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EXPERIMENTAL RESULTS OF A COMPOSITE STRUCTURE WITH COREMAT CORE

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Abstract: *The paper presents some experimental results like tensile and three-point bend tests accomplished on a glass fiber reinforced composite laminate with application to a sandwich which presents the following plies sequence: 1 x RT500 glass roving fabric/ 2 x RT800 glass roving fabric/ 1 x 450 g/m2 chopped glass fibers mat/ nonwoven polyester mat as core/ 1 x 450 g/m2 chopped glass fibers mat/gelcoat layer. Tensile test show medium values of Young module and stiffness while three-point bend tests show scatter values of Young module of bending but good flexural rigidities.*
Keywords: *sandwich, core, skin, stiffness, flexural rigidity*

1. INTRODUCTION

Fiber-reinforced composite laminates are widely used for various applications. However, the sandwich structure requires some plies sequence to optimize the resin and reinforcement consumption and to obtain equal stiffness.
Stiffness evaluation of composite laminates is for a great importance in designing composite structure especially suited for aerospace, defense and automotive industries, but also for transportation, chemistry and food industries.

2. CRITICAL OVERVIEW

It is well known that composite laminates with aligned reinforcement are very stiff along the fibers, but also very weak transverse to the fibers direction. This fact is more obvious in the case of advanced composite laminates reinforced with anisotropic carbon or aramid fibers. Getting equal stiffness of laminates is a demand.
The solution to obtain equal stiffness of laminates subjected in all directions within a plane is presented by various authors by stacking and bonding together plies with different fibers orientations. A composite laminate subjected to off axis loading system presents tensile-shear interactions in its plies. Tensile – shear interactions lead to distortions and local micro structural damage and failure, so in order to obtain equal stiffness in all of – axis loading system, a composite laminate have to present balanced angle plies.

3. THE COMPOSITE LAMINATE

The sandwich structure is composed from the following layers:
• 1 x RT500 glass roving fabric;
• 2 x RT800 glass roving fabric;
• 1 x 450 g/m2 chopped glass fibers mat;
• A nonwoven polyester mat as core;
• 1 x 450 g/m2 chopped glass fibers mat;
• A gelcoat layer.
The sandwich structure has been manufactured using the hand lay-up process. This manufacturing process has been chosen to optimize the resin and reinforcement consumption and for its simplicity.

4. RESULTS

From the sandwich structure, various specimens have been cut and subjected to tensile and three-point bend tests on Lloyd's Instruments testing machines using Nexygen Plus Testing software.
For tensile tests, some testing features are:

- Gauge length: 50 mm
- Specimens mean width: 10mm
- Specimens mean thickness: 7.9mm
- Tests speed: 1mm/min.
- For three point bend tests, testing features are as following:
- Gauge length: 130 mm
- Specimens mean width: 15.1 mm
- Specimens mean thickness: 8 mm
- Tests speed: 4mm/min.

The distribution of Young Modulus, stiffness and flexural rigidities are presented in figures 1-6.

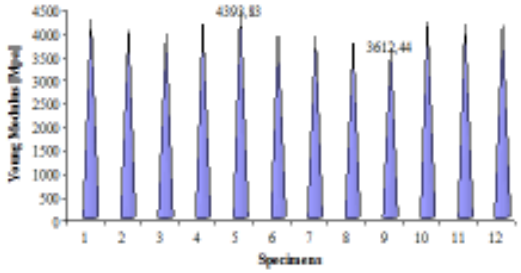

Figure 1. Distribution of Young Modulus Bending Tests

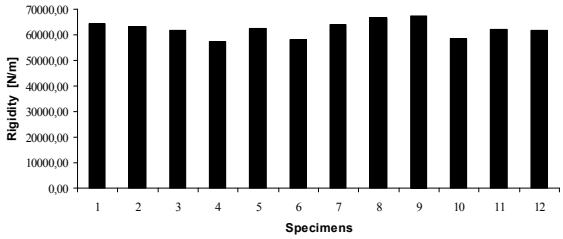

Figure 2. Distribution of Stiffness Bending Tests

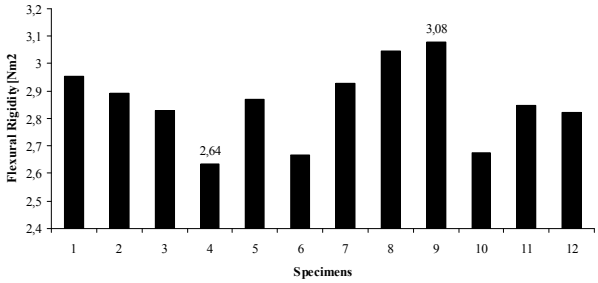

Figure 3. Distribution of flexural rigidity Bending Tests

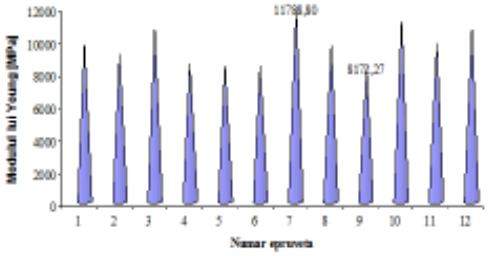

Figure 4. Distribution of Young Modulus Tensile Tests

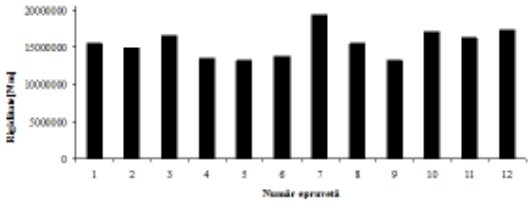

Figure 5. Distribution of Stiffness Tensile Tests

5. CONCLUSIONS AND FUTURE WORK

Tensile tests accomplished on fiber-reinforced composite laminate with the presented plies sequence , show medium values of stiffness and Young Modulus. Three point bending test present interesting values. Despite values scattering of Young modulus of bending, the values of flexural rigidity show a quite good composite laminate due to the choice of the plies sequence. Future researches will be accomplished in the following domains: tensile and three-point bending test using the same plies sequence but with a nonwoven polyester core and a finite element analysis on this structure and other composite architectures with various plies sequences.

ACKNOWLEDGEMENT

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REFERENCES

[1] Backman, B.F. (2005). Composite Structures, Design, Safety and Innovation, Elsevier Science, ISBN: 978-0080445458.
[2] Bank, L.C. (2006). Composites for Construction: Structural Design with FRP Materials, Wiley, ISBN: 978-0471681267.
[3] Daniel, I.M. & Ishai, O. (2005). Engineering of Composite Materials, 2nd ed., Oxford University Press, ISBN: 978-0195150971.
[4] Davies, J.M. (2001). Lightweight Sandwich Construction, Wiley-Blackwell, ISBN: 978-0632040278.
[5] Kollar, L.P. & Springer, G.S. (2003). Mechanics of Composite Structures, Cambridge University Press, ISBN: 978-0521801652.
[6] Noakes, K. (2008). Successful Composite Techniques: A practical introduction to the use of modern composite materials, Crowood, 4th ed., ISBN: 978-1855328860.
[7] Vinson, J.R. & Sierakovski, R.L. (2008). The Behavior of Structures Composed of Composite Materials, Springer, ISBN: 978-1402009044.