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Modelling and experiment of process-induced distortions in unsymmetrical laminate plates

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Abstract

Process-induced distortions in composite structures lead to problems with dimensional control, which can be a major concern in the manufacturing. This paper focuses on the prediction of the warpages and curvatures in unsymmetrical laminate plates using closed-form solution and finite element method. A new characterization method that the shape of the deformed composite specimen is conducted in virtue of the coordinate measuring machine through contact method is adopted to experimentally measure the process-induced distortions in unsymmetrical laminate plates. The comparison of numerical and analytical prediction with experimental results for warpages in $[0_6/90_6]$ and $[0_9/90_3]$ unsymmetrical laminates indicates that shear layer between tool and part has a significant effect on the process-induced distortions, and PTFE release film and release agent between tool and part cannot eliminate effect of the tool-part interaction on the process-induced distortions in unsymmetrical laminate plates. Moreover, the comparison of analytically and numerically predicted development of curvature with experimental results presented by previous literature for unsymmetrical laminates further reveals the effect of tool-part interaction on the process-induced distortions and the accuracy of closed-form solution.

Keywords

Cure behaviour; Residual stress; Finite element analysis; Analytical modelling

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