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**Investigation of bolt load redistribution and its effect on failure prediction in double-lap,
multi-bolt composite joints**

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Abstract: A test method was presented to measure the bolt load distribution in the progressive damage process of multi-bolt composite joints, which exhibits continuous changes with the damage propagation in composite laminates. Based on the repeated loading-unloading cycles, bolt shear loads of a double-lap, three-bolt joint were tested by alternately using modified instrumented bolt-nut pairs and aircraft-grade fasteners, from which the bolt load redistribution history was achieved. In addition, a progressive damage method was adopted to trace the load redistribution history of the joint. The numerical predictions were in good agreement with the experimental outcomes, both of which show that the load distribution tended toward equal proportions before the final failure of the joint. Using a modified failure envelope method, the failures of two-, three- and four-bolt composite joints were predicted based on the uniform load distribution and actual load distribution, and compared with that based on the traditional load distribution calculated by a traditional stiffness method (TSM). It follows that the effect of the actual load distribution on the failure of the multi-bolt joints can be more faithfully reflected by adopting a uniform load distribution than by the traditional one.

Keywords: Laminates; Finite element analysis (FEA); Joints/joining; Bolted joints; Failure envelope method.

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