# EXPERIMENTAL RESEARCHES REGARDING THE USE OF THE COMPOSITE MATERIAL IN THE STEEL BEAMS REINFORCEMENT

**Ianăşi Aurora-Cătălina**
University"Constantin Brâncuşi" of Târgu-Jiu
ianasi_c@yahoo.com

**Keywords:** steel beam, composite, epoxy resin.

**Abstract**: One of the defining features of technological progress is getting new material to be resistant, easy to process, to combine the qualities of basic materials, in the current technique, but not to borrow from them their negative properties. In recent years, carbon fiber composites have been increasingly used in different ways in reinforcing structural elements. Specifically, the use of composite materials as a reinforcement for wood beams under bending loads requires paying attention to several aspects of the problem such as the number of the composite layers applied on the wood beams.

## 1. INTRODUCTION

This paper describes an experimental study which was designed to evaluate the effect of layers number of composite material on the stiffness of the wood beams. The type of reinforcement used on the beams is the carbon fiber reinforced polymer (CFRP) sheet and an epoxy resin for bonding all the elements. Structural epoxy resins remain the primary choice of adhesive to form the bond to fiber-reinforced plastics and are the generally accepted adhesives in bonded CFRP–wood connections. Advantages of using epoxy resin in comparison to common wood-laminating adhesives are their gap-filling qualities and the low clamping pressures that are required [1,2]. Study consolidation of composites revealed that they are made by bonding fibrous material impregnated with resin on the surface of various elements, to restore or increase the load carrying capacity (bending, cutting, compression and/or torque) without significant damage of their rigidity [3,4]. Fibers used in building applications can be fiberglass, aramid or carbon. Items that can be strengthened are concrete, brick, wood, steel and stone, and in terms of structural beams, walls, columns and floors, applying lately and beam-column nodes.

## 2. EXPERIMENTAL TESTS

During this paper we work with profiles type metal material INP 100. Composite material used to strengthen steel samples is the type of carbon fiber plates - Megaplate, supplied by S.C Building Consult bought from Sika Romania S.A [4, 5]. Reinforcing material is bonded to the surface of steel beam with epoxy resin Epomax PL provided by the same firm.

Steel beams, profile INP 100, 1000mm length, were reinforced with 1000mm carbon fiber plate length, 1,5 mm thickness and attached from the beam with straps and screws like in the figure number 1 from below. The metallic material used (INP 100 profile) was subjected to successive loading and unloading without exceeding the elastic so that testing can provide conclusive data, the phenomenon has resulted in a hysteretic curve. Functional dependency graphs are represented in Excel.

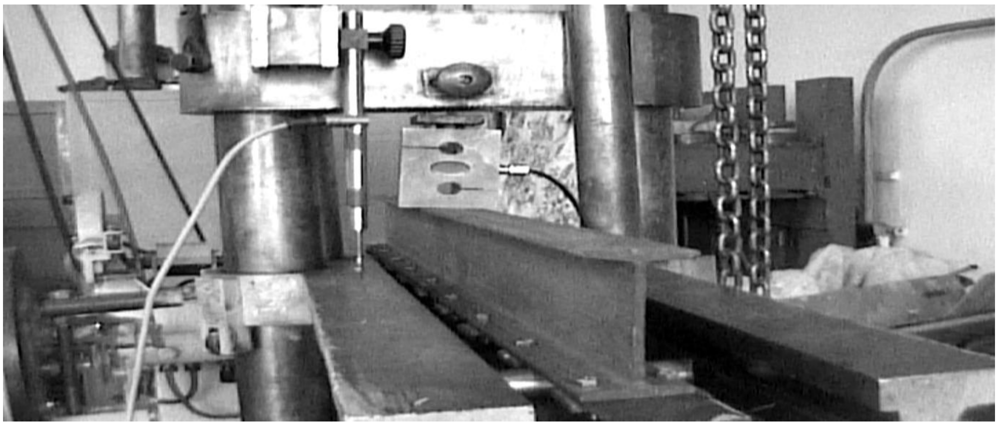

***Figure 1. INP 100 metal sample carbon fiber reinforced***

Work equipment and instrumentation used in the two cases are similar. Work equipment is made of: universal machine for mechanical tests, data acquisition system Spider 8, 12 bit resolution linear WA300, race inductive transducer, force transducer S9 50kN , IBM ThinkPad R51 notebook.

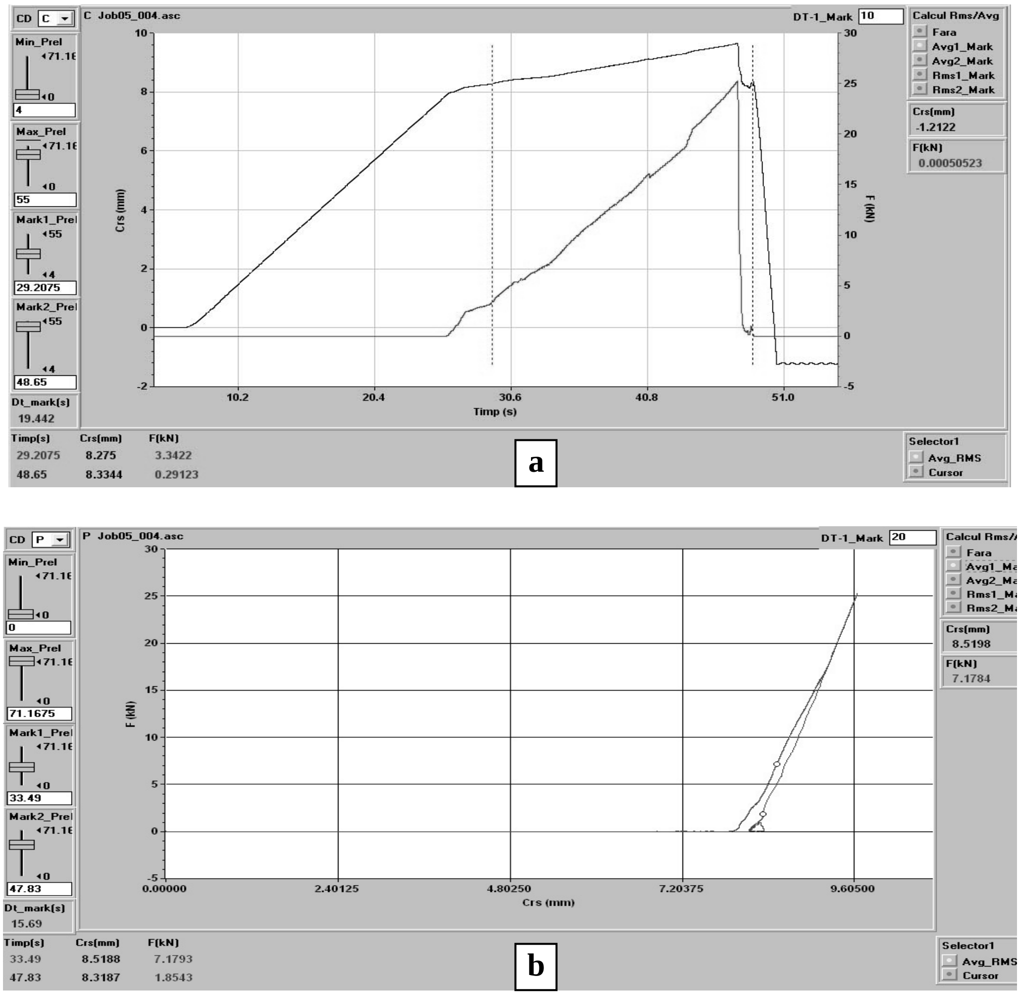


***Figure 2. Characteristics determinated for un-reinforced steel beam***

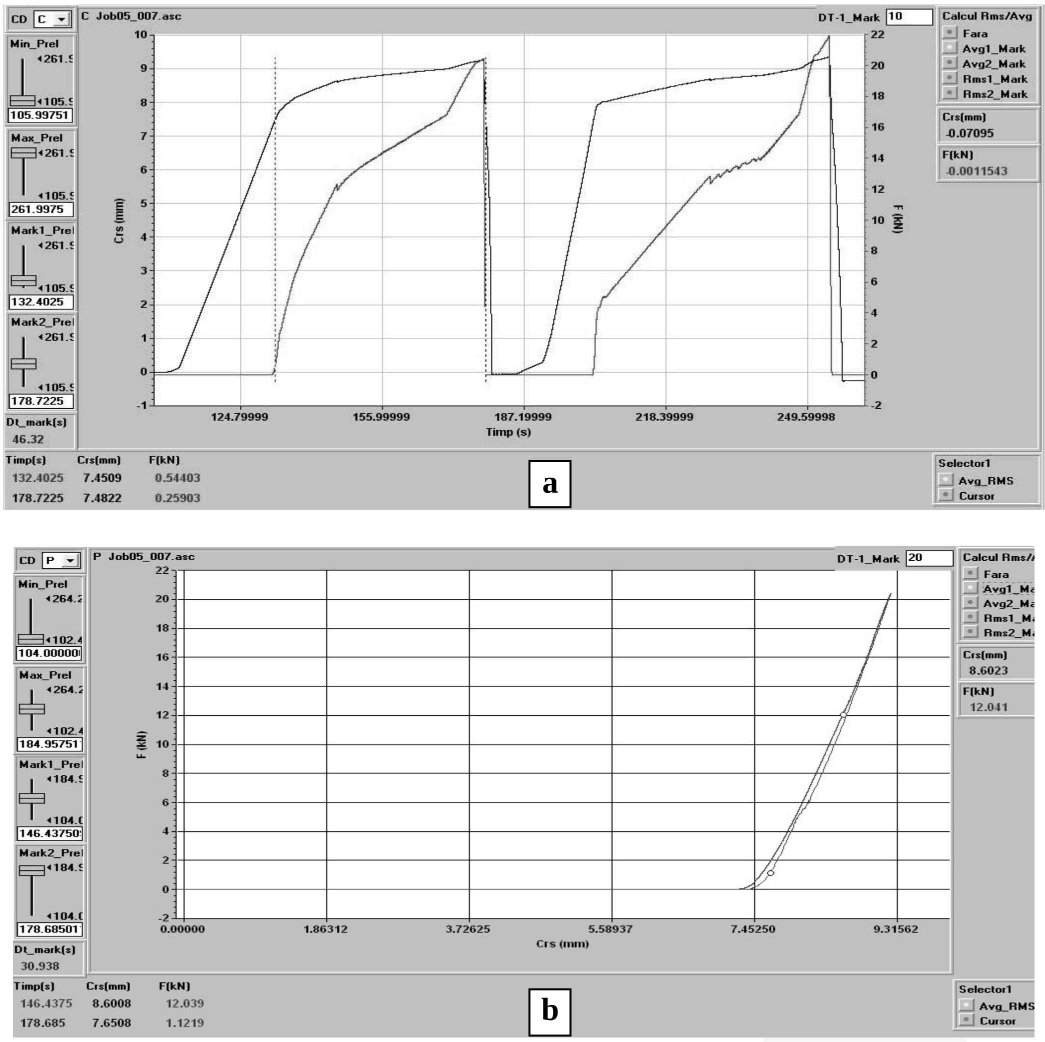


*Figure 3. Caracteristics determinated for steel beam (repeated loads)*

Parameters recorded after bending tests are: F (kN) - force hydraulic press, Crs (mm) - Race car linear framework, equal to the maximum displacement of the beam. In fig. 1 is presented the experimental assembly for metal beam INP 100.

For each test was flown the following sequence of operations:

- Complete installation experimental;
- Setting up and launch the test characteristics of data acquisition;
- Increase cross-loading progressive force;
- Downloading of force;
- Stopping the data acquisition system and the backup data file.

Experimental data processing was used the same program "Presa.tst., [5,6]. Visualization was achieved using experimental data and cursor Mark1 selected moments of time separated within 5 ... 10 seconds, under conditions of stability for the force actuator. For each point the average value was recorded, a sequence of 40 samples centered on the cursor. We used the same graphics with two sliders, with the possibility of reading the instantaneous values displays positioned in the inner and suggestive names associated with the color slider and pulled. Maximum displacement, the same car moving frame, denoted Crs (mm) is black and is reported in the left ordinate. Press force developed denoted F (kN), is red and is reported in ordinate on the right. Average values calculated on a total of 40 samples centered Mark1 mouse displays are transmitted to the right and are stored in the data file by typing selector Selector1. Acquired data were presented in tables. Figure 2 and 3 b is representing temporal variation of the force by the displacement. In Figure 3 is presented the variation in time of the force by the displacement. Analyzing the characteristics represented in polar coordinates is apparent hysteretic curve resulting in a loading-unloading cycle framework. The area covered by the hysteretic curve is a measure of energy dissipated in the beam.

## 3. CONCLUSIONS

The experimental results obtained, respectively experimentation rolled steel beams from the side, there are not enough conclusive, were seen in the limited number of test results did not provide enough for a practical application. Solution of strenghting solidarity, however, proved viable, resulting lift increase of 14% and 27% increase in rigidity. Charges were made in the spring, making possible repeated charge and discharge cycles, as demonstrated repeatability of results. The strenghting of the metal beams has the potential to improve lift lower than for wood but further research must be done, considering that viable solutions can be found growing, especially rigidity.

## References:

**1. Rosca V., Ilincioiu D., M. Marin, Aştefanei I., Resistance Testing of Materials. 2007. Publishing HouseTOP Universitaria, Craiova.**

**2. Triantafillou TC. Shear reinforcement of wood using FRP materials. 1997. J Mater Civil Eng, ASCE 9(2).**

**3. Abdel-Magid B, Dagher HJ, and Kimball T. The effect of composite reinforcement on structural wood. In: Proceedings – ASCE 1994 materials engineering conference, Infrastructure: new materials and methods for repair. 1994. San Diego, CA, November 14–16.**

**4. Borri A, Corradi M, Grazini A, A method for flexural reinforcement of old wood beams with CFRP materials. 2005. Department of Civil and Environmental Engineering, School of Engineering, University of Perugia, Composites: Part B 36, 143–153.**

**5. Ianăşi C., Pasăre M., Mechanical properties study of composite materials in beech beams strengthening case, Revista de Materiale Plastice, 48, 1/2011, pag 78-82.**

**6. Ianăşi C. Improving the mechanical properties of wood beams reinforced with CFRP composites plates, Annals of the Oradea University, Fascicle of Management and Technological engineering, CD-Rom Edition, Universitatea din Oradea, 28-29 Mai, 2010, ISSN1583-0691, cotaţie CNCSIS B$^{+}$, cod 665.**

**7. Mareş M, Materiale compozite, proprietăţi şi modelare. 2007. Ed. Tehnopress, Iaşi.**