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In-plane Buckling of Steered Tows in Hot Gas Torch-assisted Automated Fiber Placement (AFP) of Thermoplastic Composites

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ABSTRACT

Manufacturing of Variable Angle Tow (VAT) laminates by in-situ consolidation of thermoplastic composite tapes using Automated Fiber Placement (AFP) or Automated Tape Laying (ATL) techniques has gained recent popularity due to its ability to efficiently manufacture composite laminates without the need for secondary processes like curing in an autoclave. VAT lamiates allows one to design laminates with tailored stiffness for a particular application and also helps in reducing stress concentration. However, such techniques that employ steered tows have some inherent defects such as tow buckling and tape folding. The buckling of fibers may result in a reduction in the stiffness of the laminate and tape folding will affect the quality of the laminate. The understanding of these defects will allow us to design laminates with the right allowances thus resulting in a better prediction of stiffness and strength for the entire laminate. This research studies available theoretical formulations that can predict the onset of in-plane tow buckling during AFP process, its wavelength, and amplitude. Verification of the theoretical buckling predictions are performed by comparing the results to the experimental ones obtained by steering a 6.35mm (0.25in) Carbon Fiber/PEEK tow using a Hot Gas Torch-assisted AFP available at Concordia Centre for Composites at different steering radii.