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Design and optimization of defense hole system for hybrid loaded laminates
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Abstract
Stress reduction and increasing the load to weight ratio are two of the main goals of designers. Fiber reinforced composite materials are preferred by aerospace industry because of their high load to weight carrying capacity. Many parts of aircraft structures are assembled by bolts and rivets. These holes that are drilled for bolts and rivets work as stress raisers. Reducing the stress in the vicinity of these holes is a need. Defense hole theory deals with introducing auxiliary holes beside the main hole to reduce the stress concentration by smoothing the stress trajectories in the vicinity of the main hole. These holes are introduced in the areas of low stresses that appear near the main circular hole. Defense hole system under hybrid (shear and tension) loading is investigated. The optimum defense hole system parameters for a circular hole in an infinite laminated composite plate are unveiled. The study has been conducted using finite element method by utilizing commercial software package. The finite element model is verified experimentally using RGB-Photoelasticity. Digital Image Processing is utilized to analyze the photoelastic images. Stress concentration associated with circular holes in hybrid loading (i.e., tension-compression ratios of 0.25, 0.50, and 0.75) achieved maximum reduction of 31.7%. This reduction is obtained by introducing elliptical defense holes along the principal stress direction. Finite element analysis is used to optimize the size and location for defense hole system. The effect of the stacking sequence, the fiber orientation, and the stiffness of both the fiber and the matrix are investigated. © 2012, IGI Global.

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