

“A Review on Concrete using coir fibers as replacement for Sand”

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Abstract—*The rising cost of construction material is a matter of concern hence, the high cost of conventional construction material affects economy of structure. Therefore the coconut fibre as partial replacement for fine aggregate in concrete is studied. For this study, coconut fibres were used as they are freely available in large quantities. The study comprises of comparative statement of properties of coconut fibre reinforced concrete with conventional concrete based on experiments performed in the laboratory. The use of coconut fibres will also lead to better management of these waste fibres. Lack of raw materials and their increased cost is a matter of concern. The reason behind that is increased demand of construction materials like cement, aggregates which are the major ingredients of concrete. Hence the number of researches and experimental investigations are conducting to find the suitable alternative materials for concrete ingredients. In this manner the study was conducted on concrete by partial replacement of coconut fibre as fine aggregate.*

In this study M25 grade concrete was produced with the 5 mix proportions (0%, 20%, 40%, 60%, 80%) replacement partially the coir fibre with weight of fine aggregate. Total 90 specimens (30 cubes, 30 cylinders & 30 prisms) were casted for comparative analysis between conventional concrete, manufactured sand concrete and coir fiber replaced concrete by conducting compressive, split tensile and flexural strength tests at 7 days and 28 days respectively.

Workability of concrete was decreased with an increase of fibre fraction, but flexural strength and compressive strength increased with the addition of coir up to some extent. The results and observations attained from this study concludes that, addition of coir fibre increases the crack resistance of concrete, produces the structural light weight material and the suitable alternative partial replacement of coconut fibre as fine aggregate in order to overcome the lack of that. Hence the coir fibre can be used in construction and can reduce environmental waste by proper utilization. Also the use of coir fibre is cost effective and eco friendly.

Keywords : Coir Fibres, Fine Aggregate, Compression, Split Tensile Strength, Flexural Strength

I. INTRODUCTION

Natural fiber such as coconut fiber has certain physical and mechanical characteristics that can be utilized effectively in the development of reinforced concrete material. In most cases, these coconut fibers are dumped as agricultural waste, so can be easily available in large quantity hence making them cheap.

Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fibre is Coir, Cocos nucifera and Arecaceae (Palm), respectively.

There are two types of coconut fibres, brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance. White fibres are smoother and finer, but also weaker. Coconut fibres are commercially available in three forms, namely bristle (long fibres), mattress (relatively short) and decorticated (mixed fibres). These different types of fibres have different uses depending upon the requirement. In engineering, brown fibres are mostly used. Use of coconut fiber can lead to improvement in properties of cement concrete in addition to providing a proper solution for disposal of this natural waste. This study will comprise of the comparative statement of properties of coconut fibre concrete with conventional concrete.

The advantage of using such fibres provides generally a low cost construction and the elimination of the need for waste disposal in landfills. Utilization of these fibres in concrete leads to an effective solid waste management Technique. The introduction of fibres is a solution to develop concrete with enhanced Compressive Strength and Split tensile strength, which is a new form of binder that could combine Portland cement in bonding with cement

II. LITERATURE REVIEW

Slate FO (1976) Investigated compressive and flexural strength of coconut fibre reinforced mortar. Two cement-sand ratios by weight, 1:2.75 with water cement ratio of 0.54 and 1:4 with water cement ratio of 0.82 were considered. Fibre content was 0.08%, 0.16% and 0.32% by total weight of cement, sand and water. The mortars for both design mixes without any fibres were also tested as reference. Cylinders of 50 mm diameter and 100 mm height and beams of 50 mm width, 50 mm depth and 200 mm length were tested. The curing was done for 8 days only. It was found that, compared to that of plain mortar of both mix designs, all strengths were increased in the case of fibre reinforced mortar with all considered fibre contents. However, a decrease in strength of mortar with an increase of fibre content was also observed.

Cook et al (1978) reported the use of coconut fibre reinforced cement composites as low cost roofing materials. The parameters studied were fibre lengths (2.5, 3.75 and 6.35 cm), fibre volumes (2.5%, 5%, 7.5%, 10% and 15%) and casting pressure (from 1 to 2 MPa with an increment of 0.33 MPa). They concluded that the optimum composite consisted of fibres with a length of 3.75 cm, a fibre volume fraction of 7.5% and is casted under the pressure of 1.67 MPa. A comparison revealed that this composite was much cheaper than locally available roofing materials.

III. EXPERIMENTAL PROGRAMME

3.1 Materials used

In this experimental study, cement, aggregates, coir fibres are used.

Cement

Ordinary Portland Cement (OPC) of 53 grade with specific gravity of 3.15 was used in this experiment.

Sand

Locally available sand of specific gravity 2.55 passing through 4.75 mm IS sieve was used.

Coarse aggregate

Coarse aggregate of specific gravity 2.75 passing through 10 mm sieve and retaining on 4.75mm sieve was used.

Water

Potable water free from impurities was used.

Coconut fibre

Coconut fiber was used as alternative partial replacement agent for natural river sand as fine aggregate. Coir fiber was obtained from local coir industrial plant. Obtained coir fiber was chopped into 1cm, 1.5cm, 2 cm, and 2.5cm and replaced with natural river sand by weight of 20%, 40%, 60%, 80% fine aggregate .

IV. EXPERIMENTAL METHODOLOGY

4.1 Compressive strength test

In this test, the specimens of 150 X 150 X 150 mm were cast for M25 grade concrete. The percentage of coir fibres added were 0, 20, 40, 60 and 80% by weight of fine aggregate. After 24 hours the specimens were shifted to curing tank to cure for 7 and 28 days. After the curing period the cubes were tested in UTM. The compressive strength is noted. In each category 3 cubes were tested and their average value is reported.

4.2 Split Tensile strength test

In this test, the specimens of 150 X 300 mm were cast for M25 grade concrete. The percentage of coir fibres added were 0, 20, 40, 60 and 80% by weight of fine aggregate. After 24 hours the specimens were shifted to curing tank to cure for 7 and 28 days. After the curing period the cylinders were tested in UTM. The split tensile strength is noted. In each category 3 cylinders were tested and their average value is reported.

4.3 Flexural strength test

In this test, the beam specimens of dimensions 500 X 100 X 100mm were cast. . The percentage of coir fibres added were 0, 20,40,60 and 80% by weight of fine aggregate. After 24 hours the specimens were shifted to curing tank to cure for 28 days. These specimens were tested under 2 point loads. In each category 3 prisms were tested and their average value is reported.

V.EXPERIMENTAL RESULTS

5.1 Compressive strength

Table 5.1 Compression test values for 7 and 28 days

COMPRESSIVE STRENGTH:

7 DAY	TEST 1	TEST 2	TEST 3
0% CF	17.65	18.08	17.87
20%CF	18.74	18.74	18.96
40%CF	19.83	20.26	20.05
60% CF	20.70	20.48	20.70
80%CF	20.05	20.26	19.83
28 DAY	TEST 1	TEST 2	TEST 3
0% CF	26.81	26.15	27.02
20%CF	28.11	27.68	28.11
40% CF	29.20	28.98	29.43
60%CF	30.95	30.95	30.33
80%CF	30.29	30.51	29.64

5.2 Split Tensile Strength Test

Table 5.2 Split Tensile Strength test values for 7 and 28 days

SPLIT TENSILE STRENGTH:

7 DAYS	TEST 1	TEST 2	TEST 3
0% CF	1.7	1.8	1.7
20%CF	1.8	1.9	1.8
40%CF	1.9	2.0	2.0
60% CF	2.5	2.1	2.2
80%CF	2.0	2.0	1.9
28 DAYS	TEST 1	TEST 2	TEST 3
0% CF	2.6	2.6	2.7
20%CF	2.8	2.7	2.8
40% CF	2.9	2.8	2.9
60%CF	3.2	3.2	3.0
80%CF	3.0	3.0	2.9

5.3 Flexural strength

Table 5.3 Flexural strength test for 7 and 28 days

FLEXURAL STRENGTH:

7 DAY	TEST 1	TEST 2	TEST 3
0%CF	22.56	22.56	23.05
20%CF	24.03	23.54	23.55
40%CF	24.52	25.50	26.48
60%CF	26.97	27.46	28.44
80%CF	24.03	24.52	23.54
28DAYS	TEST 1	TEST 2	TEST 3
0%CF	35.80	35.31	36.29
20%CF	36.78	35.80	36.78
40%CF	37.76	38.25	37.27
60%CF	38.25	38.74	38.25
80%CF	37.27	36.78	36.29

VI CONCLUSIONS

1. Coconut fiber being low in density tends to reduce the self-weight of the fiber reinforced concrete hence it can be used as a structural light weight concrete.
2. By reinforcing the concrete with coconut fibers environmental waste can be reduced and due to vast availability we can achieve economy.
3. Addition of coir fiber in concrete increases crack resistance property of concrete as well as reduces the brittle nature of concrete.
4. Flexural strength of concrete increases with addition of 60% coir fibre by comparing with normal and manufactured sand replaced concrete.
5. Hand mixing is very difficult and leads to formation of non-homogeneous mix. So it's better and convenient to replace hand mixing by machine mixing.
6. Since, 20% and 40% fiber replacement doesn't shows favourable results, hence it can be concluded that optimum fiber percentage replacement for sand is 60%.

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