Professor James C. Newman, Jr

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Biography:
Jim Newman received his Ph.D. in Engineering Mechanics from the Virginia Polytechnic Institute and State University in 1974 and worked for the NASA Langley Research Center for 37 years. He joined the Aerospace Engineering faculty in the fall of 2001.

Honors and Awards:
Chi Epsilon

Tau Beta Pi
NASA Exceptional Scientific Achievement Medal, 1981
NASA Medal for Exceptional Engineering Achievement, 1990
NASA Superstars in Aeronautics Award, 1998
American Society of Testing Materials (ASTM), George R. Irwin Medal, 1981
ASTM Fellow, 1986
Boeing, Silver Eagle Award, 2001
U.S. Air Force, John W. Lincoln Medal, 2001
NASA/ASEE Summer Faculty Fellow, 2002

Professional Memberships:
American Society of Testing Materials (ASTM)
American Society of Engineering Education (ASEE)

Areas of Teaching:
Statics, Dynamics, Mechanics of Materials, Elasticity, Plasticity, Aircraft Structures

Courses Taught:
EM 3213 Mechanics of Materials
ASE 3223 Aircraft Structures II

Areas of Research:
Fatigue and fracture, Materials, Aircraft Structures

Funding Agencies:
Federal Aviation Administration, Office of Naval Research, NASA Marshall Space Flight Center, Alcoa, S & K Technologies, Inc.

Books/Book Chapter:
Newman, J. C., Jr., "Numerical Modeling of Fatigue Crack Growth" Chapter in Comprehensive Structural Integrity, Vol. 4, R. O. Ritchie and Y. Murakami, eds., Elsevier, June 2003.

Selected Publications:

Newman, J. C., Jr., "Finite Element Analyses of Fatigue Crack Propagation -- Including the Effects of Crack Closure," Ph.D. Thesis, Virginia Polytechnic institute and State University, Blacksburg, VA, May 1974.

Newman, J.C.,Jr., “Fracture Analysis of Various Cracked Configurations in Sheet and Plate Materials,” ASTM STP 605, 1976, pp. 104-123.

Newman, J.C.,Jr., “A Review and Assessment of the Stress-Intensity Factors for Surface Cracks,” Part-Through Crack Fatigue Life Prediction, ASTM STP 687, J. B. Chang, ed., American Society for Testing and Materials, Philadelphia, PA, 1979, pp. 16-42.

Raju, I.S. and Newman, J.C.,Jr., “Stress-Intensity Factors for a Wide Range of Semi- Elliptical Surface Cracks in Finite-Thickness Plates,” Engineering Fracture Mechanics, Vol. 11, No. 4, 1979, pp. 817-829.

Raju, I.S. and Newman, J.C.,Jr., “Stress-Intensity Factors for Two Symmetric Corner Cracks,” Fracture Mechanics, ASTM STP 677, C. W. Smith, eds., American Society for Testing and Materials, 1979, pp. 411-430.

Newman, J.C.,Jr., “A Crack Closure Model for Predicting Fatigue Crack Growth under Aircraft Spectrum Loading,” Methods and Models for Predicting Fatigue Crack Growth under Random Loading, J. B. Chang and C. M. Hudson, eds., ASTM STP 748, 1981, pp. 53-84.

Newman, J.C., Jr., “An Elastic-Plastic Finite Element Analysis of Crack Initiation, Stable Crack Growth, and Instability,” ASTM STP 833, 1984, pp. 93-117.

Newman, J.C.,Jr., “A Crack-Opening Stress Equation for Fatigue Crack Growth,” International Journal of Fracture, Vol. 24, 1984, pp. R131-R135.

Newman, J. C., Jr., Swain, M. H., and Phillips, E. P., “An Assessment of the Small Crack Effect for 2024-T3 Aluminum Alloy,” Small Fatigue Cracks, R. O. Ritchie and J. Lankford, eds., 1986, pp. 427-452.

Newman, J. C., Jr., and Edwards, P. R., “Short-Crack Growth Behaviour in an Aluminum Alloy - an AGARD Cooperative Test Programme,” AGARD R-732, 1988.

Newman, J.C.,Jr.; Booth, B.C. and Shivakumar, K.N., “An Elastic-Plastic Finite-Element Analysis of the J-Resistance Curve using a CTOD Criterion,” Fracture Mechanics: Eighteenth Symposium, ASTM STP 945, D. T. Read and R. P. Reed, eds., American Society for Testing and Materials, Philadelphia, PA, 1988, pp. 665-685.

Swain, M. H., Everett, R. A., Newman, J. C., Jr., and Phillips, E. P., “The Growth of Short Cracks in 4340 Steel and Aluminum-Lithium 2090,” AGARD R-767, P. R. Edwards and J. C. Newman, Jr., eds., 1990, pp. 7.1-7.30.

Shivakumar, K. N., and Newman, J. C., Jr., "ZIP3D - An Elastic-Plastic Finite-Element Analysis Program for Cracked Bodies," NASA TM-102753, 1990.

Newman, J.C.,Jr., “Effects of Constraint on Crack Growth under Aircraft Spectrum Loading,” Fatigue of Aircraft Materials, A. Beukers et al, eds., Delft University Press, 1992, pp. 83-109.

Newman, J. C., Jr., “FASTRAN-II - A Fatigue Crack Growth Structural Analysis Program,” NASA TM 104159, 1992.

Newman, J. C., Jr.; Bigelow, C. A. and Dawicke, D. S., “Finite-Element Analyses and Fracture Simulation in Thin-Sheet Aluminum Alloy,” Durability of Metal Aircraft Structures, S. N. Atluri et al, eds., W. H. Wolfe Associates, Alpharetta, GA., 1992, pp. 167- 186.

Newman, J. C., Jr.; Dawicke, D. S.; Sutton, M. A.; and Bigelow, C. A., “A Fracture Criterion for Widespread Cracking in Thin-Sheet Aluminum Alloys”, Durability and Structural Integrity of Airplanes, Vol. I, A. F. Blom, ed., EMAS Ltd., 1993, pp. 443-468.

Raju, I. S. and Newman, J. C., Jr., “surf3d: A 3-D Finite-Element Program for the Analysis of Surface and Corner Cracks in Solids subjected to Mode-I Loadings,” NASA TM- 107710, February 1993.

Dawicke, D. S., Sutton, M. A., Newman, J. C., Jr., and Bigelow, C. A., “Measurement and Analysis of Critical CTOA for an Aluminum Alloy Sheet,” NASA TM-109024, September 1993.

Newman, J.C.,Jr., Wu, X.R., Venneri, S. and Li, C., “Small-Crack Effects in High-Strength Aluminum Alloys,” NASA RP-1309, 1994.

Dawicke, D. S.; Sutton, M. A.; Newman, J. C, Jr. and Bigelow, C. A., “Measurement and Analysis of Critical CTOA for an Aluminum Alloy Sheet,” Fracture Mechanics: Twenty- Fifth Volume, ASTM STP 1220, F. Erdogan, ed., 1995, pp. 358-379.

Dawicke, D.S.; Newman, J.C. and Bigelow, C.A., “Three-Dimensional CTOA and Constraint Effects during Stable Tearing in a Thin-Sheet Material,” Fracture Mechanics: 26th Volume, ASTM STP 1256, W. G. Reuter, J. H. Underwood and J. C. Newman, Jr., eds., 1995, pp. 223-242.

Newman, J. C., Jr.; Harris, C. E.; James, M. A. and Shivakumar, K. N., “Fatigue-Life Prediction of Riveted Lap-Splice Joints using Small-Crack Theory,” Fatigue in New and Ageing Aircraft, R. Cook and P. Poole, eds., EMAS, Ltd., 1997, pp. 523-552.

Seshadri, B. R., Newman, J. C., Jr., Dawicke, D. S., and Young, R. D., "Fracture Analysis of the FAA/NASA Wide Stiffened Panels," Proceedings of the FAA-NASA Symposium on the Continued Airworthiness of Aircraft Structures," DOT/FAA/AR- 92/2, 1997, pp. 513-524.
ABSTRACT: This paper presents the fracture analyses conducted on the FAA/NASA stiffened and unstiffened panels using the STAGS (STructural Analysis of General Shells) code with the critical crack-tip-opening angle (CTOA) fracture criterion. The STAGS code with the "plane-strain" core option was used in all analyses. Previous analyses of wide, flat panels have shown that the high-constraint conditions around a crack front, like plane strain, has to be modeled in order for the critical CTOA fracture criterion to predict wide panel failures from small laboratory tests. In the present study, the critical CTOA value was determined from a wide(unstiffened)panelwithanti-bucklingguides. Theplane-straincoresizewasestimatedfromprevious fracture analyses and was equal to about the sheet thickness. Rivet flexibility and stiffener failure was based on methods and criteria, like that currently used in industry. STAGS and the CTOA criterion were used to predict load-against-crack extension for the wide panels with a single crack and multiple-site damage cracking at many adjacent rivet holes. Analyses were able to predict stable crack growth and residual strength within a few percent (5%) of stiffened panel tests results but over predicted the buckling failure load on an unstiffened panel with a single crack by 10%.

B. R. Seshadri and J. C. Newman, Jr. (Langley Research Center, Hampton, Virginia), **"Analyses of Buckling and Stable Tearing in Thin-Sheet Materials"**, NASA/TM-1998-208428, May 1998
ABSTRACT: This paper was to verify the STAGS (general shell, geometric and material nonlinear) code and the critical crack-tip-opening angle (CTOA) fracture criterion for predicting stable tearing in cracked panels that fail with severe out-of-plane buckling. Materials considered ranged from brittle to ductile behavior. Test data used in this study are reported elsewhere. The STAGS code was used to model stable tearing using a critical CTOA value that was determined from a cracked panel that was "restrained" from buckling. The analysis methodology was then used to predict the influence of buckling on stable tearing and failure loads. Parameters like crack-length to-specimen-width ratio, crack configuration, thickness, and material tensile properties had a significant influence on the buckling behavior of cracked thin-sheet materials. Experimental and predicted results showed a varied buckling response for different crack-length-to-sheet-thickness ratios because different buckling modes were activated. Effects of material tensile properties and fracture toughness on buckling response were presented. The STAGS code and the CTOA fracture criterion were able to predict the influence of buckling on stable tearing behavior and failure loads on a variety of materials and crack configurations.

Seshadri, B.R. and Newman, J.C., Jr., "Analysis of Buckling and Stable Tearing in Thin-Sheet Materials," Fatigue and Fracture Mechanics: 29th Volume, ASTM STP 1332, T. L. Panontin and S. D. Sheppard, eds., American Society for Testing and Materials, 1998, pp. 114-134.

Newman, J.C.,Jr., "The Merging of Fatigue and Fracture Mechanics Concepts: A Historical Perspective," Progress in Aerospace Sciences, Vol. 34, No. 5-6, 1998, pp. 345- 388.

Harris, C. E., Newman, J. C., Jr., Piascik, R. S., and Starnes, J. H., Jr., "Analytical Methodology for predicting the Onset of Widespread Fatigue Damage in Fuselage Structure," Journal of Aircraft, Vol. 35, No. 2, 1998, pp. 307-317.

Dawicke,D.S.and Newman,J.C.,Jr.,"Residual Strength Predictions for Multiple-Site Damage Cracking using a CTOA Criterion," Fatigue and Fracture Mechanics: 29th Volume, ASTM STP 1332, T. L. Panontin and S. D. Sheppard, Eds., American Society for Testing and Materials, Philadelphia, PA, 1998.

Seshadri, B. R.; Newman, J. C., Jr.; Dawicke, D. S. and Young, R. D., "Fracture Analysis of the FAA/NASA Wide Stiffened Panels," The Second Joint NASA/FAA/DoD Conference on Aging Aircraft, C. E. Harris, ed., NASA CP-208982, 1999, pp. 513-524.

Newman, J. C., Jr., "Advances in Fatigue and Fracture Mechanics Analyses for Metallic Aircraft Structures,"Structural Integrity for the Next Millennium", Vol. 1, Proceedings of the 20th Symposium of the International Committee on Aeronautical Fatigue, J. L. Rudd and R. M. Bader, eds., Bellingham, WA, July 14-16, 1999, pp. 3- 40.

Dawicke, D. S., Newman, J. C., Jr., Starnes, J. H., Jr., Rose, C. A.; Young, R. D., and Seshadri, B. R., "Residual Strength Analysis Methodology: Laboratory Coupons to Structural Components," Proceedings of the Third Joint FAA/DOD/NASA Conference on Aging Aircraft, Albuquerque, NM, September 20-23, 1999.

Dawicke, D. S.; Newman, J. C., Jr. and Tan, P. W., "FAA/NASA Wide Panel Fracture Tests – Part I Executive Summary," NASA TP (in progress), 1999.

Harris, C.E.; Newman, J.C.,Jr. and Piascik, R.S., "A Practical Engineering Approach to Predicting Fatigue Crack Growth in Riveted Lap Joints," 20th Symposium of the International Committee on Aeronautical Fatigue (ICAF), Bellevue, WA, July 14-16, 1999.

Everett, R.A.,Jr.; Newman, J.C.,Jr. and Phillips, E.P., "The Effects of Machining-Like Scratch on the Fatigue Life of 4340 Steel", Proceedings of the American Helicopter Society, 55th Annual Forum, Montreal, Quebec, Canada, May 25-27, 1999.

James H. Starnes, Jr., James C. Newman, Jr., Charles E. Harris, Robert S. Piascik, Richard D. Young and Cheryl A. Rose (NASA Langley Research Center Mail Stop 190 Hampton, VA 23681-2199, USA), "Advances in Structural Integrity Analysis Methods for Aging Metallic Airframe Structures with Local Damage", RTO AVT Specialists' Meeting on "Life Management Techniques for Ageing Air Vehicles", held in Manchester, United Kingdom, 8-11 October 2001, published in RTO-MP-079(II).
ABSTRACT: Analysis methodologies for predicting fatigue-crack growth from rivet holes in panels subjected to cyclic loads and for predicting the residual strength of aluminum fuselage structures with cracks and subjected to combined internal pressure and mechanical loads are described. The fatigue-crack growth analysis methodology is based on small-crack theory and a plasticity induced crack-closure model, and the effect of a corrosive environment on crack-growth rate is included. The residual strength analysis methodology is based on the critical crack-tip-opening-angle fracture criterion that characterizes the fracture behavior of a material of interest, and a geometric and material nonlinear finite element shell analysis code that performs the structural analysis of the fuselage structure of interest. The methodologies have been verified experimentally for structures ranging from laboratory coupons to full-scale structural components. Analytical and experimental results based on these methodologies are described and compared for laboratory coupons and flat panels, small-scale pressurized shells, and full-scale curved stiffened panels. The residual strength analysis methodology is sufficiently general to include the effects of multiple-site damage on structural behavior.

Wang, C. H., Rose, L.R.F. and Newman, J. C., Jr., "Closure of Plane-Strain Cracks under Large-Scale Yielding Conditions," Fatigue and Fracture of Engineering Materials and Structures, Vol. 25, No. 2, February 2002, pp.127-139.

Forth, S. C., Newman, J. C., Jr. and Forman, R. G., "On Generating Fatigue Crack Growth Thresholds", International Journal of Fatigue, Vol. 25, May 2002, pp. 9-15.

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"A review of the CTOA/CTOD fracture criterion", Engineering Fracture Mechanics, Vol. 70, Nos. 3-4, February-March 2003, pp. 371-385, doi:10.1016/S0013-7944(02)00125-X
ABSTRACT: The crack-tip-opening angle or displacement (CTOA/CTOD) fracture criterion is one of the oldest fracture criteria applied to fracture of metallic materials with cracks. During the past two decades, the use of elastic–plastic finite-element analyses to simulate fracture of laboratory specimens and structural components using the CTOA criterion has expanded rapidly. But the early applications were restricted to two-dimensional

analyses, assuming either plane-stress or plane-strain behavior, which lead to generally non-constant values of CTOA, especially in the early stages of crack extension. Later, the non-constant CTOA values were traced to inappropriate state-of-stress (or constraint) assumptions in the crack-front region and severe crack tunneling in thin-sheet materials. More recently, the CTOA fracture criterion has been used with three-dimensional analyses to study constraint effects, crack tunneling, and the fracture process. The constant CTOA criterion (from crack initiation to failure) has been successfully applied to numerous structural applications, such as aircraft fuselages and pipelines. But why does the "constant CTOA" fracture criterion work so well? This paper reviews the results from several studies, discusses the issues of why CTOA works, and discusses its limitations.

J. C. Newman, Jr. (Mechanics and Durability Branch, NASA Langley Research Center, Hampton, Virginia, USA 23681), "Advances in Fatigue and Fracture Mechanics Analyses for Aircraft Structures", Proc. ICAF, 2003 (publisher not given)
ABSTRACT: This paper reviews some of the advances that have been made in stress analyses of cracked aircraft components, in the understanding of the fatigue and fatigue-crack growth process, and in the prediction of residual strength of complex aircraft structures with widespread fatigue damage. Finite-element analyses of cracked structures are now used to determine accurate stress-intensity factors for cracks at structural details. Observations of small-crack behavior at open and rivet-loaded holes and the development of small-crack theory has lead to the prediction of stress-life behavior for components with stress concentrations under aircraft spectrum loading. Fatigue-crack growth under simulated aircraft spectra can now be predicted with the crack-closure concept. Residual strength of cracked panels with severe out- of-plane deformations (buckling) in the presence of stiffeners and multiple-site damage can be predicted with advanced elastic-plastic finite-element analyses and the critical crack-tip-opening angle (CTOA) fracture criterion. These advances are helping to assure continued safety of aircraft structures.

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"Residual strength analyses of stiffened and un-stiffened panels—Part I: laboratory specimens", Engineering Fracture Mechanics, Vol. 70, Nos. 3-4, February-March 2003, pp. 493-507,
doi:10.1016/S0013-7944(02)00133-9
ABSTRACT: This paper presents the results of residual strength analyses on stiffened and un-stiffened panels using the STructural Analysis of General Shells (STAGS) finite-element shell code and the critical crack-tip-opening angle (CTOA) fracture criterion. Previous analyses of wide, flat panels have shown that high-constraint conditions around a crack front must be modeled in order for the critical CTOA fracture criterion to predict wide panel failures from small laboratory tests. Thus, the STAGS code with the _plane-strain _ core option was used in all analyses. In the present study, the critical CTOA (_®c) value and the plane-strain core height were determined from a fit to the experimental load-against-crack-extension results from a series of middle-crack tension specimens (76 _1016 mm wide) tested with anti-buckling guides. In the residual strength analyses of the 305-mm wide stiffened panels with a single crack, modeling of the sheet, stiffeners, rivet flexibility and buckling were based on methods and criteria, like that currently used in industry. STAGS and the CTOA criterion were used to predict load-against-crack extension for the single stiffened panels for both intact and cut stiffeners. Analyses were able to predict stable crack growth and residual strength of the single stiffened panels within about ±5% of the test failure loads.

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"Residual strength analyses of stiffened and unstiffened panels—Part II: wide panels", Engineering Fracture Mechanics, Vol. 70, Nos. 3-4, February-March 2003, pp. 509-524, doi:10.1016/S0013-7944(02)00134-0
ABSTRACT: This paper highlights the results from fracture analyses conducted on the FAA/NASA wide panels (with and without stiffeners) using structural analysis of general shells code and the critical crack-tip-opening angle (CTOA) fracture criterion. The critical CTOA and plane-strain core height values, calibrated from a fit to the experimental load-against-crack-extension results from a series of unstiffened panels (76–1016 mm wide) tests with anti-buckling guides (Part I of this paper), were used in the analyses of wide stiffened and unstiffened panels. As discussed in Part I of this paper, high constraint around the crack front like plane strain has been accounted for by using the "plane-strain core" option in all analyses. By accounting for high constraint around crack front, it was possible for the critical CTOA fracture criterion to predict wide panel failures from small laboratory tests. As followed in Part I of this paper, rivet flexibility and stiffener failures in the analyses of wide panels were based on methods and criteria like that currently used in the industry. Analyses were able to predict stable crack growth and residual strength of both stiffened and unstiffened panels with various amounts of multiple-site damage within ±10% of the test results. Finally, it has been demonstrated that, it is possible to predict the residual strength of wide stiffened and unstiffened panels with critical CTOA calibrated from small laboratory coupons.