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Experimental Study on Pineapple Leaf Fiber Reinforced RCC Beams

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Abstract - Concrete made with Portland cement is comparatively strong in compression but weak in tension and tends to be brittle. The weakness in tension can be overcome by the use of conventional rod reinforcement and to some extent by including sufficient volume of certain fibers. There has been a growing interest in utilizing natural fibers for making low cost construction materials in recent years. For environmental protection purposes, the use of natural fibers rather than synthetic fibers is highly recommended. Pineapple leaf fiber (PALF) is more compatible natural fiber resource and constitutes a good chemical composition and has highest tensile strength when compared to other natural fibers.

However, the main disadvantages of natural fibers in composites are the poor compatibility between fiber and matrix and the relative high moisture sorption. The chemical treatment of fiber improves the adhesion between the fiber surface and the matrix may not only modify the fiber surface but also increase fiber strength.

In this study combined dilute alkali and polymer treated pineapple leaf fiber are provided as secondary reinforcement in concrete beams. The concrete members were experimentally studied. The ultimate Load carrying capacity of beams were obtained and compared with the ordinary RCC beams.

Keywords – Natural fiber**,** Pineapple leaf fiber, Secondary reinforcement, Ultimate Load, Combined dilute alkali and polymer treatment , Tensile strength, RCC beam.

INTRODUCTION

Concrete made with Portland cement is comparatively strong in compression but weak in tension and tends to be brittle. The weakness in tension can be overcome by the use of conventional rod reinforcement and to some extent by including sufficient volume of certain fibers. There has been a growing interest in utilizing natural fibers for making low cost construction materials in recent years. [12], [17]

Fibers are thread like materials which can be used for different purposes. Fibers produced by plants (vegetable, leaves and wood), animals and geological processes are known as natural fibers. Researchers have used plant fibers as an alternative source of steel and/or artificial fibers to be used in composites (such as cement paste, mortar and/or concrete) for increasing its strength and ductility. Natural fibers have the advantages of low density, low cost, and biodegradability. When concrete cracks, the randomly oriented fibers start functioning, arrest crack formation and propagation, and thus improve strength and ductility [2], [5]

Pineapple leaf fiber is more compatible natural fiber resource and constitutes a good chemical composition. Pineapple leaf fiber (PALF) is vital natural fiber, which have high specific strength, rigidity, flexural and torsional rigidity than other fibers. Pineapple-Leaf Fiber-Reinforced concrete beam is a structural model designed to address three major problems: waste management, pollution control and climate change. [1]

However, the main disadvantages of natural fibers in composites are the poor compatibility between fiber and matrix and the relative high moisture sorption. Therefore, chemical treatments are considered in modifying the fiber surface properties. The chemical treatment of fiber aimed at improving the adhesion between the fiber surface and the matrix may not only modify the fiber surface but also increase fiber strength. Water absorption of composites is reduced and their mechanical properties are improved. For homogeneous distribution of natural fiber into the cement matrix both the chemical composition as well as surface properties of natural fiber have to be modified by a combined dilute alkali and polymer emulsion treatment [14]

EXPERIMENTAL WORK

A. General

The experimental work includes the casting of conventional RCC beams and the same set of specimens added with combined dilute alkali and polymer treated pineapple leaf fibers. The beams are casted in the size 150 mm x 200 mm x 1250 mm.

B. Mix Proportions and Materials Used

The characteristic compressive strength of the concrete after 28 days of curing is assumed to be 25 i.e. the fck value is 25. The cement used is ordinary Portland cement with 53 as grade. The coarse aggregate is 20 mm in size and the fine aggregate is well sieved. The mix proportion is designed as per the IS code for the M25 grade of cement.

TABLE 1

MIX PROPORTION

Material	Cement	Fine Aggregate	Coarse Aggregate	Water
Weight (kg/m^3)	437.77	636.396	1174.931	197
Ratio	1	1.45	2.68	0.45

The fiber that is used is pineapple leaf fiber and the mechanical properties of fiber are listed below in the form of a table

TABLE 2

MECHANICAL PROPERTIES OF PALF

Type	Tensile Strength (Mpa)	Youngs Modulus (Gpa)	Density (g/cm^3)	Length (cm)
Natural	387-1486	29.8-81	1.3	12.5

C. Experimental process

RC beams of size 150mm width, 200mm depth and 1250mm length were casted using M25 conventional mix and fiber added mix. Combined dilute alkali and polymer treated PALF fiber are added in the mix. Combined polymer alkali treatment was done by

soaking the required amount of PALF in 0.5% alkali solution following which the spent alkali solution was decanted out after 24 h of soaking. Next the respective amounts of Sika latex containing solid (carboxylated styrene butadiene (SBR) was diluted with 1000 ml of water and added to the alkali soaked wet PALF. The fiber that is added along with the mix is in the percentage of 0.75 (by weight).The beams were designed for flexural failure with 2#12mm bars as the bottom longitudinal reinforcement and 2#8mm bars as the top longitudinal reinforcement. Two legged 8mm stirrups were provided as shear reinforcement at spacing of 130 mm from the supports. The beams were tested under two point loading test after 28 days water curing.

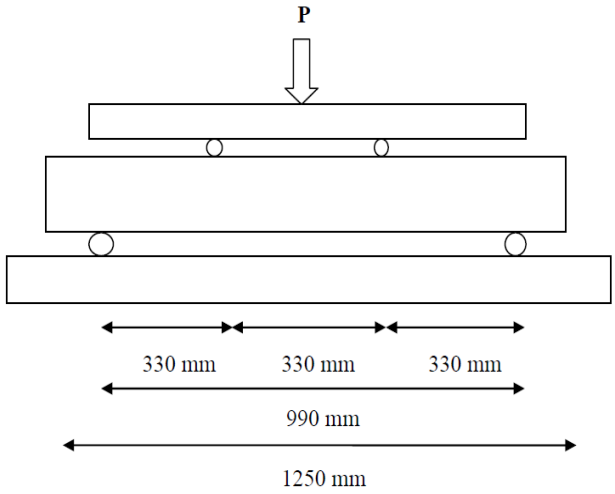

Fig. 1 Schematic Setup for Testing

RESULTS

The mode of failure of control beam and beam reinforced with treated PALF are shown in Fig. 2 and Fig. 3 respectively.

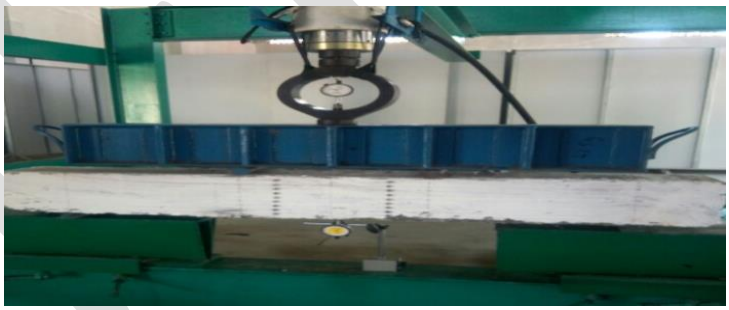

Fig. 2 Failure of control beam

The mode of failure was found to be flexural in both control beam and fiber added beam. It was also observed that the crack width increased with the increase of load.

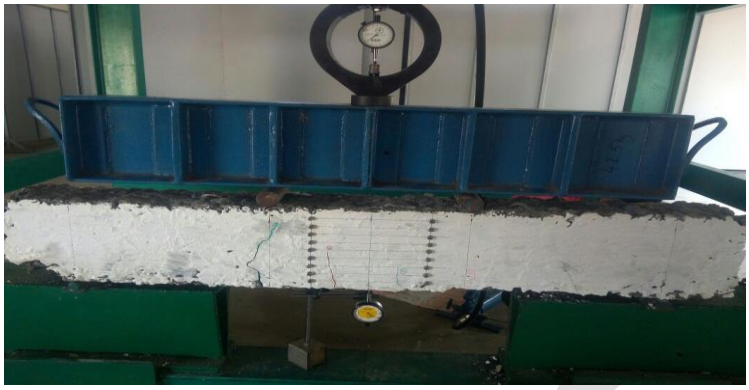

Fig. 3 Failure of beam with treated PALF

DISCUSSION

The ultimate loading carrying capacity of control specimen was obtained as 147.15 kN. The ultimate load carrying capacity of beams reinforced with treated PALF was obtained as 191.29 kN which is greater than that of the control beam.

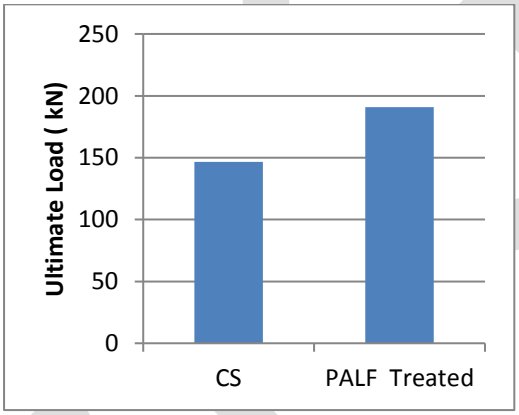

Fig. 4 Ultimate Load Carrying Capacity

CONCLUSION

The flexural behavior of concrete beams with PALF as secondary reinforcement has been presented in this study. Based on the findings from the beam flexure tests performed, the following conclusions can be drawn,

1. The ultimate load bearing capacity of the PALF reinforced beam was very much higher than the conventional type specimens in the flexural test that was carried out. In combined dilute alkali polymer treated beams the load carrying capacity is increased by 24%.
2. Both control beam and treated PALF added beams failed in flexure.
3. Beam without fiber or normal concrete start cracking at lower loads, and the cracks continue towards compression region. However, beam with fiber start cracking in higher loads because of higher tensile strength due to fiber addition.

REFERENCES:

[1] A.Khalina et.al, A Review on Pineapple Leaves Fibre and Its Composites, International Journal of Polymer Science,2016

[2] A.Majid**,** Natural fibres as construction materials, Journal of Civil Engineering and Construction Technology, Vol. 3(3), pp. 80-89,2012

[3] C.Andressa et.al, Mechanical behavior of natural fiber composites, Sciencedirect, journal of cement & concrete composite,Vol. 10, pp. 2022-2027,2011

[4] E.Mello et.al, Improving Concrete Properties with Fibers Addition, International Journal of Civil and Environmental Engineering, Vol. 8, pp. 249-254,2014

[5] E.Sinha et.al, Influence of fibre-surface treatment on structural, thermal and mechanical properties of jute, Springer, Journal of Material Science , Vol.43, pp.2590–2601,2008

[6] F.Faizal, Properties and Applications of Fiber Reinforced Concrete, *JKAU: Eng. Sci.*, Vol. 2, pp. 49-63,2005

[7] G. Ramakrishna et.al , Studies on the durability of natural fibers and the effect of corroded fibers on the strength of mortar, Science Direct, journal of cement & concrete composite,Vol. 27, pp. 575-582,2005

[8] H. Ujwala et.al, Effect of Maleic Anhydride Grafted Polypropylene on the Mechanical and Morphological Properties of Chemically Modified Short-Pineapple-Leaf-Fiber-Reinforced Polypropylene Composites, Journal of Applied Polymer Science, Vol. 107, pp. 1507–1516,2007

[9] L.Natinee et.al, Performance of Pineapple Leaf Fiber–Natural Rubber Composites: The Effect of Fiber Surface Treatments**,** Journal of Applied Polymer Science, Vol. 102, pp.1974–1984,2005

[10] M.G. Aruan Efendy et.al, A review of recent developments in natural fibre composites and their mechanical performance, Elsevier, journal of cement & concrete composite,Vol. 83, pp. 98-112,2016

[11] M.Linto et.al, Mechanical Properties of Pineapple Fibre Reinforced Concrete Subjected to High Temperature, Global Research and Development Journal for Engineering,Vol. 2,pp. 200-205,2017

[12] M.R. Sanjay et.al, Study on properties of Natural-Glass fibre reinforced Polymer Hybrid Composites, Science Direct, journal of cement & concrete composite,Vol.2, pp. 2959-2967,2015

[13] P.Satyanarayan et.al, Chemical Treatments of Natural Fiber for Use in Natural Fiber-Reinforced Composites: A Review, J Polym Environ Vol.15, pp. 25–33,2007

[14] R.M. Vignesh et.al, Experimental study on natural fibers in RCC beams, International Journal of Civil Engineering and Technology, Vol.8, pp.179-184,2017

[15] S.Aiswarya et.al, fiber addition and its effect on concrete strength, International Journal of Innovative Research in Advanced Engineering, Vol. 1, pp.144-149,2014

[16] S.Chattopadhyay et.al, Influence of Varying Fiber Lengths on Mechanical, Thermal, and Morphological Properties of MA-g-PP Compatibilized and Chemically Modified Short Pineapple Leaf Fiber Reinforced Polypropylene Composites, Journal of Applied Polymer Science, Vol. 113, pp.3750–3756,2009

[17] V.Sandeepani et.al, Study On Addition Of The Natural Fibers Into Concrete, International journal of scientific & technology research ,Vol. 2, pp. 213-218,2013

[18] W.O. Soboyejo et.al , Fracture and fatigue of natural fiber-reinforced cementitious composites, Science Direct, journal of cement & concrete composite,Vol. 31, pp. 232-243,2009