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Evaluation of the in-situ damage and strength properties of thin-ply CFRP laminates by micro-scale finite element analysis

Higuchi, R ; Aoki, R ; Yokozeki, T ; Okabe, T

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Title	Evaluation of the in-situ damage and strength properties of thin-ply CFRP laminates by micro-scale finite element analysis
Author	Higuchi, R › Aoki, R › Yokozeki, T › Okabe, T ›
LCSH and PCI subjects	micro-scale simulation › thin-ply CFRP › in-situ strength › progressive damage analysis ›
Language	English
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Description	A micro-scale simulation scheme is developed in this study to evaluate in-situ damage and strength properties of CFRP laminates with various ply thicknesses. To capture both the initiation and propagation of transverse cracks, the microscopic random fiber configuration and the constraint effect from neighboring plies should be carefully considered. This study considers the representative volume element (RVE), consisting of the 'inhomogeneous' ply in which the solid elements individually modeled the fiber and matrix, and the 'homogenized' plies, homogeneously modeled by the shell elements. Matrix damage and debonding between fiber and matrix were modeled in the inhomogeneous ply to reproduce transverse crack propagation. Furthermore, in the RVE simulation, the key degree of freedom method was incorporated to evaluate the in-situ properties of each ply effectively. The validity of the proposed tool was examined by comparing the predicted cracking behavior with the results of unidirectional tensile tests on cross-ply laminates having different 90º ply thicknesses. The effects of ply thickness on the in-situ damage and strength properties of cross-ply laminates were numerically investigated, and the continuum damage mechanics model for thin-ply laminate was proposed based on the numerical results.
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