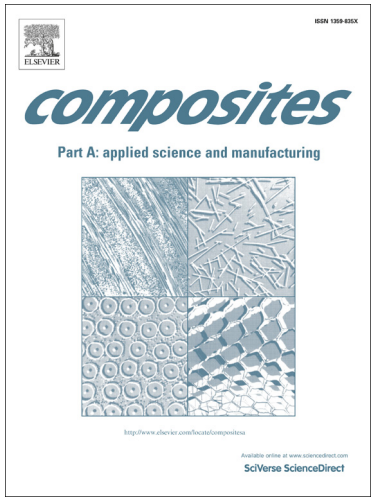

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Delamination-free Drilling of Thick Composite Materials

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Abstract

The machining of composite materials is a growing problem in the aeronautical field. In particular, the drilling of these materials, required to assemble different parts, is difficult to control and often leads to delamination at the exit of the laminates. This can affect the strength of the structure. In this paper, the drilling of thick composite plates with a large-diameter drill is studied. An analytical model is developed to determine the critical thrust force at delamination at the hole exit. This analytical model is divided into several zones, along the geometry of the tool active part. A cutting force model, based on the same zones decomposition as the analytical model, is also presented. This model gives the drilling thrust force as a function of the cutting conditions. Finally, the two considered models are used to determine the optimal cutting conditions for delamination-free drilling. The results are validated numerically and experimentally.

Keywords : A. Composite Materials; B. Drilling; C. Delamination; D. Cutting Conditions.

1. Introduction

Composite materials are nowadays widely used in aeronautics. This growing interest is due to the resistance/weight ratio which is relatively high for these materials. The assembly of various composite structures requires drilling of different parts. The drilling of composite materials is a very interesting topic for industry due to defects propagated during drilling. These defects at the entry, on the wall of the hole and at the exit, reduce the resistance of the structure against failure. Rahme et al. [1] identified these defects and demonstrated that defects at the exit of the laminate are the major drilling defects. Moreover, Piquet et al. [2] and Hocheng and Tsao [3] showed that delamination at the hole exit is directly related to the drilling thrust force. The study of this thrust force is then interesting in order to reduce defects at the exit.