Mechanical Testing and Diagnosis
ISSN 2247 – 9635, 2012 (II), Volume 3, 79-85

SOME RESEARCH ON FINITE ELEMENT ANALYSIS OF COMPOSITE MATERIALS

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ABSTRACT

The aim of this paper is to verify the accuracy of composite materials data input into ANSYS Parametric Design Language for the numerical analysis. For this purpose, some specimens of the laminated composite were subjected to a bending moment and the deformations were measured. At the same time, the data obtained by simulating the specimens with the help of ANSYS APDL, were analyzed and compared to the experimental data in order to establish the degree of the accuracy.

Keywords: deformations, composites, bending, specimens, FEM analysis

1. INTRODUCTION

1.1 . Properties of Glass/Polyester Composites

The rotor blades of the laminated glass fibre composites with polyester resin as the matrix material, are still widely used, today. The glass used in the blade construction is E-glass, which has good structural properties in relation to its cost [2].

The plate elements forming the spar of a GFRP blade are normally laminates consisting of several plies, with fibres in different orientations to resist the design loads. Within a ply (typically 0.25–0.6 mm in thickness), the fibres may all be arranged in the same direction, unidirectional (UD) or they may run in two directions at right angles in a wide variety of woven or non-woven fabrics.

Although the strength and stiffness properties of the fibres and the matrix are well defined, only some of the properties of a ply can be derived from them, using simple rules. Thus, for a ply reinforced by UD fibres, the longitudinal stiffness modulus, E_1, can be accurately derived from the mixtures' rule formula:

$$E_1 = E_f V_f + E_m (1 - V_f)\text{, [GPa]} \quad (1)$$

where E_f is the fibre modulus (74 GPa for E-Glass), E_m is the matrix modulus (in the range 4 GPa) and V_f is the fibre volume fraction [3].

The transverse modulus, E_{12}, is determined by the formula: