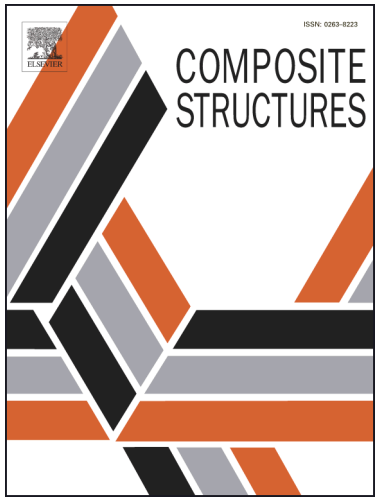

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A NEW METHOD TO REDUCE DELAMINATIONS DURING DRILLING OF FRP LAMINATES BY FEED RATE CONTROL

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Abstract

Assembling of parts made of composite materials is often obtained by bolted or riveted joints. Therefore, drilling is one of the most common machining operation for composite laminates. However, this process causes some kinds of damage on the laminates, as delamination; the aim of this work is to reduce the delamination of the laminate. First of all, in this paper the influence of cutting parameters on the drilling process was studied for both CFRP and GFRP laminates, focusing the attention on the measurement of the forces acting on the laminate for several values of cutting speed and feed rate. Then both peel-up and push-out delamination factors were evaluated and related to the measured forces. In such manner, harmful sets of cutting parameter, capable of damaging the laminate, were identified. This analysis was useful for defining a new method to reduce push-out delamination, that was introduced and verified.

Keywords: A. Polymer-matrix composites (PMCs); B. Delamination; D. Process monitoring E. Machining.

1 Introduction

CFRP (Carbon Fibre Reinforced Polymer), GFRP (Glass Fibre Reinforced Polymer) and FML (Fibre metal laminates) are the most widespread fibre reinforced laminates in the industrial field. Thanks to their remarkable performance advantages, such as rigidity-to-weight and high strength-to-weight ratios, they are employed for substituting the common metals in a variety of industrial fields (aeronautics, defence and aerospace) [1,2]. Even if composite material artefacts are designed considering a limitation of machining operations, these often are necessary as they permit to obtain mechanical couplings that cannot be performed by bonding. In fact, the bolted and riveted mechanical joints are required for manufacturing multipart assemblies, that involve components made of different materials, and hence the execution of holes is mandatory. However, they should be as limited as possible as they cause the fibre continuity disruption and so the reduction in the resistance properties of the artefact [3]. Although special non-conventional machining technologies, such as electro-erosion, water-jet and laser have been appropriately industrialised for making holes on composite laminates, the traditional contact-type technologies, involving the use of special or conventional drilling tools, are the main considered ones, even if they are rather cumbersome since composite materials present a low machinability, caused by the anisotropy, the inhomogeneity and the presence of extremely abrasive fibres [4-7]. The poor workability practically gives rise to the phenomena of fragmentation, delamination, poor surface finish and matrix thermal damaging, that are induced by drilling