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Energy Absorption and Damage Propagation in 2D Triaxially Braided Carbon Fiber Composites: Effects of Polymer Matrix

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ABSTRACT

Results from an experimental program to investigate the propagation of damage and energy dissipation in 2D triaxially braided carbon fiber textile composites (2DTBC) under static conditions are reported. A methodology is presented in which classical concepts from fracture mechanics are generalized to address damage growth in an orthotropic and heterogeneous structural material. Along with results from the experimental program, a novel numerical technique that employs ideas from cohesive zone modeling, and implemented through the use of finite element analysis, is also presented. The inputs that are required for the discrete cohesive zone model (DCZM) are identified. Compact tension specimen (CTS) fracture tests and double notched tension tests were carried out to measure the fracture energy (G_{Ic}), and the maximum cohesive strength (σ_c), of the 2DTBC. The DCZM modeling strategy was independently verified by conducting single edge notched three point bend (SETB) tests using a modified three-point bend test fixture. The experimental and numerical analyses were carried out for two different types of 2DTBC made from the same textile architecture but infused with two different resin systems to validate the proposed methodology. The proposed method appears to be versatile in capturing the physics of damage growth and shows good agreement against experiment for a variety of loading cases (Figure 1).

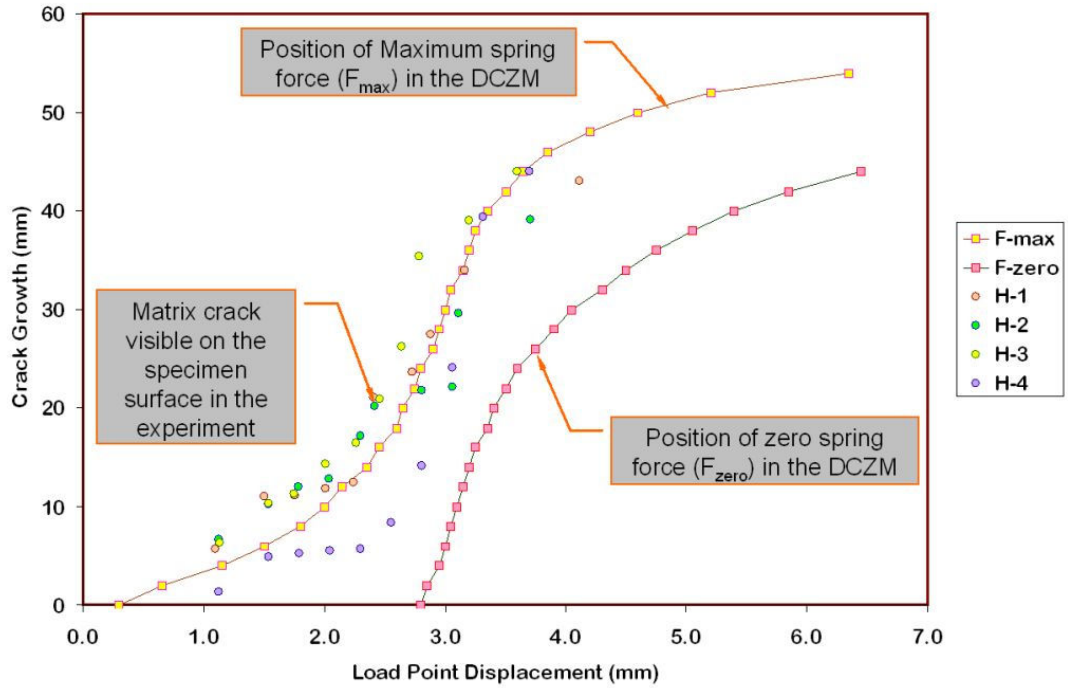

Figure 1 (a): Comparison of crack position in experiment and DCZM

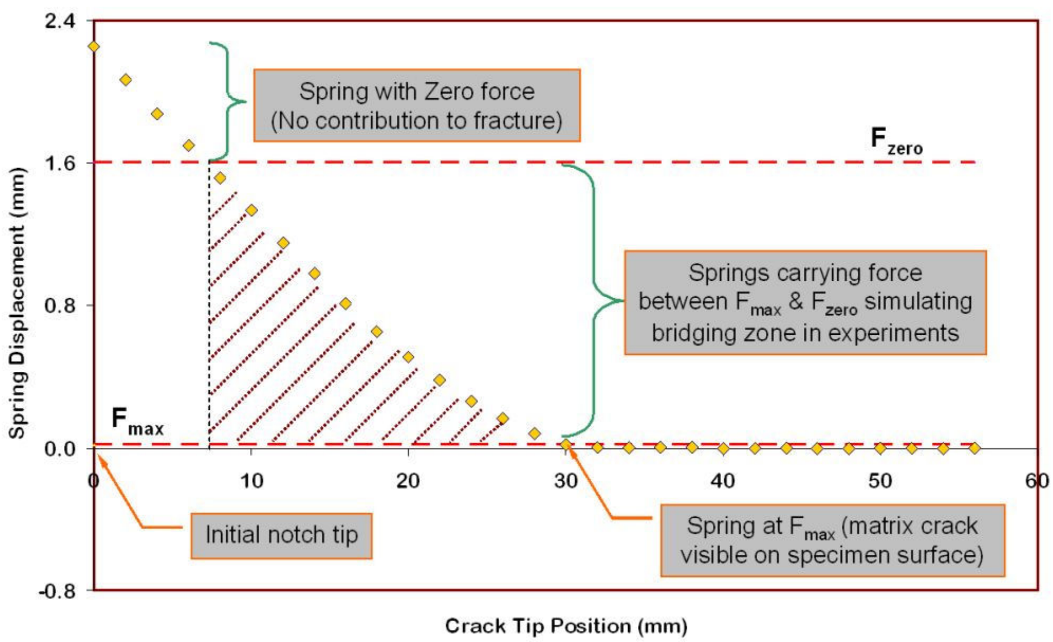

Figure 1 (b): Location of bridging zone in DCZM simulation