ASPECTS REGARDING REINFORCEMENT WITH COMPOSITE MATERIALS

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Abstract: The need to reduce the consumption of raw materials has led to the emergence of new materials with superior properties, namely composite materials. Due to their superior properties they have compared to common materials, composite materials are used in almost all sectors of activity. In this paper are presented some wood beams reinforced with carbon fiber composite materials. This kind of reinforcement ensures to the consolidated elements improved mechanical properties such as increased bending strength.

Key words: properties, reinforcement, strength, composites

1. INTRODUCTION

Composite materials are very used in our days in many fields of activity due to their advantages. These materials have come to replace the usual ones due to their properties and possibilities of application. Because of their properties composite materials such as fiber-reinforced composites are now used in marine, automobile structures, medicine, electronics, sports equipment, transports, aeronautics, construction, energy field, etc[1,2].

These kinds of materials have two or more components therefore they can give to the materials applied on improved properties. The components from the composites material are matrices and reinforcement elements. Depend the area of utilization, the matrices and reinforcements can be from different types. For example, the matrices are based on different polymers such as: epoxy resins, phenol resins, polyurethanes, polyethylene, polypropylene, etc. [3,5].

In turn, the reinforcement can be classified, according to the researchers, as: particles, whiskers, powders and continuous or discontinuous fiber or yarn [4].

Also the reinforcement can be done from different types of elements like artificial and natural which do the composite to be used in different fields of activity [5].

Among the fields where the composites materials are also used is the construction field thus the composites used including: carbon fiber in a wide range but also glass fiber, aramid fiber, basalt fiber, boron fiber, etc. In civil and industrial constructions, when elements of resistance as beams present phenomena of wear and fatigue is necessary to be strengthening [6].

Regarding the use of composite materials in the field of construction, they are used for consolidations and reinforcements in this way the consolidation can be done with plates, fabrics, sandwich panels, composite profiles [7,13].

In the last years many studies on composite materials showed that fiber-reinforced epoxy matrix composites are among the best in terms of mechanical properties [2].

About the utilization of carbon fibers used for reinforcements they have the advantage that are twice as stiff and five-times stronger than steel. Because of these properties, carbon fiber is lighter than steel [8].

In the specialized literature the composites are studied regarding also the obtaining way, the influence of working parameters and their properties [9,10].

Other important properties of the composites materials are also light weight - therefore are largely used in industry, high mechanical properties - stiffness, strength,

good resistance to a wide range of chemical, electrical properties, high vibration damping capacity, good tensile strength, low density in relation to metals [9,12].

Also the very good properties of these types of composite materials are due to the very good adhesion between the reinforcement and the matrix because of the chemical structure [11].

2. EXPERIMENTAL STUDY

In this paper are presented some consolidated beams with composite materials as carbon fibers plates as a reinforcement. The composite material was applied up and down on the wood beams. Usually, a regular wood beam can withstand a relatively small concentrated bending force. When on the beam without reinforcement is applied the bending force then the wood will be more easily destroyed.

If a composite material is added on the wood beam then the wood beam can withstand a bigger bending force.

Consolidation of the beams and reinforcement is done with carbon fiber plates.

The beam is supported at both ends in the axial supports of the device and stressed transversely until breaking, registering the transverse force, the axial force (tensioning) and the maximum displacement. The tensioning force is applied with the screw system of the device.

In the figure 1 we can see the device used for testing the wood beams which is mounted on the testing machine.

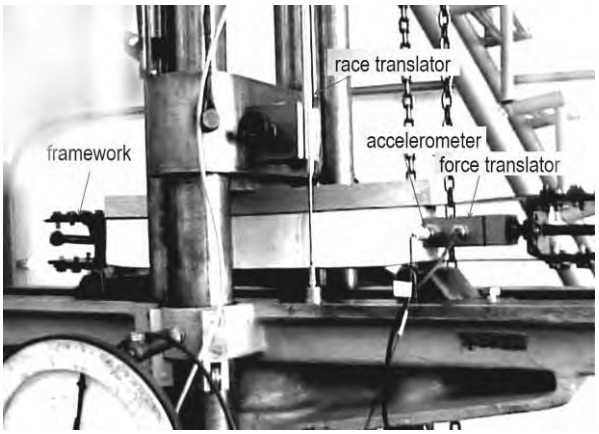

Fig. 1 Device for testing the wood beams

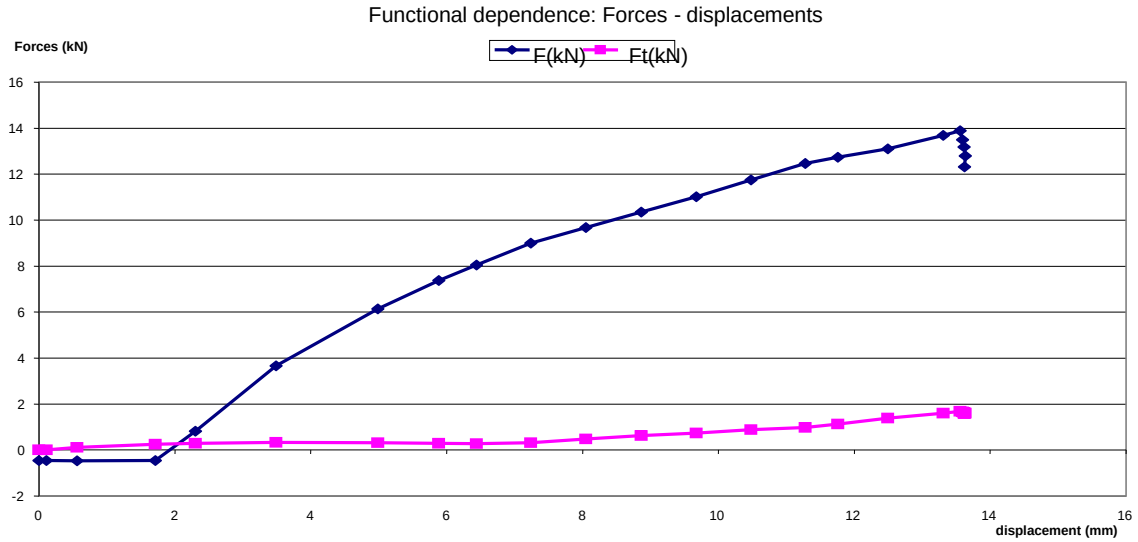

Fig.2. Beam without reinforcement

In the figure 2 is presented the bending test of the unreinforced wood beam. It can be seen that the beam resisted at a maximum applied force of 14kN when the beams gets a maximum displacement of around 13,6mm.

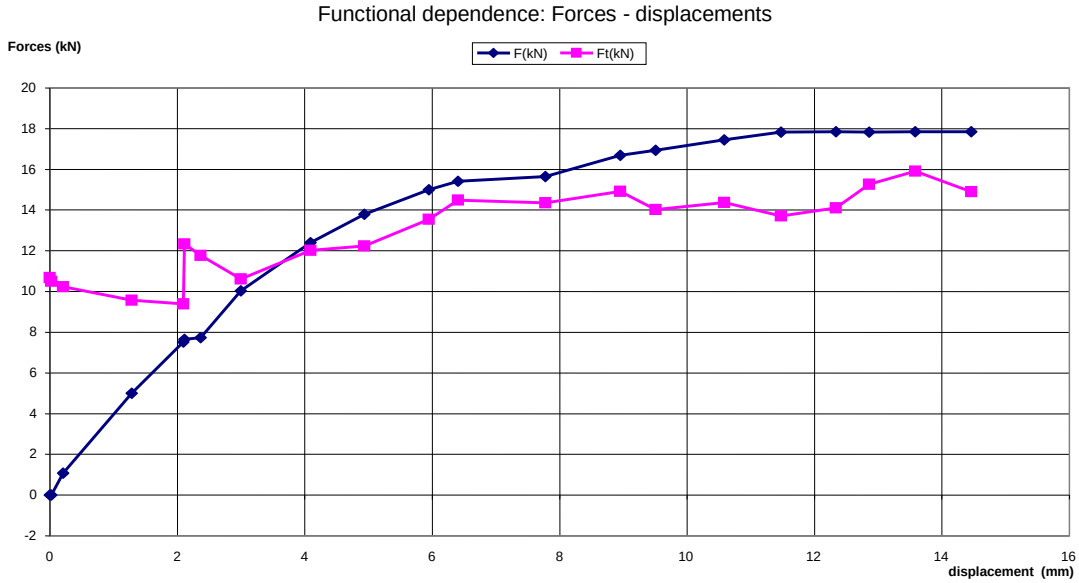

Fig.3. Beam with reinforcement and tensioning force Ft = 10kN

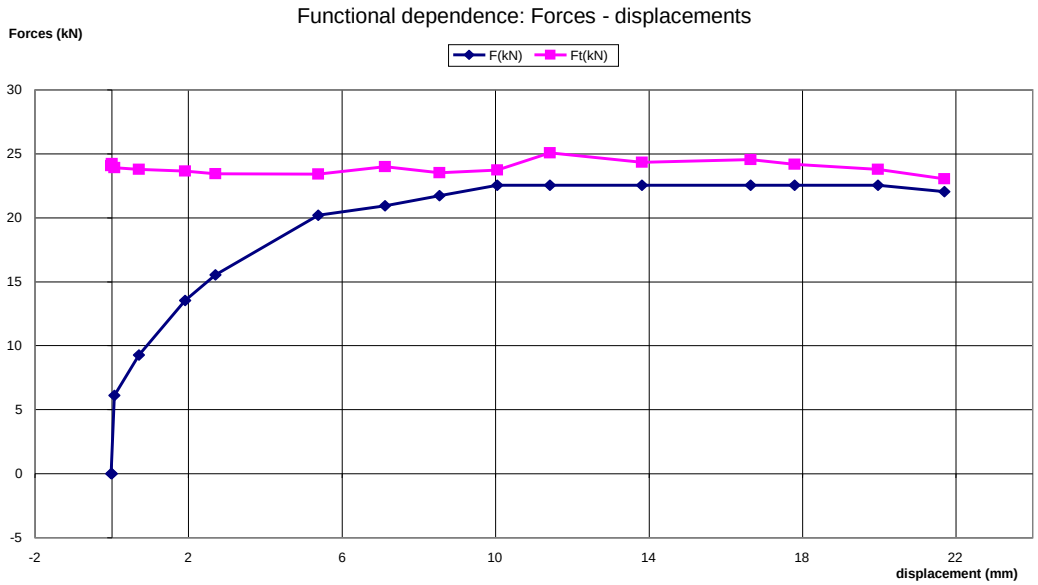

Fig.4. Beam with reinforcement and tensioning force Ft = 24kN

In the figure 3 and 4 is presented the bending test of the reinforced wood beams with carbon fiber plates. The beech beams have 50x100x500 mm dimensions, reinforced with two carbon fiber plates applied up and down the beams.

It can be seen that the displacement of the beams increased at around 14,5mm when maximum applied force gets the value of 18kN (fig.3) and the displacement of the beams increased at around 21,8mm (fig.4) when maximum applied force gets the value of 22,5kN.

High tensioning forces up to 24 kN allow the composite to take a maximum applied force for a certain period of time until the beam is destroyed. The elastic lift is significantly influenced by the tensioning force.

The maximum applied force and the maximum displacement of the beams reprezent experimental parameters to quantify the strength beam quality comparing with the unreinforced beam parameters.

CONCLUSION

The method of reinforcement with carbon fiber composite materials offers improved mechanical properties such as increased resistance of the consolidated elements.

By adding these composite materials based on carbon fiber on the wood beams showed an increasing of the resistance of the beams, in time, under the bending force which can also provide information on a real behavior of the beam in construction field.

The variations of the forces can be approximated with linear functions until close to the maximum values of the tensioning force, due to the fact that the composite plates used for reinforcement help to take over and distribute the transverse force evenly along the wood beam length therefore the beams can get a bigger resistance at the bending stress.

The bending tests performed on these beam systems show encouraging results so that they can continue choosing other types of wood for beams but also other types of composite materials for the reinforcing material.

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