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TOOL GEOMETRY EVALUATION FOR CARBON REINFORCED COMPOSITE LAMINATES

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Summary. *The subject of this work is the study of drilling conditions and tool geometry in order to minimize delamination damage. Delamination is evaluated by enhanced radiography and damage criteria applied to compare different tools and cutting parameters.*

1 INTRODUCTION

For the past decades composite materials are increasing their importance as one of the most interesting materials group, due to their unique properties of low weight, high strength and stiffness. Nevertheless, there are still some issues when considering the use of composite laminates. Some of these issues are cost-related, but considerations about machining also lead to some difficulties and lack of acceptance for the implementation of these materials.

One of the main machining operations needed in composite structures is drilling, as it is required to use bolts, rivets or screw when joining different parts. Usually, it is accepted that drilling can be carried out using conventional machinery with adaptations. However, as composites are non-homogeneous, drilling causes some difficulties. In fact, some damage in the region around the hole boundary is evident after operation is completed, being delamination the most serious as it can reduce the load carrying capacity of the joint – figure 1. The main mechanism responsible for delamination is the indentation effect caused by the quasi-stationary drill chisel edge. This effect can be diminished by a correct choice of tool geometry and/or cutting parameters. In general, it is accepted that a drilling process that reduces the thrust force exerted by the drill chisel edge can prevent delamination risk [1].

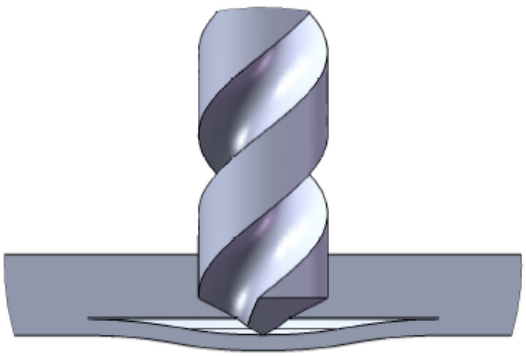

Figure 1: Delamination mechanism.

2 EXPERIMENTAL PROCEDURE

In this work a total of five different drill geometries – twist with two point angles, Brad type, Dagger type and bidiametral – were compared for thrust force during drilling of carbon/epoxy composite laminates, hole wall roughness and delamination extension after drilling. Delamination is evaluated through the use of enhanced radiography combined with a dedicated computational platform for image processing and analysis [2]. A design of experiment – DOE – was planned, based on orthogonal arrays, and results were evaluated using ANOVA (analysis of variance).

Results show that a cautious combination of the factors involved, like drill tip geometry or cutting parameters can help to reduce delamination damage.

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