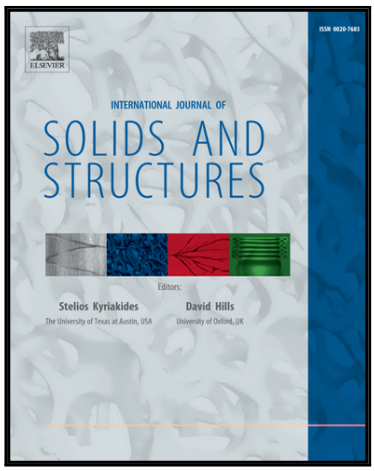

Estimating the Process Zone Length of Fracture Tests used in Characterizing Composites

Jiawen Xie, Anthony M. Waas, Mostafa Rassaian

PII: S0020-7683(16)30179-2
DOI: 10.1016/j.ijsolstr.2016.07.018
Reference: SAS 9235

To appear in: *International Journal of Solids and Structures*

Received date: 8 January 2016
Revised date: 10 July 2016
Accepted date: 14 July 2016

Please cite this article as: Jiawen Xie, Anthony M. Waas, Mostafa Rassaian, Estimating the Process Zone Length of Fracture Tests used in Characterizing Composites, *International Journal of Solids and Structures* (2016), doi: 10.1016/j.ijsolstr.2016.07.018

Estimating the Process Zone Length of Fracture Tests used in Characterizing Composites

Jiawen Xie[a], Anthony M. Waas[b,*], Mostafa Rassaian[c]

[a] *Dept. of Aerospace Engineering, University of Michigan, Ann Arbor, MI 48109-2140*
[b] *William E. Boeing Dept. of Aeronautics and Astronautics, University of Washington, Seattle, WA 98195-2400*
[c] *Boeing Company, Seattle, WA, 98124*

Abstract

This paper provides closed-form expressions for the process zone lengths and load-displacement responses of cohesive zone modeling, for the popular mode I double cantilever beam (DCB) test, the mode II end notched flexure (ENF) test and the mixed-mode I/II bending (MMB) test of composite materials. By incorporating traction-separation laws that consist of only one quasi-brittle softening segment, the problems are formulated and analytically solved for homogenous material or mid-plane symmetric laminates within the framework of classical lamination theory (CLT). The solutions of the MMB test are obtained by the superposition method. Having been known as depending on the mode mixity, the material and interfacial fracture properties, the process zone length is found as a *system parameter* that is also influenced by the specimen geometry, including the thickness and the crack length, especially for mode II. Based on the parametric studies and the comparison against finite element (FE) simulations, suggestions for estimating the process zone length are provided.

Keywords: Closed-form, Cohesive zone, Process zone length, Flexural Response, Delamination, DCB test, ENF test, MMB test

*Corresponding author
Email addresses: jwxie@umich.edu (Jiawen Xie), awaas@aa.washington.edu (Anthony M. Waas), mostafa.rassaian@boeing.com (Mostafa Rassaian)