Pak. J. Biotechnol. Vol. 14 (3) 372-376 (2017) ISSN Print: 1812-1837
www.pjbt.org ISSN Online: 2312-7791

COMPARATIVE ANALYTICAL AND EXPERIMENTAL STUDY BASED ON STRENGTHENING OF RC BEAM USING TEXTILE FIBER AND ARAMID FIBER

Sharmilee S.[1], Pavithra C.[2], Karthiga S.[2]

SRM University, Kattankulathur, Kancheepuram, India.[1]sharmisai214@gmail.com [2]pavithra.c@srmuniv.edi.ac.in. [3]karthiga.s@srmuniv.edu.ac.in

Article received 1.8.2017, Revised 30.8.2017, Accepted 8.2017

ABSTRACT

Textile fiber and aramid fiber is being used as the polymer used in the strengthening of the beam in tensile and flexure. The jute textile fiber's tensile and flexural property is compared with the kevlar aramid fiber. The jute textile fiber is readily available in the Indian market as it is been used in many other fields. The jute fiber reinforced polymer is cheap when compared with the kevlar fiber reinforced polymer. Kevlar is the material used in the armor jackets, gloves since it has great resistance except to direct contact with the ultra-violet rays. This work carries out the comparative study of the jute fiber reinforced polymer and kevlar fiber reinforced polymer in strengthening of material using the wrapping technique. The fiber is externally wrapped on the beam. The wrapping is placed on the beam and coated with the primer. The fiber reinforced polymer is wrapped around the beam in single layer with different percentages. The percentages used here in this beam are 25%, 50%, 90% in experimental and in analytical.

Keywords: jute fiber reinforced polymer, kevlar fiber reinforced polymer, strengthening, wrapping technique.

INTRODUCTION

Many researchers have used these fibers in alternative source of steel or in composites such as cement paste, mortar and in concrete for increasing the strength. The strengthening of the beam is carried out using technique called wrapping. Usually the wrapping material used in the construction field is of many forms which include woven, nonwoven, textile and fabric. The materials used in this study are aramid and textile fibers. The jute textile and kevlar aramid are used. The textile fiber is compared with the aramid fiber to study the high deformability index between them. So that it can be used in retrofitting and repairing of buildings after any deterioration of deformation of the structural element. The application of composites in structural facilities generally targeting on increasing the strength of the structures with the assistance for strengthening functions. In the recent researches it is found that the fibers used for the strengthening purpose of the structural element using wrapping method has increased strength respective to fibers wrapped when compared with the default structure. The experiments carried out for studying the failure mode, flexural strengthening, torsional behavior, effect on ultimate load and load deflection behavior as well as deflection ductility of the rc beam using the fibers wrapped in u config in single layer, along the entire length and strip wrapping, the outcome of these result showed that the beam with the fibers wrapped had improved their strength [Tara and Reddy, 2013, Sharaddha and Rathi 2015]. The effectiveness of the carbon fiber anchored externally bonded fiber reinforced polymers and textile reinforced mortar.

Various config of externally bonded fiber reinforced polymer and textile reinforced. of artificial fibers and doesn't address the Mortar sheets connected via carbon ber spike problems of properties those materials used anchors experimentally including the Reinforced concrete column. This results in the prevention of premature delamination of fiber reinforced polymer and textile reinforced mortar sheets from the concrete surface [Sri et al., 2015]. The textile reinforced mortar is less effective when compared with the fiber reinforced polymer in increasing the shear strength of the concrete [Bournas et al., 2014]. The aramid fibers used for enhancing the dynamic strength, final strain and energy absorption density square measure sensitive to strain rate which the external aramid fiber improves these properties within the concrete [Zoi, et al., 2015, Hui, et al., 2015]. The glass fiber use as the alter material for carbon reinforced polymer material for increasing the strength. The result using fiber reinforced polymer under applied loads reveals the cost effectiveness and also the strengthening properties of the concrete [Yeole and Wakchaure 2013]. High performance fiber reinforced concrete are tested for pseudo strain hardening behavior, high strength and fracture toughness its results shows that this technique is safer alternate for the flexure strengthening of the structural element [Attaria et al., 2012, Thenmozhi and Shri, 2012, Ramadevi and Shri, 2015].

1. Material characterization of jute and aramid composites

2.1 General

Materials used are jute fibers and kevlar fibers which is compared in the strengthening of reinforced concrete beams. The jute fiber is natural fiber whereas the kevlar is synthetic fibers. Of older buildings is changing into additionnal economical in order that trending style techniques combined with information of the condition of building, modify the present concrete to be used with solely minor modifications.

2.2 Fiber

The fibers square measures either natural or artificial substance that's considerably longer than its wide. These are usually utilized in the manufacture of alternative materials. The strongest engineering materials usually incorporate fibers. In this study for the Strengthening of the beam textile fiber and aramid fiber are used.

2.3 Textile Fiber

Textile fiber are often spun into a yarn or created into a material by numerous strategies together with weaving, knitting, and braiding, felting, and twisting. Textile fibers are being used in the home garnishing, furnishing, wire covering, wall covering, blench, air tux. Textile fibers have two major classifications. In this study, the textile fiber used is jute. This is cheaper and most economically used in all fields. It is made from the cellulose rich fiber of the jute plant.

Table 2.1: Properties Of Jute Fiber

PROPERTIES	Values
DENSITY	1.3 g/cm^3
YOUNG'S	2650 kg/m^3
POISSON'S RATIO	0.30

2.4 Aramid Fiber

Aramid fibers a category of warmth resistant and robust artificial fibers. They're utilized in part and military applications, for trajectory rated armor cloth and trajectory composites, in bicycle tires and as amphibole substitute. Aramid are sensible resistance to abrasion, organic solvents, no conducting, no freezing point, low flammability, sensible cloth integrity at elevated temperatures, sensitive to acids, salts and ultraviolet radiations.

The aramid fiber which is used in this study is kevlar. This fiber and filament comes in different varieties of types each with its own unique set of properties and uses. These fibers are performance characteristics based on their different needs.

The types of this fiber are Kevlar AP, Kevlar 29, Kevlar49, Kevlar100, Kevlar119, Kevlar 129, and Kevlar KM2. In this study Kevlar49 is being used since it is mainly used in the fiber optic cables, plastic reinforcement, ropes, cable sandal so as composites.

Table 2.2 Properties of Kevlar Fiber

PROPERTIES	Values
DENSITY	1.44 g/cm^3
YOUNG'S MODULUS	1470 kg/m^3
POISSON'S RATIO	0.35

2. *Analytical study*

The analytical study of strengthening the beam is carried out by wrapping fiber on the surface of the RC beam with the help of epoxy. This analysis is carried out in ansys software, in which the properties of each material is defined as per the norms of the material used in the experiment, the analysis of rc beam is first carried out using the usual properties and loading system available in the software, beam of size 1m x 0.15m x 0.23m is first designed with the particular reinforcement detailing. Every single element in the beam is drawn as per the require-ment of study.

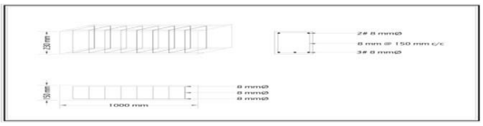

Figure 3.1: Reinforcement Details

The model is then selected separately for reinforcement and concrete to denote their flexibility. After which the body interactions of the beam are defined. The mesh for the beam is created element size of 0.009m, after which the complete beam is ready for withstanding the load. The load is applied on the beam. The result is generated for total deformation, maximum and minimum principal stress.

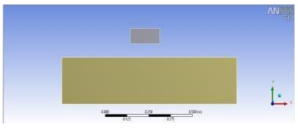

Figure 3.2: Conventional Beam

When the analysis is started to be performed the maximum point where the deflection and maximum and minimum principal stress is noted. When the load is applied the deflection of the beam is at the mid-section of the beam. Maximum principal stress is found to be at the end corner of the supported face of beam, whereas the minimum principal stress is found to be on the top face of the beam.

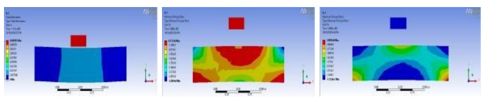

Figure 3.3:Results Generated on Applying Load

After generating the results for the conventional beam, using the same method the beam with the size mentioned for conventional is created and the fibers are wrapped on the beam, which forms a layer above the beam in U shape. This is then defined for their flexibility, connections and body interaction. After which the mesh for the model is done. The finished model beam is tested applying load. The results are generated as generated for the conventional beam (i.e., total deformation, maximum and minimum principal stress)

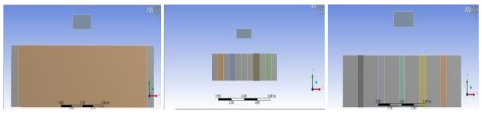

Figure 3.4: Beam With 90%,50% And 25% Kevlar Fiber Wrapped.

When the load is applied on the surface of the beam, the gets deformed accordingly with respect to the force of the load. After applying the load on beam, the deformation is noted for the various percent of fiber used. Figure 3.5 describes the deformation of the beam with the load applied. The maximum deformation is also noted for the beams the total deformation is found at the midpoint and the fiber tends to absorb the load and thus allowing the beam to withstand more load without the beam getting deformed. The 50% jute wrapped beam tends to withstand more load when compared with 90% and 25%.

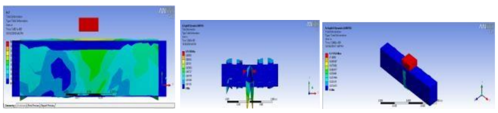

Figure 3.5: Total Deformation on The Beam With Jute Fiber

Correspondingly when the load is applied their respective maximum principal stress is noted with different percentage of fiber wrapped. Figure 3.6 describes the maximum principal stress for different percentage of fibers wrapped. The 90% wrapped beam tends to possess-higher strength when compared with the rest of the wrapping. The jute fiber withstands the load much more when the beam is wrapped at 90%

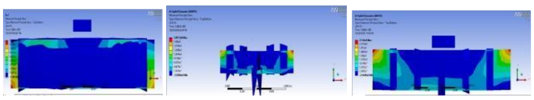

Figure 3.6: Principal Maximum Stress Of Beam With Kevlar Fiber

The load is applied on the beam in which the fibers wrapped and the principal minimum stress is noted accordingly. The figure 3.7 describes the principal minimum stress of the beam according to the loads applied. The minimum principal stress is more when the beam is wrapped either by 25% or 50 % since the load withstood the fiber at these percentages are approximately equal.

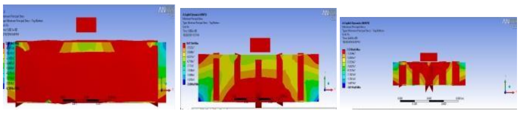

Figure 3.7: Principal Minimum Stress of Beam with Kevlar Fiber

The figure 3.8 shows beam being wrapped with jute fiber different percentage. The load is applied on the beam. The result is noted for total deformation, principal minimum and maximum stress.

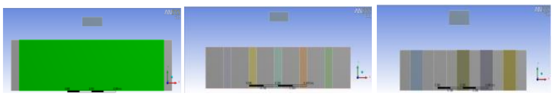

Figure 3.8: Beam Wrapped With 90%, 25% And 50% Jute Fiber

The figure 3.9 shows the total deformation of the beam at maximum load application. The 50% wrapped beam tends to withstand more load then the 90% and 25% wrapping. The beam wrapped by 25% tends to withstand more deformation then the 25% and 50% wrapped beam.

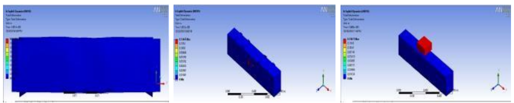

Figure 3.9: Total Deformation Of Beam With Jute Fiber

The figure 3.10 shows the principal maximum stress of the RC beam at the maximum load applied on it. The principal maximum stress of the beam wrapped with this fiber tends to possess more strength when compared with the jute fibers. The maximum principal stress of the beam is increased by 20% when the beam is wrapped with 50% fiber.

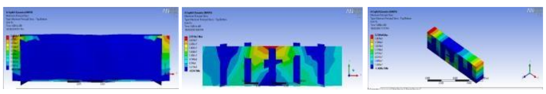

Figure 3.10: Principal Maximum Stress Beam With Jute Fiber.

The figure 3.11 represents the principal minimum stress of the beam according to the load applied on the beam. The principal minimum stress of the beam with this fiber wrapped tends to possess less strength when compared with the jute fiber. But when studied the beam wrapped by the fiber its noted that the beam wrapped with 90% strength to withstand the minimum principal stress.

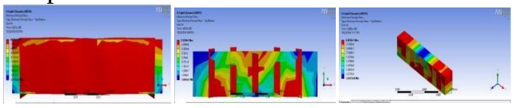

Figure 3.11: Principal Minimum Stress Of Beam With Jute Fiber

3. *RESULT AND DISCUSSION*

The analytical study reveals that the jute fiber wrapped on the beam at 25% gets more deformed whereas the aramid fiber wrapped at 90% gives 20% more compressive strength and resists the deformation.

1. The beam was able to withstand maximum principal stress and minimum principal stress when it is wrapped with fibers.
2. Jute tends to resist deformation when the structural element is wrapped at 25%.
3. Since jute has lesser elasticity when compared with Kevlar, it tends to fail sooner than the Kevlar when wrapped at 50% and 90%.
4. Kevlar gave up to 20% increase in strength of the beam when compared with the conventional beam and Jute increases strength by 10%.

4. *REFERENCES*

Attaria, N., S. Amzianeb, M. Chemroukc, Flexural strengthening of concrete beams using CFRP, GFRP and hybrid FRP sheets. Construction and Building Materials Pp 746-757 (2012).

Bournas, D.A., P. Alberto and W. Tizani, Tensile capacity of fiber reinforced polymer anchors inn connecting fiber reinforced polymer and textile reinforced mortar sheets to concrete. Engineering Structures 82: 72-81 (2014).

Ramadevi, K. and S.D. Shri, Flexural Behaviour of Hemp Fiber Reinforced Concrete Beams. ARPN Journal of Engineering and Applied Sciences 10: 1819-6608 (2015)

Sharaddha B.T. and V.R. Rathi, Comparative experimental study on torsional behavior of reinforced concrete beam using carbon fiber reinforced polymer and glass fiber reinforced polymer fabric wrapping. Procedia Technology 24: 140-147 (2015)

Sri T., H.A. Lie and B.A. Hidayat, An experimental study to the influence of fiber reinforced polymer (FRP) confinement on beams subjected to bending and shear. Procedia Engineering 25: 1070-1075 (2015).

Tara, S. and H.N.J. Reddy, Strengthening of reinforced concrete beams flexure using natural jute fiber, textile reinforced its comparative study with cd composite and carbon fiber reinforced polymer and glass fiber reinforced polymer strengthening system. International Journal of Sustainable Building 2: 41-55 (2013).

Thenmozhi, R. and S.D. Shri, An Experimental investigation on the flexural behavior of scc ferrocement slabs incorporating fibers. International Journal of Engineering Science and Technology 4(5) 2146 – 2158 (2012)

Yang, H., H. Song, S. Zhang, Experimental investigation of the behavior of aramid fiber reinforced polymer confined concrete subjectted to high strain-rate compression. Composite Structures 95: 87-93 (2015).

Yeole P.M. and M.R. Wakchaure, Enhan-cement of flexural strength of RC beam using kevlar fabric. International Journal of Advanced Technology in Civil Engineering 2: 124-129 (2013).

Zoi C. T., L.N. Koutas and D.A. Bournas, Textile reinforced mortar vs. fiber reinforced polymers in shear strengthening of concrete beams. Composite Structures 77: 338-348 (2015).