ESTIMATING THE SIZE DISTRIBUTION OF THE FIBER/MATRIX INTERFACE CRACK IN UD AND CROSS-PLY LAMINATES

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Transverse cracking manifests itself at first in the form of fiber/matrix interface cracks (debonds), that propagate along the arc direction of the fiber surface and coalesce together to form a continuous through-the-thickness crack. Characterization of this process has been mainly directed to the evaluation of the Energy Release Rate (ERR); however, the attention has been devoted to the study of a central partially debonded fiber placed in an effectively medium and the effect of nearby fibers [1]. In this work, the ERR in Mode I and Mode II is evaluated for debonds appearing in Representative Volume Elements (RVEs) of regular microstructures of UD and cross-ply laminates. We then consider a mixed-mode criterion for propagation and analyze the effect of the size of the initial flaw and of the mode sensitivity parameter, thus leading to the estimation of the expected size distribution of a debond in these representative microstructures (see Fig. 1). Finally, the results are compared with available microscopic observations [2].

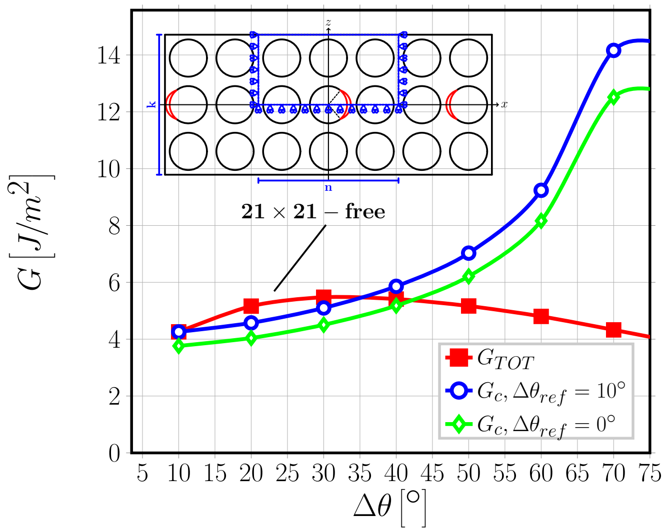

Figure 1. Estimation of expected debond's size by comparing the total ERR to the mixed mode expression of the critical ERR. Glass fiber/epoxy, fiber volume fraction $V_f = 60\%$, applied tensile strain $\varepsilon_x = 1\%$.

References

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[2] E. Correa, M. I. Valverde, M .L. Velasco and F. París (2018) Microscopical observations of inter-fibre failure under tension. *Engineering Fracture Mechanics*, **155**, 213–220.