GLASS FIBERS – MODERN METHOD IN THE WOOD BEAMS REINFORCEMENT

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***Abstract**: One of the defining goals of this paper is getting new resistant material which combine the qualities of basic materials that get into its composition but not to borrow from them their negative properties. Specifically, the use of GFRP composite materials as 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.*
The results obtained in this paper indicate that the behavior of reinforced beams is totally different from that of un-reinforced one. The main conclusion of the tests is that the tensioning forces allow beam taking a maximum load for a while, something that is particularly useful when we consider a real construction, The experiments have shown that the method of increasing resistance of wood constructions with composite materials is good for it and easy to implement.

Keyword: GFRP fibers, epoxy resin, wood beams, bending test

1. INTRODUCTION

In this paper is described an experimental study which was designed to evaluate the effect of GFRP on the stiffness of the wood beams [3]. By using composite materials in constructions is expected growth flexural strength and shearing, and confinement elements tablets (increased wood resistance) [5]. Applied to reinforced concrete structures for flexure, GFRP typically has a large impact on the strength of the reinforced elements. Consolidation and reinforcement is done with items as sheets and glass fiber rods [3,6].

The type of reinforcement used on the beams is the glass fiber reinforced polymer (GFRP) sheet MapeWrap G FIOCCO with a traction resistance of 2560 N/mm^2 and an epoxy resin for bonding all the elements MapeWrap Primer 1. Structural epoxy resins remain the primary choice of adhesive to form the bond to fiber-reinforced plastics [5,7,8,9] and are the generally accepted adhesives in bonded GFRP–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.

MapeWrap G FIOCCO is a special mesh made of pre-primed glass fiber, alkali resistant, which thanks to the special fabric pattern increases the ductility and uniformizes the distribution of the work on the masonry armed work. As a result, if the structure is subject to deformations, it distributes the efforts across the surface of elements that have been armed using it bag. The system adheres perfectly to the substrate so that concentrated efforts cause the support layer to yield itself before failure at the interface between the support / reinforcement system.

2. EXPERIMENTAL STUDY

The total number of wood specimens manufactured is 7, five of which are reinforced, and two are un-reinforced. The wood part of all beams was formed by dry wood beech which size is equal to 25 by 50 by 500 mm and ash which size is equal to 25 by 50 by 500 mm [3]. Three beams were reinforced using one glass fiber sheet of thickness equal to 1.5 mm, width equal to 25 mm and the length is equal to 500 cm. The finished dimension of these beams is equal to 25 by 101.5 by 500 mm because they are two beach wood beams stick together with one glass fiber sheet of MapeWrap G FIOCCO and MapeWrap Primer 1epoxy resin (fig.1) [10].

Fig. 1 *Testing a reinforced wood beam with one GFRP sheets*

For glass fiber sheet, once it is placed on the wood beam, with the epoxy resin, all what is required is to press the glass fiber sheet with a simple roller and pull out the air [1,2,4,6]. The GFRP are compatible with wood with respect to its mechanical properties. The bending test results for a reinforced wood beam with one GFRP sheet are shown in table 1 and the figure 2 from below:

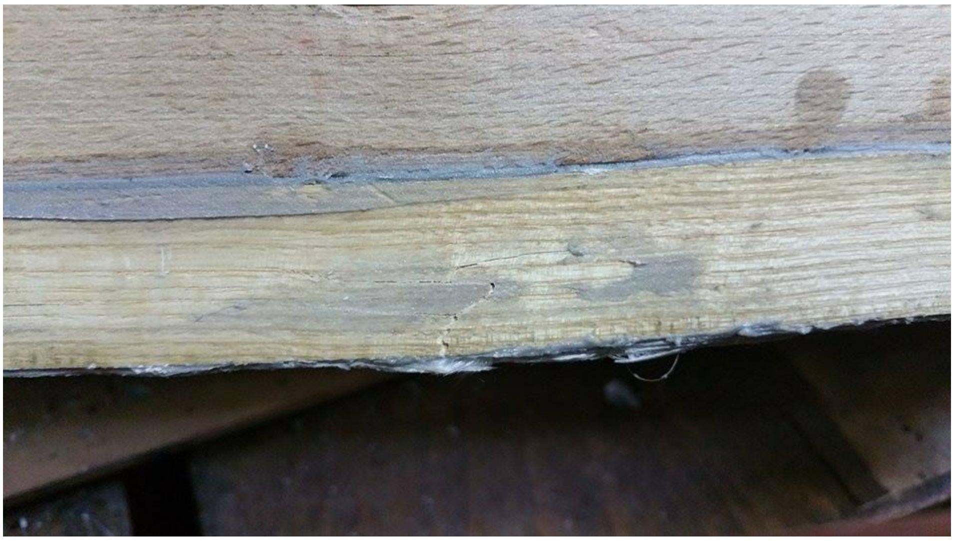

Fig. 2 *Tension failure of a reinforced wood beam with one GFRP sheet*

Table 1. Results for a reinforced wood beam with one GFRP sheet

Force (kgf/cm^2)	100	500	800	1200	1500	1850	2050	2200
Deflection f (mm)	2	5	7	10	14	17,8	19,4	22

Other two beams were reinforced using two glass fiber sheets of thickness equal to 3 mm, width equal to 25 mm and the length is equal to 500 cm. The finished dimension of these beams is equal to 25 by 73 by 500 mm because they are two slides of beech up and down stick by the main ash wood beam, with two glass fiber sheets of MapeWrap G FIOCCO and MapeWrap Primer 1epoxy resin (fig.3).

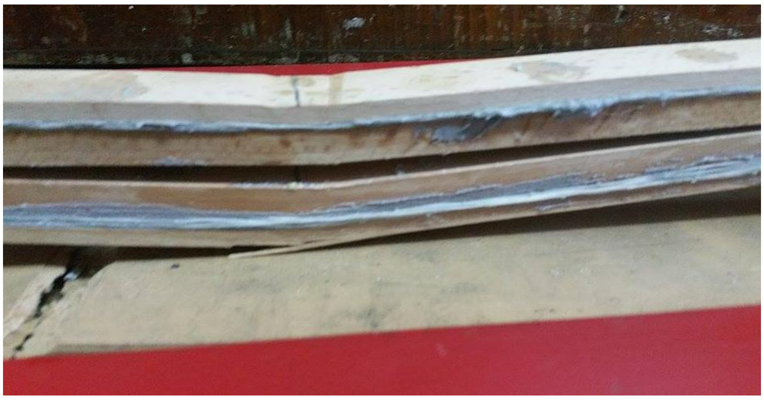

Fig. 3 *Testing a reinforced ash wood beam with two GFRP sheets and two slides of beech wood (up and down)*

The bending test results for a reinforced ash wood beam with two GFRP sheets and two slides of beech wood are shown in table 2.

Table 2. Results for a reinforced wood beam with two GFRP sheets

Force (kgf/cm^2)	20	70	150	210	270	320	390	420
Deflection f (mm)	2,2	3,6	7,5	12,7	17	22,5	28,7	35

Fig. 4 *Tension failure of a reinforced ash wood beam with two GFRP sheets and two slides of beech wood (up and down)*

The last two beams were reinforced using one glass fiber sheet of thickness equal to 1,5 mm, width equal to 25 mm and the length is equal to 500 cm. The finished dimension of these beams is equal to 25 by 101,5 by 500 mm because they are two wood beams stick together from beach and ash with one glass fiber sheet of MapeWrap G FIOCCO and an epoxy resin MapeWrap Primer 1 (fig. 4). The bending test results are shown in table 3 [11,12].

Fig. 5 *Testing a reinforced ash and beach wood beam with one GFRP sheet (in the middle of the beam)*

Table 3. Results for a reinforced wood beam with one GFRP sheet (in the middle)

Force (kgf/cm^2)	100	500	1100	1600	1800	2000	2100	2220
Deflection f (mm)	1	3	4	5	6	8	10	12

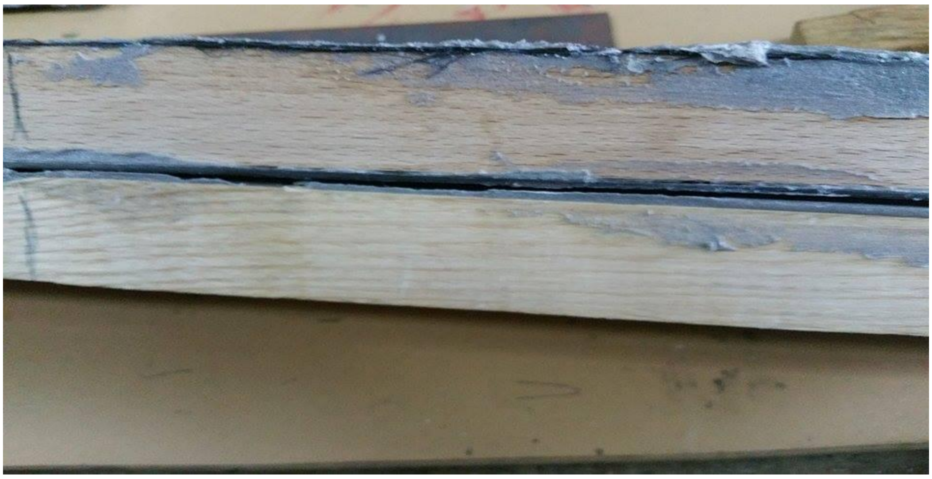

***Fig. 6** Tension failure of a reinforced ash and beach wood beam with one GFRP sheet (in the middle of the beam)*

The specimens tested were not subjected to lateral instability during loading. The total load on the beam was applied equally at one point equidistant from the reactions (the half length of the beam).

We use the bending device of the universal machine for mechanical tests which has the distance between the rollers l = 460 mm. Standard samples was dry beech and ash wood beams with a rectangular section of 25x50 x500 mm (bxhxl).

After we study those examples we observe that the reinforced wood beam with one GFRP sheet is the most resistant and has a good elasticity breaking at 22 mm deflection. Also, we can say that the number of composite material layers influences the stiffness of the wood reinforced beams.

CONCLUSIONS

It is proposed to use an inexpensive and easily processed material that is wood. As a rigid material with good strength and relatively low cost, we use a composite. A several un-reinforced and reinforced wood beams were tested in order to find their flexural capacity. The results indicate that the behavior of reinforced beams is totally different from that of un-reinforced one. The reinforcement has changed the mode of failure from brittle to ductile and has increased the load-carrying capacity of the beams.

Observations of the experimental load–displacement relationships show that flexural strength increased and middle vertical displacement decreased for wood beams reinforced with GFRP sheets compared to those without GFRP sheets. Also, we can say that the number of composite material layers of glass fiber sheets and their positions influence the stiffness of the wood reinforced beams.

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