Exponent®
Engineering & Scientific Consulting

Brett R. Davis, Ph.D., P.E.

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Professional Profile

Dr. Davis specializes in fracture mechanics, structural mechanics, mechanics of materials and computational mechanics. He has expertise in finite element analysis (FEA). Dr. Davis applies this expertise across a wide range of projects and industries, including industrial equipment, pipelines, consumer products, oil and gas, vehicles, biomedical devices and other structural/mechanical systems. A major focus of Dr. Davis' work is failure analysis where his capabilities include collecting and integrating complex data sets (e.g., material test data and detailed geometry characterization), analysis of structural behavior, stress analysis, damage initiation and damage evolution. This breadth of analysis experience covers a variety of structural materials, including metals, composites, and polymers. Dr. Davis has been involved in projects where he has analyzed damaged pipelines and pressure vessel equipment, evaluated fatigue and fracture of pipelines, assessed integrity of welded-connections, and performed high-cycle fatigue analysis of turbomachinery.

Dr. Davis has project experience preforming fitness for service analysis (e.g., API 579, ASME Boiler and Pressure Vessel Code), providing design review and support, evaluating structural systems with respect to safety and regulation, and supporting product development. He also has experience developing custom analysis code and data management systems. Dr. Davis collaborates across various practices within Exponent, including materials and Corrosion Engineering, Thermal Engineering, Biomedical Engineering, and Data Sciences. This versatile network uniquely positions Dr. Davis to build teams to solve highly multidisciplinary problems. Dr. Davis is interested in developing approaches to leverage advanced materials characterization techniques to improve simulation fidelity, as well as utilizing methodologies to account for uncertainty and probability in simulated real world applications, including using data driven approaches, machine learning and artificial intelligence.

Prior to joining Exponent, Dr. Davis was a member of the Cornell Fracture Group, where his doctoral research aimed to develop computational tools to simulate and predict fracture and damage in structural components. His novel simulation technique included generating complex cracked models, computing accurate fracture mechanics parameters, and employing a new formulation to calculate explicitly 3-D, crack-front evolution. Dr. Davis has extensive experience with commercial finite element software (Abaqus) and fracture analysis software (FRANC3D).

While at Cornell, Dr. Davis served as a Teaching Assistant for structural modeling and behavior classes, as well as providing formal mentorship for undergraduate research related to damage tolerance of composite materials. He also collaborated with the Durability, Damage Tolerance and Reliability Branch at NASA Langley Research Center. He continues to collaborate with the Cornell Fracture Group.

Academic Credentials & Professional Honors

Ph.D., Civil and Environmental Engineering, Cornell University, 2014

B.S., Civil and Environmental Engineering, University of Virginia, 2008

Licenses and Certifications

Licensed Mechanical Engineer, California, #38378

Professional Affiliations

Society for Experimental Mechanics

Publications

Kramer SLB, Jones A, Mostafa A, Ravaji B, Tancogne-Dejean T, Roth CC, Gorji MB, Pack K, Foster JT, Behzadinasab M, Sobotka JC, McFarland JM, Stein J, Spear AD, Newell P, Czabaj MW, Williams B, Simha H, Gesing M, Gilkey LN, Jones CA, Dingreville R, Sanborn SE, Bignell JL, Cerrone AR, Keim V, Nonn A, Cooreman S, Thibaux P, Ames N, Connor DO, Parno M, Davis B, Tucker J, Coudrillier B, Karlson KN, Ostien JT, Foulk III JW, Hammetter CI, Grange S, Emery JM, Brown JA, Bishop JE, Johnson KL, Ford KR, Brinckmann S, Neilsen MK, Jackiewicz J, Ravi-Chandar K, Ivanoff T, Salzbrenner BC, Boyce BL. The third Sandia Fracture Challenge: deterministic and probabilistic modeling of ductile fracture of additively-manufactured material. International Journal of Fracture 2019; 219(1-2):209-229.

Davis BR, Wawrzynek PA, Hwang CG, Ingraffea AR. Decomposition of 3-D mixed-mode energy release rates using the virtual crack extension method. Engineering Fracture Mechanics 2014; 131:382-405.

Davis BR, Wawrzynek PA, Ingraffea AR. 3-D simulation of arbitrary crack growth using an energy-based formulation - Part I: Planar Growth. Engineering Fracture Mechanics 2014; 115:204-220.

Davis BR, Wawrzynek PA, Ingraffea AR. Simulation of arbitrary mixed-mode crack growth using an energy-based approach. Society for Experimental Mechanics Annual Conference, Greenville, SC, June 2014.

Davis BR, Wawrzynek PA, Ingraffea AR. Simulation of arbitrary delamination growth in composite structures using the virtual crack extension method. American Society for Composites 27th Technical Conference, Arlington, TX, October 2012.

Presentations

Hudgins A, Myca K, Davis B, Bhargava Y, Mega Rule Deep Dive: Engineering Analysis, Crack-like features, Corrosion + Seismicity, Western Energy Institute (WEI) Transmission Integrity Webinar, July 13, 2021.

Hudgins A, Myca K, Davis B, Bhargava Y. A Systematic Approach to Pipeline Fatigue Analysis, American Gas Association (AGA) Transmission Integrity Mega Rule Implementation Webinar, October 15, 2020.

Hudgins A, Davis B. Crack Assessment Methods. American Gas Association Fall 2018 Transmission Integrity Management Committee Meetings, Fort Worth TX, October 23, 2018.

Hudgins A, Davis B. A metallurgical and fracture mechanics approach to understanding crack-like defects. American Gas Association Transmission Integrity Management Workshop, Pittsburgh, PA, June 14, 2017.

Klopp RW, Davis BR. The advantages of pressure-testing electrofusion saddle tees prior to tapping the main. American Gas Association Operations Conference & Biennial Exhibition, Orlando, FL. May 2-5, 2017.

Davis BR. Three-dimensional simulation of arbitrary crack growth. Durability, Damage Tolerance and Reliability Branch, NASA Langley Research Center, Hampton, VA, June 2014.

Davis BR. Simulation of arbitrary mixed-mode crack growth using an energy-based approach. Society for Experimental Mechanics Annual Conference, Greenville, SC, June 2014

Davis BR. 3-D simulation of arbitrary crack growth using a new energy-based formulation. SES 50th Annual Technical Meeting, ASME-AMD Annual Summer Meeting, Brown University, Providence, RI, July 2013.

Davis BR. Simulation of arbitrary delamination growth using a new energy-based formulation. American Society for Composites 27th Technical Conference, Arlington, TX, October 2012.

Davis BR. Computational simulation of delamination growth in composite structures. Durability, Damage Tolerance and Reliability Branch, NASA Langley Research Center, Hampton, VA, December 2011.

Davis BR. DDSim: Damage and durability simulator. NASA CUIP and ACT Initiative Annual Report, NASA Marshall Space Flight Center, Huntsville, AL, January 2010.

Davis BR. Damage and durability simulator (DDSim). NASA CUIP and ACT Initiative Annual Report, NASA Langley Research Center, Hampton, VA, January 2009.