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Comparison of Different Natural Fiber Reinforced Concrete: Review

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Abstract

In recent years, a great deal of interest in concrete leads to the most frequently used construction material in the world. The fiber reinforcement can effectively improve the toughness, shrinkage and durability characteristics of concrete. Out of commonly used fibers, easily available low cost natural fibers can be used. In spite of many of the researchers of using different natural fibers to improve the different properties of light weight concrete still required a lot of research as well as investigations. The present work consists of the comparison of different natural fibers. The slump, compressive strength as well as flexural strength were compared for these natural fibers. It was observed that oil palm trunk fibers shown very good results not only for compressive strength but also for flexural strength. This work is only an accumulation of information about GFRC and the research work which is already carried out by other researchers.

Keywords: Fiber reinforced concrete, natural fibers, light weight concrete

Introduction

Concrete is the most frequently used construction material all across the world. But it has low tensile strength, low ductility as well as low energy absorption. The cause for the poor tensile behavior of concrete is proved to be the low toughness and the presence of defects. So it is the need to improve the concrete toughness and reducing the size and amount of defects in concrete would definitely lead to better concrete performance.

Fiber reinforced concrete is cement based composite material and it is generally reinforced with discrete, usually randomly distributed fibers. Fibers of various shapes and sizes produced from different fibers like steel, synthetic, glass and natural materials are usually used to make fiber reinforced concrete. Fiber reinforcement mainly enhances the post-cracking properties of concrete and leads to a more ductile material behavior.

Review of Literature

The experimental investigation [2] was carried out to study the properties of lightweight crushed brick containing palm fibers of different volume fractions. While an experimental program was planned in which the test such as density, compressive strength and flexural strength were conducted to investigate the properties of lightweight crushed brick concrete reinforced by palm fiber. The result indicated that the use of palm fiber with the lightweight crushed brick concrete enhances not only the mechanical properties of the concrete but also the optimization of the palm fiber fractions was required to get the best performance.

Investigations [3] to overcome the brittle response and limiting post-yield energy absorption of concrete had led to the development of fiber reinforced concrete using discrete fibers within the concrete mass. In the study, the durability of natural fiber such as coconut coir as well as sugarcane bagasse had been reported by conducting an experimental investigation. From the experimental study, it was well known that natural fibers enhanced all the strength as well as flexural performance of concrete. It was observed that both the natural fiber reinforced concrete were less susceptible against not only sulphate attack in terms of mass loss but also compressive strength deterioration.

The experimental study [6] was carried out on the use of coconut fiber as enhancement of concrete. It was observed that the addition of coconut fibers significantly improved many of the engineering properties of concrete such as torsion, toughness and tensile strength of concrete. Also it was observed that the resistance to cracking as well as spalling also enhanced. However it was observed that the addition of coconut fibers adversely affected the compressive strength. Overall it was stated that the addition of coconut fibers leads to improvement of concrete in the toughness torsion and the tensile stress.

The study [8] was conducted experimentally to compare the effectiveness of oil palm trunk which was

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used at relatively low volume fractions, in enhancing the mechanical properties of concrete material. Fiber content in the study ranges from zero to three percent by volume, while fiber length was 25 mm and the concrete matrix compressive strength was about 30 MPa. Flexural as well as compressive test were conducted which was according to BS 1881. Oil palm trunk fibers increased the flexural strength of concrete material with 1.0 percent volume fraction of OPTF. The average flexural strength was 18.35 % higher than the corresponding properties of plain concrete.

Results and Comparison

The comparison is done for adding varying amount of natural fibers in normal concrete with different percent of fiber. The results of the slmp, compressive strength and flexural strength are as presented in the following table.

Table 1: Slump Comparison

Sr. No	Author	Type of Fiber	Days of Curing	Percentage of fiber	Slump (mm)
1	Youjiang Wang, et al	Carpet waste fibers	28	0.14	191
				0.47	70
2	Mahyuddin Ramli, et al	Palm fiber	28	0.2	150
				0.4	140
3	Z Ahmad, et al	oil palm trunk fiber	28	1	106
				2	98
4	M Sivaraja, et al	Coconut coir fiber	28	1.5	84

Table 2: Compressive Strength Comparison

Sr. No	Author	Type of Fiber	Days of Curing	Percentage of fiber	Compressive strength (MPa)
1	Youjiang Wang, et al	Carpet waste fibers	28	0.14	25.6
				0.47	27.6
2	Mahyuddin Ramli, et al	Palm fiber	28	0.2	24.2
				0.4	24.5
3	Z Ahmad, et al	oil palm trunk fiber	28	1	35.1
				2	25.1
4	M Sivaraja, et al	Coconut coir fiber	28	1.5	27.8

Table 3: Flexural Strength Comparison

Sr. No	Author	Type of Fiber	Days of Curing	Percentage of fiber	Flexural strength (MPa)
1	Youjiang Wang, et al	Carpet waste fibers	28	0.14	4.06
				0.47	3.79
2	Mahyuddin Ramli, et al	Palm fiber	28	0.2	4.41
				0.4	4.6
3	Z Ahmad, et al	oil palm trunk fiber	28	1	32.24
				2	22.26

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Conclusion

From the above results and comparison following point are observed:

- The value of slump decreases as the percent of natural fiber increases.
- Compressive strength of the concrete increases as the percent of natural fibers increases but it is limited to certain extent.
- It was observed that the oil palm trunk fibers in the concrete shown good increase in compressive strength as compared to other natural fibers.
- It was also observed that the flexural strength also increases with the increase in percent of natural fibers.
- It was observed that the for flexural strength oil palm trunk fibers shown very good results as compared to the other natural fibers.

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