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THEORETICAL AND EXPERIMENTAL DETERMINATION OF PROPERTIES FOR COMPOSITE MATERIAL TYPE ROVING SUBJECTED TO BENDING

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***Abstract**: Finite element modeling has enabled reinforcement solution optimization of welded frame in order to stress reduction in critical points based on strain and stress solutions. Validation of reinforcement solutions of welded frames obtained by finite element modeling was done experimentally. Thus, the first model is a physical model, very often called analytical model and it is derived from the actual structure by abstraction or idealization of the geometry, boundaries and boundary conditions etc.*
***Keyword:** Finite element method, fiberglass composite, roving*

1. INTRODUCTION

As far analytical techniques have developed significantly and although still widely used shell discontinuity analysis in structural analysis, it is increasingly replaced by numerical computing methods. Most widely used technique in contemporary design of complex mechanical systems is the finite element method, a powerful technique that allows detailed modeling of complex systems.
Method is used to determine the flexural behavior of test specimens and determination of flexural strength, modulus of elasticity in bending and other aspects of relationship stress / strain under the circumstances. Apply a lever simply supported, loaded in three or four point bending. How to place and test specimen is chosen so as to limit deformation to shear and interlaminar shear avoid breakage.
If materials have physical properties, such as elasticity, dependent on direction, specimens should be chosen so that during the test, voltage sag is applied in the same direction as that in which the products are requested service.
Experimental determination of the specimens was performed according to standard EN ISO 14125 *Compozite de materiale-plastice armate cu fibre, Determinarea proprietăţilor de încovoiere*.
Specimen supported as a lever is subjected to bending constant speed until rupture or deformation reaches a predetermined value. During the test measured the force applied to the specimen and arrow.

2. THEORETICAL METHOD (FEM) AND EXPERIMENTAL METHOD (ETM)

The material behavior was studied during pure bending, when subjected to a force of 600N and the postprocessor program used was MSC Nastran.
Most widely used technique in contemporary design of complex mechanical systems is the finite element method, a powerful technique that allows detailed modeling of complex systems.
This idealization requires very often and assumptions regarding the characteristics of the material or constitutive laws, which are unknown for real structural.
The study was made for the following types of composite materials:
• RT 800, structured on 4 layers, weft disposition, fiberglass composite (fabric) in the matrix of epoxy, figure 1;
• RT 800, structured on 4 layers, warp disposition, fiberglass composite (fabric) in the matrix of epoxy, figure 2.

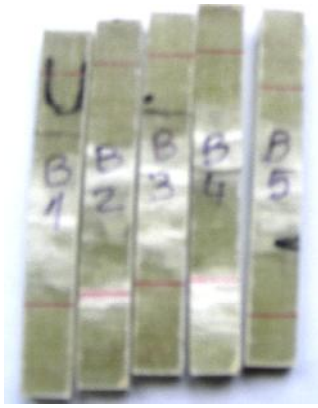

Figure 1 Roving specimens with 4 Layers on warp **Figure 2** Roving specimens with 4 Layers on weft

Table 1 Load values of the parameters for roving specimen

	E U1	E U2	E U3	E U4	E U5	E B1	E B2	E B3	E B4	E B5
Cali-brated part length *mm*	60	60	60	60	60	60	60	60	60	60
Load speed *mm / min*	5	5	5	5	5	5	5	5	5	5
Test-piece width *mm*	10,4	10,8	11	10,5	10,6	10,5	10,8	10,5	10,4	10,6
Test-piece thick-ness *mm*	4	4,2	4,2	4,1	4,5	4,5	4,4	4,5	4,4	4,4
Area mm^2	41,6	45,36	46,2	43,05	47,7	47,25	47,52	47,25	45,76	46,64

Table 2 Mean values of mechanical bending

Mechanical properties for Roving subjected at bending	Roving average values for roving at warp	Roving average values for roving at weft
Stiffness, *N/m*	207560	247850
Young's modulus, *MPa*	11397	10404
Tensile Strength, Nm^2	0,69286	0,82738
Extension from preload at Minimum Extension, *MPa*	288,02	285,86
Strain at Maximum Extension	0,031726	0,030984
Deformaţia specifică a epruvetei de la valoarea iniţială până la valoarea maximă, *mm*	7,9326	7,4885
Work to Minimum Extension,*Nmm*	4967	5652
Load at Minimum Extension, *kN*	0,97834	1,1098
Stress at Minimum Extension, *MPa*	261,39	258,36
Elongation at Fracture	0,040164	0,040205

For material RT 800 (warp fabric) the specific deformation experimental using 600 N force, was determined between values -0.016164 şi 0.017041 and theoretical was determined between values -0.014 şi 0.014, figure 2.

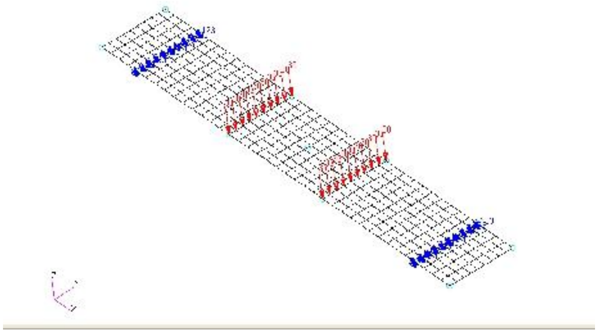

Figure 3 Specimen RT800 warp subjected to bending , at 600 N

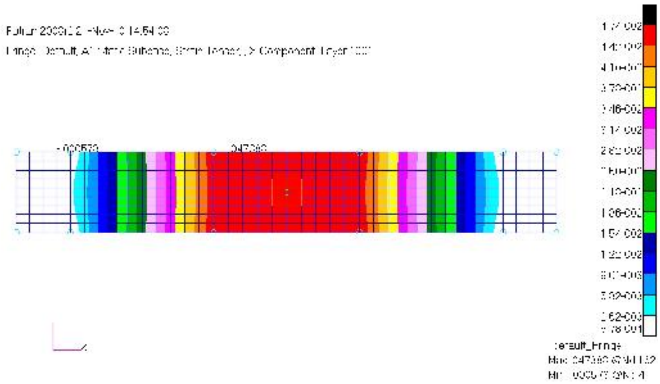

Figure 4 Specific strain distribution RT800, at warp, layer 1

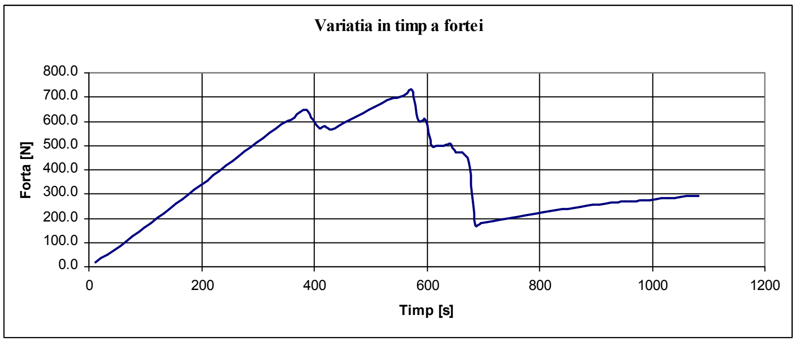

Figure 5 Time variation of force for the specimen RT800 at warp

For type of material RT 800 (weft fabric) the specific deformation experimental using 600 N force, was determined between values -0.02 şi 0.02 and theoretical was determined between values -0.020 şi 0.021, figure 3.

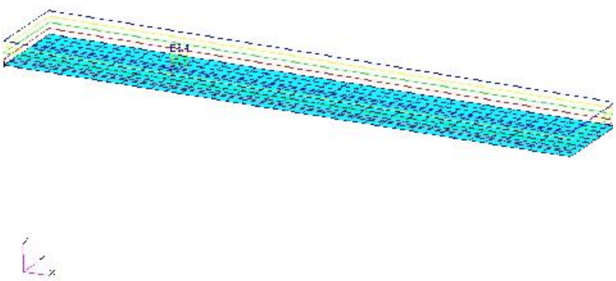

Figure 6 Discretized specimen and layout layers RT800 at weft

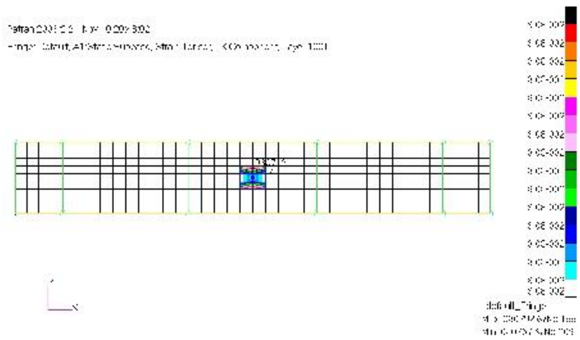

Figure 7 Specific strain distribution for specimen RT800, at weft, layer 1, TER zone

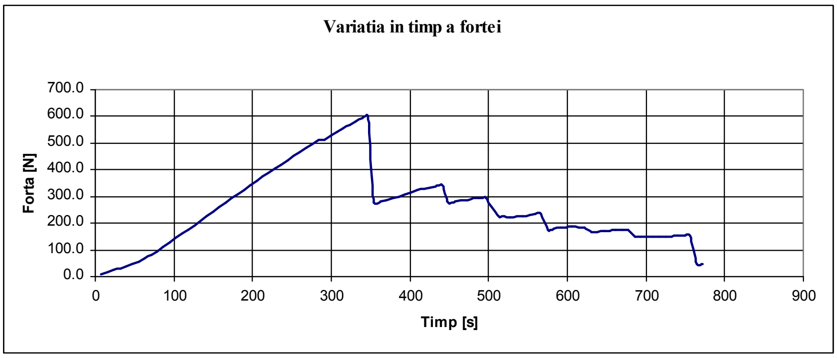

Figure 8 Time variation of the force for specimen RT800 at weft

3. CONCLUSION

Validation of reinforced solutions obtained by finite element modeling was experimentally done by electrical resistive tensometry. The measurement results were correlated with results from finite element modeling.
We find that using the finite element method for the study of anisotropic material such as the composite materials we are able to easily change the load, boundary conditions, way of application, having the opportunity of selecting the optimum choice, the dimensions and required characteristics of materials. Each part of the material can be assessed and the results are checked out by help of the experimental determination.
For reinforcement materials tensile test results depend essentially on the size of the specimen used, temperature of polymers specific influence on the strength and deformation at break them upward.

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