysis, and that the traditional industry practice of applying a buckling-load knock-down factor can result in an ultra-conservative design. Results are also presented that show that a fluid-filled shell can be highly sensitive to initial geometric imperfections, and that the use a buckling-load knock-down factor is needed for this case.

Nemeth, M. P. (NASA Langley Research Center, Hampton, Virginia, USA), "Buckling Behavior of Long Anisotropic Plates Subjected to Fully Restrained Thermal Expansion," NASA TP-2003-212131, February 2003.
ABSTRACT: An approach for synthesizing buckling results and behavior for long, balanced and unbalanced symmetric laminates that are subjected to uniform heating or cooling and that are fully restrained against thermal expansion or contraction is presented. This approach uses a nondimensional analysis for infinitely long, flexurally anisotropic plates that are subjected to combined mechanical loads and is based on useful nondimensional parameters. In addition, stiffness-weighted laminate thermal-expansion parameters are derived that are used to determine critical temperature changes in terms of physically intuitive mechanical buckling coefficients, and the effects of membrane orthotropy and membrane anisotropy are included. Many results are presented for some common laminates that are intended to facilitate a structural designer’s transition to the use of the generic buckling design curves that are presented in the paper. Several generic buckling design curves are presented that provide physical insight into the buckling response in addition to providing useful design data. Examples are presented that demonstrate the use of the generic design curves. The analysis approach and generic results indicate the effects and characteristics of laminate thermal expansion, membrane orthotropy and anisotropy, and flexural orthotropy and anisotropy in a very general and unifying manner.

Hilburger, M. W., Nemeth, M. P., and Starnes, J. H., Jr., Shell buckling design criteria based on manufacturing imperfection signatures, NASA/TM-2004-212659, May 2004

ABSTRACT: An analysis-based approach for developing shell buckling design criteria for laminated-composite cylindrical shells that accurately account for the effects of initial geometric imperfections is presented. With this approach, measured initial geometric imperfection data from six graphite-epoxy shells are used to determine a manufacturing-process-specific imperfection signature for these shells. This imperfection signature is then used as input into nonlinear finite-element analyses. The imperfection signature represents a "first-approximation" mean imperfection shape that is suitable for developing preliminary-design data. Comparisons of test data and analytical results obtained by using several different imperfection shapes are presented for selected shells. These shapes include the actual measured imperfection shape of the test specimens, the "first-approximation" mean imperfection shape, with and without plus or minus one standard deviation, and the linear-bifurcation-mode imperfection shape. In addition, buckling interaction curves for composite shells subjected to combined axial compression and torsion loading are presented that were obtained by using the various imperfection shapes in the analyses. A discussion of the nonlinear finite-element analyses is also presented. Overall, the results indicate that the analysis-based approach presented for developing reliable preliminary-design criteria has the potential to provide improved, less conservative buckling-load estimates, and to reduce the weight and cost of developing buckling-resistant shell structures.

Hilburger, M. W., Nemeth, M. P., Riddick, J. C., and Thornburgh, R. P. (Mechanics and Durability Branch, NASA Langley Research Center, Hampton, Virginia 23681-0001), “Effects of elastic edge restraints and initial prestress on the buckling response of compression-loaded composite panels, 45th AIAA SDM Conference, April 2004

ABSTRACT: A parametric study of the effects of test-fixture-induced initial prestress and elastic edge restraints on the prebuckling and buckling responses of a compression-loaded, quasi-isotropic curved panel is presented. The numerical results were obtained by using a geometrically nonlinear finite element analysis code with high-fidelity models. The results presented show that a wide range of prebuckling and buckling behavior can be obtained by varying parameters that represent circumferential loaded-edge restraint and rotational unloaded-edge restraint provided by a test fixture and that represent the mismatch in specimen and test-fixture radii of curvature. For a certain range of parameters, the panels exhibit substantial nonlinear prebuckling deformations that yield buckling loads nearly twice the corresponding buckling load predicted by a traditional linear bifurcation buckling analysis for shallow curved panels. In contrast, the results show another range of parameters exist for which the nonlinear prebuckling deformations either do not exist or are relatively benign, and the panels exhibit buckling loads that are nearly equal to the corresponding linear bifurcation buckling load. Overall, the results should also be of particular interest to scientists, engineers, and designers involved in simulating flight-hardware boundary conditions in structural verification and certification tests, involved in validating structural analysis tools, and interested in tailoring buckling performance.

Michael P. Nemeth (Langley Research Center, Hampton, Virginia), “Buckling Behavior of Long Anisotropic Plates Subjected to Elastically Restrained Thermal Expansion and Contraction”, NASA/TP-2004-213512, December 2004

ABSTRACT: An approach for synthesizing buckling results and behavior for thin balanced and unbalanced symmetric laminates that are subjected to uniform heating or cooling and elastically restrained against thermal expansion or contraction is presented. This approach uses a nondimensional analysis for infinitely long, flexurally anisotropic plates that are subjected to combined mechanical loads and is based on useful nondimensional parameters. In addition, stiffness-weighted laminate thermal-expansion parameters and compliance coefficients are derived that are used to determine critical temperatures in terms of physically intuitive mechanical-buckling coefficients. The effects of membrane orthotropy and membrane anisotropy are included in the general formulation. Many results are presented for some common laminates that are intended to

facilitate a structural designer’s transition to the use of the generic buckling design curves. Several curves that illustrate the fundamental parameters used in the analysis are presented, for nine contemporary material systems, that provide physical insight into the buckling response in addition to providing useful design data. Examples are presented that demonstrate the use of the generic design curves. The analysis approach and generic results indicate the effects and characteristics of elastically restrained laminate thermal expansion or contraction, membrane orthotropy and anisotropy, and flexural orthotropy and anisotropy in a very general and unifying manner.