The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

TOPICS IN MECHANICAL ENGINEERING
THE FRANK W. OTTO DISTINGUISHED LECTURE SERIES

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Lecture Title: Experimental Stress Analysis in Fracture Mechanics

Friday, October 22, 2010, 2:00 PM, Room 173 Light Engineering

Abstract

Photographically recorded crack tip opening in a rupturing subscale pipe was used to drive a ring model of pipe rupture from which the crack tip opening angle (CTOA) resistance curve for mild steel was deduced. This CTOA resistance curve was then used to predict rapid crack propagation in rupturing, subscale and full scale gas-pressurized pipes. A CTOA resistance curve, which was measured directly with moiré interferometry, for 1.6/0.8-mm thick 2024-T3 aluminum was used to propagate cracks in an elastic-plastic/dynamic finite element (FE) model of the fracture specimens and specimens with simulated multiple site damage (MSD). The CTOA of a curved crack in this thin 2024-T3 scattered between 4^o to 8^o but the resultant CTOD, which is the vector sum of the mode-I COD and the mode-II crack sliding displacement (CSD), remained a constant 0.16 mm. The CTOA of a rapidly propagating crack in 1.6-mm thick, 7075-T6 SEN specimens increased from 4.5^o at a low crack velocity to a constant 7^o at a higher and the terminal crack velocity. The trailing fracture process zone of a growing crack at elevated temperature of an alumina specimen was analyzed by a combined moiré interferometry/FE analysis and the crack bridging stress and the dissipated energy were calculated. Residual stress in shot-peened 7075-T7351 SENB specimens were measured by X-ray diffraction stress analyzer and incorporated into a 3-D FE model for correlating the effective K with the da/dN along curved crack fronts in fatigued SENB specimens. This presentation will conclude with the complex fracture process zone in carbon/carbon composite, as seen through moiré interferometry analysis, and an attempt to model this fracture process zone by 2-D FE analysis.

Biography

Professor Kobayashi started his academic career in 1958 as an assistant professor in the Department of Mechanical Engineering, University of Washington. He retired in 1997 but continued his research for another ten years. His publications cover the fields of experimental stress analysis, finite element analysis, and biomechanics in addition to his main interest in fracture mechanics. Professor Kobayashi is a member of the National Academy of Engineering, an Honorary Member of the Society for Experimental Mechanics (SEM), a Fellow of the American Society of Mechanical Engineers (ASME), an Honorary Fellow of the International Congress of Fracture, and a member of the American Academy of Mechanics. He held numerous offices in SEM and ASME and was the president of SEM, 1989-90. In addition to his many awards from SEM, JSME, ASME and ASEE, he was awarded the Order of Rising Sun, Gold Rays with Neck Ribbon from the Emperor of Japan on April 29, 1997. He was elected to the ME Hall of Fame in 2006. Three international symposiums honoring his 60th and 70th birthdays and his retirement were held in San Antonio, Tokyo and Seattle, respectively. A mini-symposium in his honor was held in Austin, 2007.

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