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SPECIFIC DEFORMATION OBTAINED BY THEORETICAL AND EXPERIMENTAL METHOD

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Abstract: *This paper presents reinforcement assessment of welded frames for metallic structures in order to increase their bearing capacity. It is analysis the consolidation of a welded frame with finite element modeling and experimental determinations using electric resistive tensometry method. This refers to the stress and strains measured by strain gauges applied to loaded welded structures, the results of mechanical tests and the results of non-destructive examination (passive thermography method). 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 by electrical resistive tensometry method. Tensometry measurements results were correlated with finite element modeling results.*
Keywords: *Finite element method, Resistive tensometry method, Thermography*

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.
Most commercial systems provide various checks and corrections for the element form, according to usual industrial guidelines. The validity of these checks for elasto-plastic behavior is largely unknown. It is important to try to give the element form in extended plasticity regions close to their natural form of "square", but this requires proper qualification of the analyst and may require rebuilding the network once the plastic region is identified.
As a result, the stresses are discontinued from item to item and overall balance is satisfied only at nodes. When it is placed in the context of a highly nonlinear material, this means that stresses are even less secure in the nonlinear analysis than linear and so is very easy to produce errors while load increases. An approach of design by analysis for a complex mechanical system designed follows:

- Providing an understanding of how to conduct finite element model;
- Ensuring that there is an understanding of how to behavior the actual structure;
- Fitness for purpose of the real structure;

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

This requires more explanation for a clearly distinguish between the real structure on the one hand and the two different models of its second.
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.
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:
• MAT 450, structured on 4 layers, fiberglass composite (short wires) in the matrix of epoxy resin;
• RT 800, structured on 4 layers, weft disposition, fiberglass composite (fabric) in the matrix of epoxy;
• RT 800, structured on 4 layers, warp disposition, fiberglass composite (fabric) in the matrix of epoxy;
• MAT 450, structured on 2 layers, RT 800, structured on 4 layers, weft disposition, MAT 450, structured on 2 layers, fiberglass composite (short wires) in the matrix of epoxy resin;

• MAT 450, structured on 2 layers, RT 800, structured on 4 layers, warp disposition, MAT 450, structured on 2 layers, fiberglass composite (short wires) in the matrix of epoxy resin;

The material behavior was studied during pure bending, when subjected to a force of 600N and the postprocessor program used was MSC Nastran. For the experimental setup we used Spider8 equipment, the results being recorded by help of dedicated software CATMAN.

In order to determine the unit loadings σ in the structure of the composite material, we used 120 Ω strain gauges, applied on the studied structure.

For the first type of material (MAT450) the specific deformation using 600 N force, was determined between values -0.033210 şi 0.033580 and theoretical was determined between values -0.025 and 0.025, figure 1.

The specific deformation measurement with TER are suitable fibers that are stuck TER's. Maximum specific deformations of the outer fibers were measured by TER.

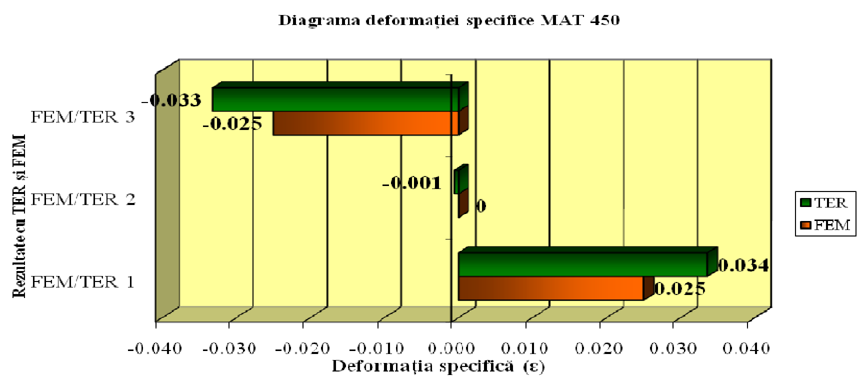

Figure 1 Comparison diagram of specific deformations for MAT 450

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.

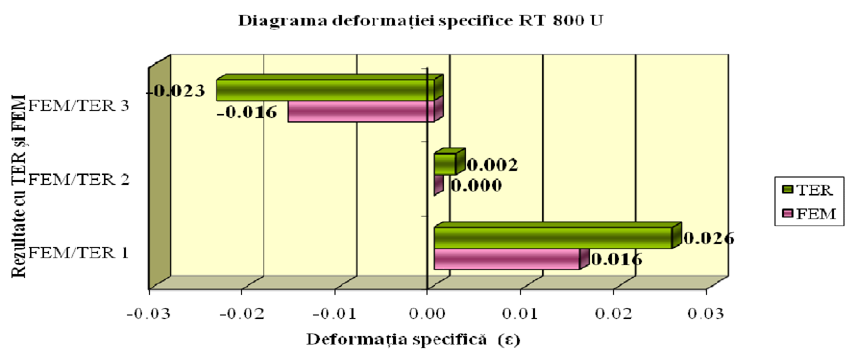

Figure 2 Comparison diagram of specific deformations for RT 800 (warp fabric)

The difference is insignificant between the warp and weft fabric of roving, as determined by MEF, but also experimentally proven that the material is more rigid on the weft.

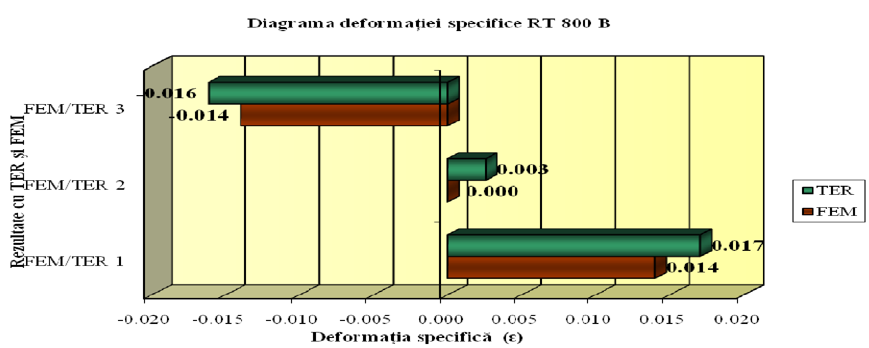

Figure 3 Comparison diagram of specific deformations for RT 800 (weft fabric)

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.

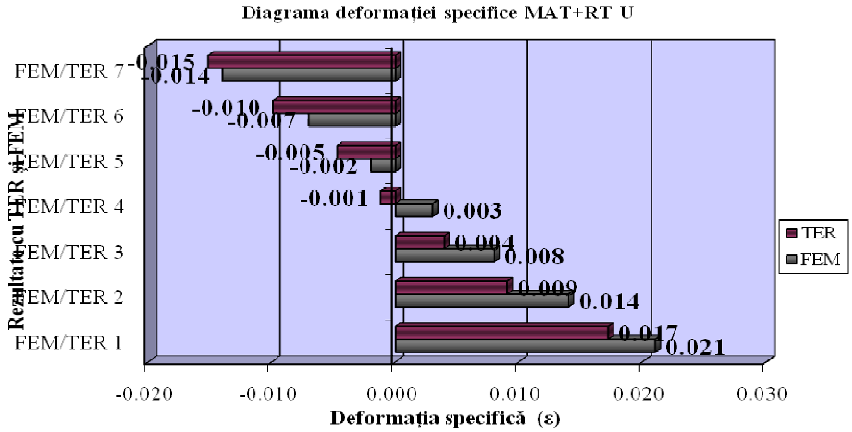

Figure 4 Comparison diagram of specific deformations for MAT450-RT 800 (warp fabric) - MAT600

For type of material MAT AND RT (warp fabric) the specific deformation experimental using 1000 N force, was determined between values -0.014 şi 0.017 and theoretical was determined between values -0.015 şi 0.021, figure 4.

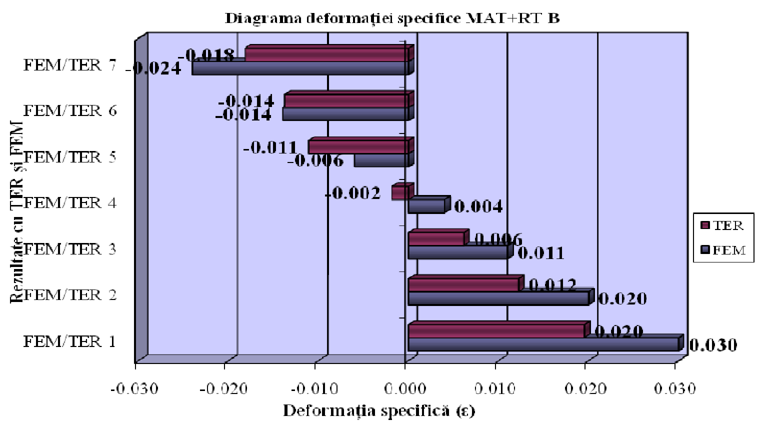

Figure 5 Comparison diagram of specific deformations for MAT450-RT 800 (warp fabric) - MAT600

For type of material MAT AND RT (weft fabric) the specific deformation experimental using 1000 N force, was determined between values -0.02 şi 0.02 and theoretical was determined between values -0.024 şi 0.030, figure 5.
In Deformations and stresses plane is noted that the work inside is associated with three components of effort from coordinated plane. The problem of stress distribution in the bodies of revolution (axially-symmetric) under axial-symmetric loading has an important interest. From a mathematical problem have many similarities with the stress and strain analysis of plane, so the situation is two-dimensional.

3. CONCLUSION

In this paper has analyzed the behavior of a frame of beams in different constructive variants (reinforced and unconsolidated), which were tested in the laboratory. Finite element modeling has enabled optimization of constructive solution of welded frame in order to reduce the stresses in critical points based on obtaining the stress and strain solutions. Analyzing the obtained solutions for the principal stresses, von Misses stresses and stresses after x, y, and z directions, it was found consistently reducing of stresses for reinforced models.
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.

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