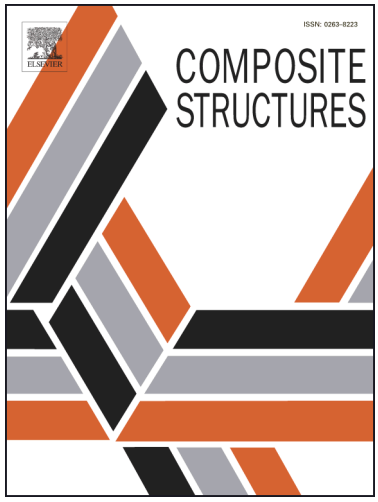

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Experimental investigation of the effect of defects in Automated Fibre Placement produced composite laminates

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Abstract

Automated composite manufacturing processes such as Automated Tape Laying (ATL) and Automated Fibre Placement (AFP) are effective methods to produce high quality, lightweight parts. Typically, preimpregnated fibres or tapes are laid side-by-side onto a tooling surface to generate the composite preform. Although these two main technologies are widely used to produce large composite components, inconsistencies such as overlapping tapes or gaps between adjacent tapes may occur during the manufacturing. Within this study, the effect of gaps and overlaps, so-called defects, has been investigated experimentally. Tensile and compressive testing has been carried out on specimens with a quasi-isotropic, symmetric layup into which artificial defects in various defined formations were introduced. Of particular interest were the strength knockdown factors and changes in the failure mode.

Keywords: A. Automated fibre placement, B. Defects, C. Fibre misalignment, D. Delamination

1. Introduction

Conventional hand lay-up techniques are strongly confined by the requirement of a manual operator during the manufacturing process. Furthermore, the size of the structure is limited by the worker's reach. In terms of these two aspects, it is obvious that the production of even small composite parts is time-consuming and becomes more uneconomical for greater production numbers. Thus automation is required in most industrial fields to increase the productivity as well as the structures' size [1].

In the area of composite manufacturing two main technologies have been established: Automated Fibre Placement (AFP) and Automated Tape Laying (ATL). These technologies are being employed today to manufacture advanced composite laminates from unidirectional prepregs. Both techniques are fairly similar to each other. ATL is able to place wide unidirectional prepreg tapes onto a tooling surface with automatic removal of the ply backing. AFP, in contrast, uses a band of narrow strips or tows of prepreg material. These strips are aligned in the layup head and can be cut individually if desired. Finally, the strips are layed down adjacent to each other [2]. By using one of these techniques large composite parts can be produced.