EXPERIMENTAL STUDY ON CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY LIME AND COCONUT FIBER

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ABSTRACT

This experimental study is aimed to create a concrete mixture consisting of Lime and Coconut Fibre which replaces the cement. It is also used to analyze the effect of Lime and Coconut Fibre concrete in terms of workability, adhesion of aggregates and etc. After preparing the concrete block, the difference in weight between the original concrete and Lime and Coconut Fibre concrete block is also tested. The Lime and Coconut Fibre is mixed in different proportions such as 1%, 2%, 3% and 5%,10%,15% respectively in the concrete by replacement of cement. And then various tests are conducted for fresh concrete as well as hardened concrete. The results might indicate that both the density and the compressive

strength may decrease with respect to the percentage of Lime and Coconut Fibre mixed in the concrete.

Keywords: - Lime, Coconut Fiber, Waste utilization, Cement.

1. INTRODUCTION:-

Concrete is the most widely used construction material all over the world .with Innovations in science and technology in construction industry, the scope of concrete as a structural material has widened. Concrete is strong compression but it is weak in tension and flexure, The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but over use of the material has led to environmental concerns, Attempts have also been made to reduce the cost of the total construction cost by investigating and ascertaining the usefulness of Lime and Coconut Fibre .Thus, this research investigates the potential use of Lime and Coconut Fibre to produce a low-cost and lightweight composite for construction and engineering purpose.

2. OBJECTIVES:

The objectives of the present study are stated below:

1. To compare the water absorption of Fiber Concrete block by varying proportionof Lime and Coconut fiber percentage.

2. To compare the density of Fiber concrete block varying percentage of Lime and Coconut Fiber

3. To find out optimum percentage of replacement of cement by Lime and coconut fiber.

4. To compare the strength characteristics of normal concrete with Lime and coconut fiber concrete.

SCOPE : 1**.** To provide an alternate lightweight material

2. To compare the compressive strength of the lime and coconut fiber with the conventional mix.

3. MATERIALS USED:-

3.1. Lime:

Lime is a calcium-containing inorganic mineral composed primarily of oxides, and hydroxide, usually calcium oxide and/or calcium hydroxide. These materials are still used in large quantities as building and engineering materials (including limestone products, cement, concrete, and mortar), as chemical feedstocks, and for sugar refining, among other uses. Lime industries and the use of many of the resulting products date from prehistoric times in both the Old World and the New World. Lime is used extensively for wastewater treatment with ferrous sulfate.

Table 1: Physical Characteristics of Lime

SR.No.	Properties	Value
1	Optimum Moisture Content (%)	20-23
2	Maximum Dry Density (g/cc) (MDD)	1.89
3	Specific Gravity (G)	1.22

3.2. Coconut Fiber:

Coconut fiber, commonly known as coir, is obtained from the fibrous husk of the coconut. The addition of coconut fiber in concrete improves various engineering properties of concrete. Coconut fiber is treated as natural fiber before using in concrete. Addition of coconut fiber improves the compressive strength, flexural strength and split tensile strength of concrete.

Table 1: Physical Characteristics of Coconut Fibre

SR.No.	Properties	Value
1	Optimum Moisture Content (%)	1.1
2	Maximum Dry Density (g/cc) (MDD)	1.89
3	Specific Gravity (G)	2.65

3.3. Cement:

Cement used in the experiment work is Portland pozzolona cement of grade 53 conforming to IS: 8112: 2013.The properties of cement are shown in following Table.

Table 2: Physical Properties of Cement

Sr.No.	Characteristics	Value
1	Specific Gravity	3.15
2	Standard Consistancy	37
3	Setting Time 1) Initial (Min) 2) Final (Min)	 Min 27 Max 613

3.4. Fine Aggregates:

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone III as per the specification of IS:383:1970

Table 3: Physical Characteristics of fine aggregate

Sr. No	Charactertics	Value
1.	Specific Gravity	2.7
2.	Fineness	2.71

3.5. Coarse Aggregate:

Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates.

Table 4: Physical Characteristics of coarse aggregate

Sr.No	Characteristics	Value
1.	Specific Gravity	2.64
2.	Fineness	6.816

3.6. Water:

Water used was normal water from tap, which was free from salt and confirming the requirement of IS: 456-2000.

4. METHODOLOGY:

Portland Pozzolona cement of grade 53 was used as a binding material which satisfies the requirements according to Indian standards, IS 8112: 2013. Coarse aggregate was obtained from a local quarry work. Sand was sourced from a local supplier in Pandharpur. While Lime and coconut fibre was obtained from a local shop. A concrete mix of ratio 1:1.5:3 by volume was used as control; to which the properties of the other mixes were compared. Lime and coconut fibre was used to replace cement at percentages of 5%, 10%, 15% and 1%, 2%, 3% by weight. A water cement ratio of 0.5 was adopted. Sieve analyses of Lime were carried out by using standard sizes of sieves. Concrete was produced by mixing the constituent raw materials in an electric concrete mixer. Two specimens for every percentage and Four specimens of each mix were produced. Concrete was casted in cast iron moulds measuring 150mm× 150mm× 150mm internally. A total of Twenty Two (22) specimens were casted in accordance with IS: 456-2000. After twenty four (24) hours of casting, the specimens were demoulded and placed in a curing tank until the day of testing. The compressive strengths of the samples were determined at 7 and 28 days of curing using a 1000kn compression testing machine. On the day of crushing, the specimens were removed from the curing tank, wiped clean with a soft towel and placed on the surface of the laboratory for approx two hours before crushing. The densities of the samples were decided by weighing and calculation of volume. The results presented are the intermediate value of three samples of the same mixture. All tests were conducted at the Concrete Technology laboratory in the department of civil engineering of the SVERI's College of Engineering, Pandharpur.

5. RESULTS:

5.1. Compressive Strength

Table 5: Compressive Strength (N/mm^2)

	Percentage Replacement of Lime and Coconut fibre	Compressive Strength at Age(days)	
		7	28
Ordinary	-	12	14.22
Lime	05%	13.33	17.17
	10%	15.11	18.89
	15%	8.89	12
Coconut Fibre	1%	12	16.22
	2%	15.55	18.88
	3%	6.67	9.77

It is seen from table 5 that for the control mix, the compressive strength of concrete at Lime 05% ,10%, 15% replacement increased from at 7 days 13.33 N/mm^2 , 15.11 N/mm^2 , 8.89 N/mm^2 at 28 days to 14.22 N/mm^2 ,17.17 N/mm^2 , 18.89 N/mm^2 and Coconut fibre 1%,2%,3% replacement increased from at 7 days 12 N/mm^2 ,15.55 N/mm^2 ,6.67 N/mm^2 at 28 days 16.22 N/mm^2 ,18.88 N/mm^2 ,9.77 N/mm^2 .

Table 5.1: Compressive Strength (N/mm^2)

Percentage Replacement of Lime	Percentage Replacement of Coconut Fibre	Compressive Strength at Age(days)	
		7	28
5%	1%	15.67	19.56
10%	1%	18.44	22.67
5%	2%	16.22	18.70
10%	2%	18	21.54

It is seen from table 6 that for the control mix, the compressive strength of mix concrete at 5% and 1% mix replacement increased from at 7 days 15.67 N/mm^2 at 28 days to 19.56 N/mm^2 at 28 days .Similarly, at 10% and 1% replacement the compressive strength increased from at 7 days 18.44 N/mm^2 at 28 days 22.67 N/mm^2. Similarly, at 5% and 2% replacement the compressive strength increased from at 7 days 16.22 N/mm^2 at 28 days 18. N/mm$^{2.}$ Similarly, at 10% and 2% replacement the compressive strength increased from at 7 days 18 N/mm^2 at 28 days 21.54 N/mm^2

6.2 Density:

Table 5.2: Density(kg/m^3)

	Percentage Replacement of Lime and Coconut fibre	Density at days	
		7	28
Ordinary	-	2536.29	2625.15
Lime	05%	2530.37	2634.52
	10%	2447.40	2552.3
	15%	2542.22	2659.56
Coconut Fibre	1%	2459.25	2570.61
	2%	2448.6	2549.25
	3%	2458.96	2510.86

It is seen from table that for the control mix, the Density of concrete at Lime 05% ,10%, 15% replacement increased from at 7 days 2530.37 kg/m^3,2447.4 kg/m^3 , 2542.22 kg/m^3 at 28 days to 2634.52 kg/m^3,2552.3 kg/m^3 , 2659.56 kg/m^3 and Coconut fibre 1%,2%,3% replacement increased from at 7 days to 2459.25 kg/m^3,2448.6 kg/m^3 , 2458.96 kg/m^3 ^{2} at 28 days to 2570.61 kg/m^3,2549.25 kg/m^3 , 2510.86 kg/m^3 .

Table 5.3: Density(kg/m^3)

Percentage Replacement of Lime	Percentage Replacement of Coconut Fibre	Density at days	
		7	28
5%	1%	2484.62	2515.36
10%	1%	2569.42	2550.15
5%	2%	2463.22	2510.45
10%	2%	2498.47	2467.53

It is seen from table that for the mix, the density of mix concrete at 5% and 1% mix replacement increased from at 7 days 2484.62 kg/m^3 at 28 days 2515.36 kg/m^3 at 28 days .Similarly, at 10% and 1% replacement the Density increased from at 7 days 2569.42 kg/m^3 at 28 days2615.61 kg/m^3. Similarly, at 5% and 2% replacement the Density

increased from at 7 days 2463.22 kg/m^3 at 28 days 2586.7 kg/m^3 .Similarly, at 10% and 2% replacement the Density increased from at 7 days 2498.47 kg/m^3 at 28 days 2614.54 kg/m^3

5.4 Water Absorbtion :

Table No.5.4: Water Absorption

	% Replacement	Water Absorbtion %
Lime	5%	2.20
	10%	3.54
	15%	4.15
Coconut Fibre	1%	0.89
	2%	1.17
	3%	1.42

Table No.5.4: Water Absorbtion

Percentage Replacement of Lime	Percentage Replacement of Coconut Fibre	Water Absorption %
5%	1%	2.254
10%	1%	3.765
5%	2%	2.981
10%	2%	3.945

7. CONCLUSIONS :

1. In this project study we are replaced cement by Lime and coconut fibre in 5% , 10% ,15% and 1%, 2%, 3% and mix 5%-1%, 5%-2%, 10%-1% and 10%-2% respectively. The maximum compressive strength obtained for the concrete mix design containing the replacement of cement by 10%-1%, 10%-2% with Lime and Coconut fibre.

2. As the percentage of Lime and Coconut fibre increases bonding between cement and aggregate reduces.

3. From the result, we have obtained appropriate replacement percentage for Lime and Coconut fibre. It is around 10% and 2%.

4. However more than 10 percentage replacement is not satisfactory as it affects the strength of the blocks.

5. As the amount of Lime and Coconut fibre increase the density of the concrete decrease.

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