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MICHAEL D. HAYES, Ph.D., P.E.
SENIOR CONSULTANT

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Dr. Michael D. Hayes is a Senior Consultant for Engineering Systems Inc. (ESI). Dr. Hayes is a licensed mechanical engineer specializing in the analysis of mechanical parts, structural systems, failure analysis, polymers (plastics) and composites, applied mechanics, materials engineering, product development and support, durability and life prediction, and finite element analysis (FEA).

Dr. Hayes has led complex multidisciplinary investigations involving a wide range of materials and applications, including consumer products, packaging, medical devices, construction materials, plumbing, civil/structural, automotive, railroad, and heavy equipment. His technical interests are solving problems at the intersection of engineering mechanics and materials science and utilizing advanced engineering concepts and cutting-edge tools to provide simple answers to his clients. Dr. Hayes has provided testimony in matters pending before both state and federal courts.

Areas of Specialization

Applied Mechanics	Finite Element Analysis (FEA)
Mechanical & Structural Analysis	Strength & Durability
Polymers (Plastics, Elastomers, Thermosets)	Fatigue & Fracture Mechanics
Fiber-Reinforced Composite Materials	Creep & Stress Relaxation
Root Cause Failure Analysis	Life Prediction
Stress Analysis	Product Research & Development
Constitutive Modeling	Viscoelasticity & Nonlinear Materials
Fractography	Damage Mechanisms & Failure Modes

Education

Ph.D., Engineering Mechanics, Virginia Tech, 2003
M.S., Engineering Mechanics, Virginia Tech, 1997
B.S., Engineering Science and Mechanics, Virginia Tech, 1995

June 2017

Licensed Professional Engineer (P.E.)

State of Georgia.....License No. 032210
State of Alabama .....License No. 28913
NCEES .....License No. 52849

Professional Affiliations/Honors

American Society of Civil Engineers (ASCE)

Member

American Society of Composites (ASC)

Member

ASM International

Member

American Society of Mechanical Engineers (ASCE)

Member

American Society of Standards and Technology (ASTM)

Member

Failure Analysis Society (FAS)

Member

SAE International

Member

Society of Plastics Engineers (SPE)

Board Member of the Failure Analysis and Prevention Special Interest Group (FAPSIG)
Moderator of FAPSIG Technical Session #T30 at SPE's ANTEC Conference, April 29, 2014
Recipient of the Dr. Myer Ezrin Best Paper Aware at ANTEC 2015, March 25, 2015

Additional Professional Activities

Instructor, "Failure Analysis of Plastic Products through Stress Analysis," Day 5 of ESI's "Plastics Failure Analysis Workshop & Prevention Seminars," June 2015.

Adjunct Professor, COE 2001 "Statics," Georgia Tech, Fall 2010.

Reviewer, *Journal of Failure Analysis and Prevention*.

Reviewer, *Journal of Composites for Construction*.

Reviewer, SPE's ANTEC Failure Analysis and Prevention Special Interest Group proceedings.

Positions Held

Engineering Systems Inc., Norcross, Georgia
Senior Consultant, 2007 – Present

Metals & Materials Engineers, LLC, Suwanee, Georgia
Senior Engineer, 2006 – 2007

Stress Engineering Services, Inc., Norcross, Georgia
Associate, 2004 – 2006

Michelin Americas Research & Development Corp., Greenville, South Carolina
Materials Engineer, 1998 – 2000

Continued Education

Failure Analysis of Polymers using FEA (online), Veryst Engineering, Needham, MA, 2013.

ASME Boiler and Pressure Vessel Code: Section VIII, Division I, Design and Fabrication of Pressure Vessels with Repairs and Alteration Consideration, ASME, Houston, TX, 2010.

Practical Fracture Mechanics, ASM International, Ithaca, NY, 2009.

Practical Fractography, ASM International, Ithaca, NY, 2009.

NEiNastran Nonlinear Analysis: Introductory Training, Noran Engineering, Westminster, CA, 2006.

Introduction to Composites, ANSYS Customized Training, Blacksburg, VA, 2002.

Metallurgy for the Non-Metallurgist, ASM International, Cleveland, OH, 1998.

Publications/Presentations

M.D. Hayes, D.B. Edwards, and A.R. Shah, Fractography in Failure Analysis of Polymers, 1st Edition, Elsevier Inc., printed by Edwards Brothers Malloy, Ann Arbor, MI, 2015.

M.D. Hayes, M.E. Stevenson, and D.A. Turnquist, "Failure Analysis of a Glass Filled Phenolic Resin Power Steering Pump Pulley," SPE's ANTEC 2015, Orlando, FL, March 25, 2015. (*Presentation given) – paper also reprinted in the September 2015 edition of Plastics Engineering Magazine*

M.D. Hayes and D.L. Ahearn, "Thermomechanical Analysis of a Ceramic Cooker," *Journal of Failure Analysis and Prevention*, v13 n4 (2013), 383-388.

M.D. Hayes, "Development of a Ring Tensile Test for Evaluating the Chemical Compatibility of Plastic Pipes," ANTEC 2012, Orlando, FL, April 2-4, 2012.

M.D. Hayes and J.J. Lesko, "Failure Analysis and Fatigue Life Prediction of a Composite Structural Beam," American Society for Composites Series on Advances in Composite Materials: Vol 3, Fatigue of Composite Materials, ed. Ronald F. Gibson, August 2012.

M.E. Stevenson, M.D. Hayes, J.L. McDougall, and S.A. Sanders, "Failure Analysis of Hydraulic Fitting Brazed Connections," *ASM Journal of Failure Analysis and Prevention,* Vol. 12, Issue 2, April 2012.

M.D. Hayes, M.L. Hanks, F.E. Hagan, D.B. Edwards, and D.E. Duvall, "Challenges in Investigating Chlorinated Polyvinyl Chloride Pipe Failures," *Journal of ASTM International*, v8 n1 (2011). (*Presentation given)*

M.T. Kenner, J.A. Wilkinson, M.E. Stevenson, and M.D. Hayes, "Uses of Abaqus/Standard in Failure Analysis," SIMULIA Customer Conference, London, England, May 2009.

M.D. Hayes and J.J. Lesko, "Failure Analysis of a Hybrid Composite Structural Beam," Composites: Part A, v38 (2007), 691-698.

M.D. Hayes and J.J. Lesko, "The Effect of Non-Classical Behaviors on the Measurement of the Timoshenko Shear Stiffness," *Journal of Composites for Construction*, v11 n3 (2007), 336-342.

M.D. Hayes and J.J. Lesko, "The Effect of Transverse Compressibility on the Measurement of the Timoshenko Shear Stiffness," *Journal of Composites for Construction*, v11 n3 (2007), 343-349.

M.D. Hayes and J. J. Lesko, "The Effect of Non-Classical Behaviors on the Measurement of the Timoshenko Shear Stiffness," CICE 2004, December 8-10, 2004 Adelaide, Australia.

M.D. Hayes and J. J. Lesko, "Strength and Life Prediction for a Composite Structural Beam," CICE 2004, December 8-10, 2004, Adelaide, Australia.

M.D. Hayes and J. J. Lesko, "The Effect of Non-Classical Behaviors on the Measurement of the Timoshenko Shear Stiffness," ASC/ASTM-D30 Joint 19th Annual Technical Conference, October 17-20, 2004 - Atlanta, GA, CD-ROM, FF3 (Session 11: Fracture and Failure I, paper 3).

M.D. Hayes and J. J. Lesko, "Failure Analysis and Fatigue Life Prediction of a Composite Structural Beam," ASC/ASTM-D30 Joint 19th Annual Technical Conference, October 17-20, 2004 - Atlanta, GA, CD-ROM, MD3 (Session 14: Modeling I, paper 3). (*Presentation given)*

M.D. Hayes and J. J. Lesko, "Assessment of the Timoshenko Shear Stiffness in FRP Structural Beams," SAMPE 2003, 11-15 May 2003, Long Beach, CA, 2089-2103. (*Presentation given)*

M.D. Hayes, T. Schniepp, and J. J. Lesko, "Development of A Stress Analysis for Use In Strength And Life Predictions For A Hybrid FRP Beam," The Second International Conference on Durability Of Fiber Reinforced Polymer (FRP) Composites For Construction, May 29-31, 2002, Montréal (Quebec), Canada. (*Presentation given)*

T. J. Schniepp, M.D. Hayes, J. J. Lesko and T. E. Cousins "Design Manual Development for the Strongwell 36-Inch DWB," Proceedings of the Composites in Infrastructure (ICCI02), San Francisco, CA 8-12 June 2002, CD-ROM, Paper # 082, p.10.

M.D. Hayes and J. J. Lesko, "Refined Strength and Life Analysis of FRP Beams," Proceedings of the Composites in Infrastructure (ICCI02), San Francisco, CA, June 8-12, 2002, Paper # 050, p.10. (*Presentation given)*

C. Waldron, M.D. Hayes, E. Restrepo, T. E. Cousins, and J. J. Lesko, "Determining the Design Parameters for an FRP Girder Bridge in Virginia," 6th International Conference on Short and Medium Span Bridges, Vancouver, BC, July 31- August 2, 2002.

M.D. Hayes, J. J. Lesko, T. E. Cousins, C. Waldron, and T. Schniepp, "Implementation of the Deep DWB in the Dickey Creek Bridge," SAMPE 2001, Vol. 46 - II, May 6-10, 2001, Long Beach, CA, pp. 1587-1596.

M.D. Hayes, J. J. Lesko, T. E. Cousins, C. Waldron, D. Witcher, G. Barefoot, and J. Gomez, "Implementation of FRP Girders in Short Span Bridge," International Bridge Conference, June 4-6, 2001, Pittsburgh, PA, pp. 472-478.

M.D. Hayes, J. J. Lesko, T. E. Cousins, C. Waldron, D. Witcher, G. Barefoot, and J. Gomez, "Design of a Short Span Bridge Using FRP Girders," Composites in Construction International Conference, October 10-12, 2001, Porto, Portugal, A.A. Balkema Pub. (Swets & Zeitlinger) Lisse, 2001, pp. 707-712.

M.D. Hayes, J.J. Lesko, J. Haramis, R.E. Weyers, T.E. Cousins, J.C. Duke, J. Gomez, and P. Masarelli, "Laboratory and Field Testing of a Composite Bridge Superstructure," *Journal of Composites for Construction*, v4 n3 (August 2000), 120-128.

McBagonluri, F., Garcia, K., Hayes, M., Verghese K.N.E., and Lesko, J.J., "Characterization of Fatigue and Combined Environment on Durability Performance of Glass/Vinyl ester Composite for Infrastructure Applications," *International Journal of Fatigue*, v22 n1 (2000), 53-64.

M.D. Hayes, D. Ohanehi, J.J. Lesko, T.E. Cousins, and D. Witcher, "Performance of Tube and Plate Fiberglass Composite Bridge Deck," *Journal of Composites for Construction*, v4 n2 (May 2000), 48-55.

N. Verghese, M.D. Hayes, K. Garcia, C. Carrier, J. Wood, J.R. Riffle, and J.J. Lesko, "Influence of Matrix Chemistry on the Short Term, Hydrothermal Aging of Vinyl Ester Matrix and Composites Under Both Isothermal and Thermal Spiking Conditions," *Journal of Composite Materials*, v33 n20 (1999), 1918-1938.

J. J. Lesko, M.D. Hayes, J. Haramis, J. Hou, T. E. Cousins, J. Gomez, and P. Massarelli, "Laboratory & Field Characterization of the Tom's Creek Bridge Composite Superstructure," International Conference on Composites in the Infrastructure, 1998, pp. 634-644.

K. N. E. Verghese, M.D. Hayes, K. Garcia, J. Wood, J. J. Lesko, and C. Carrier, "The Effects of Temperature Sequencing During Hygrothermal Aging of Polymers and Polymer Matrix Composites: The Reverse Thermal Effect," International Conference on Composites in the Infrastructure, 1998, p.720-738.

M.D. Hayes, K. Garcia, K. N. E. Verghese, and J. J. Lesko, "The Effects of Moisture on the Fatigue Behavior of an E-Glass/Vinyl Ester Composite," International Conference on Composites in the Infrastructure (ICCI), Tucson, AZ, 1998, pp. 1-13. (*Presentation given)*

M.D. Hayes, J. J. Lesko, T. E. Cousins, and D. Ohanehi, "Static and Fatigue Performance of a Square Tube and Plate Type Fiberglass Composite Bridge Deck System," Proceedings of the International Composites Expo, 1998, pp. 7A1-7. (*Presentation given)*

Additional Presentations & Seminars

M.D. Hayes, "Failures in Fiberglass Lift Booms," Materials Science & Technology 2015, October 6, 2015, Columbus, OH.

M.D. Hayes, "Red Herrings in Polymer Fractography and Failure Analysis," Materials Science & Technology 2014, October 15, 2014, Pittsburgh, PA.

M.L. Hanks and M.D. Hayes, "Product Liability: Understanding the Design Process," CEU Presentation to Hartford, Orlando, FL, August 24, 2010.

F.E. Hagan and M.D. Hayes, "Product Evaluation: An Engineer's Perspective," CPCU I-Day, Atlanta, GA, October 27, 2009.

M.D. Hayes, "Engineering Tools in Forensic Investigations," ProNet International, Inc. Continuing Education Conference, Atlanta, GA, September 10, 2009.

M.D. Hayes, "Investigation Techniques: Material Evidence," CEU Presentation to Sedgwick Claims, Knoxville, TN, July 29, 2009.

M.D. Hayes, "The Role of Mechanics in Failure Analysis," The Mechanics Conference to Celebrate the 100th Anniversary of the Department of Engineering Science and Mechanics, Blacksburg, VA, May 30, 2008.

M.D. Hayes, "Investigation Techniques: Material Evidence," CEU Presentation to CNA Insurance, East Syracuse, NY, March 19, 2008.