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IMPROVEMENT OF STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH COCONUT SHELL AND FINE AGGREGATE WITH COIR FIBRE

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ABSTRACT

The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources. These include the use of by-products and waste materials for building construction. The utilization of coconut shells and coir fiber as a partial replacement for fine and coarse aggregates has been investigated in this study. This research work includes the experimental study of using locally available coconut shells as partial replacement with coarse aggregates and coir fiber obtained from metal casting industries as partial replacement with sand to achieve maximum compressive strength of concrete. At the moment, 90% of this waste is disposed of to landfill as non-hazardous waste while only 10% is beneficially reused. In the present study, steps have been taken to partially replace the fine aggregate with coir fiber. The use of coconut shells and coir fibre sand in concrete will considerably decrease the scarcity of natural aggregates. Because of this reason coconut shells and coir fiber are utilized as partial replacement in fine and coarse aggregates in concrete with 0%, 5% + 5%, 10% +10% , 15%+15%, and 20%+ 20% substitution in M_{30} grade concrete. These were casted and tested for compressive strength and Flexural strength after a curing period.. Based on the results presented in this project, it can be concluded that concrete mixture can be prepared with coir fiber sand and coconut shells as partial replacement to improve the strength of concrete structure.

Keywords: *Coconut shells, Coir fiber, Compressive strength, Flexural strength, Fine aggregates, coarse aggregates.*

I. INTRODUCTION

The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources. These include the use of by-products and waste materials for building construction.

The high cost of regular building materials is a main consideration influencing development in India. In creating nations where plentiful agrarian and modern squanders are released, these squanders can be utilized for different purposes in development industry. This will have twofold the preferences, diminishment in the cost of development material and furthermore as a methods for transfer of squanders. In this way the approach is coherent, commendable and inferable. Thusly an Endeavour has been made in this investigation to use the coconut shell and fly ah as fractional substitution of coarse total and bond in the improvement of light weight concrete. So an examination on different quality and strength properties of these materials is required. Additionally reasonable measures must be received for accomplishing the objective quality.

Coconut Shell (CS) are not ordinarily utilized as a part of the development business but rather are frequently dumped as agrarian squanders. Coconut is developed in 92 nations with a worldwide generation of 51 billion nuts of which India produces 9500 kilo ton of coconut. In India, ventures and casual segments reuse around 15-20% waste in different building material.

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Table 1. Availability of coconut shells

S.No	Country	Coconut Production 2012 (metric tonnes)	% of World Total
1	Indonesia	18,000,000 t	30.0%
2	Philippines	15,862,386 t	26.4%
3	India	10,560,000 t	17.0%
4	Brazil	2,888,532 t	4.8%
5	Sri lanka	2,000,000 t	3.3%

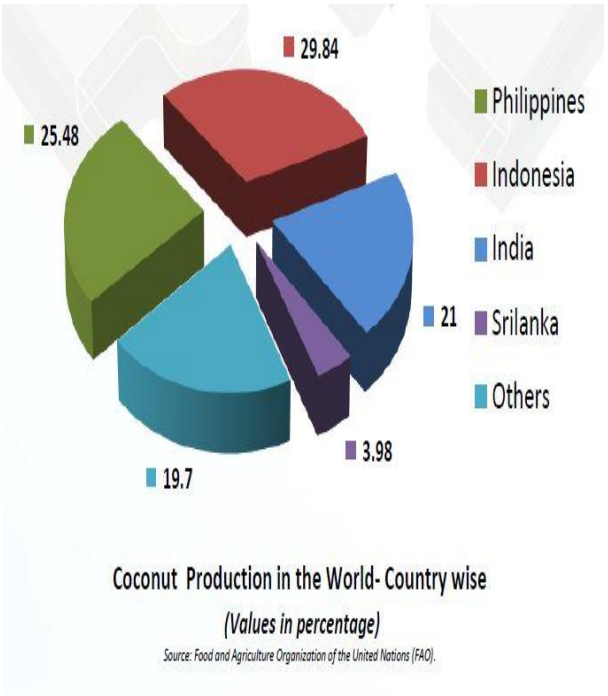

Figure 1: Coconut production in the world

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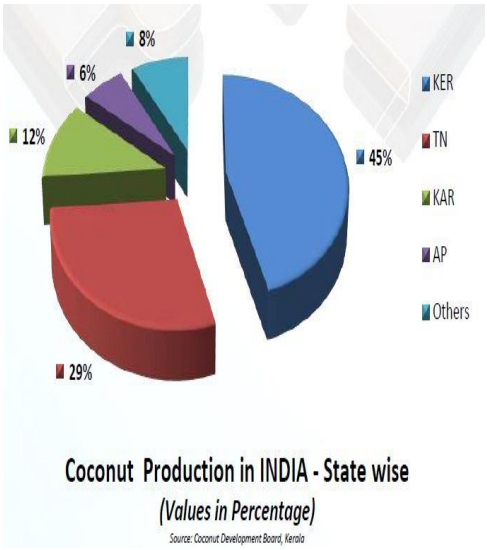

Figure 2: Coconut production in India- state wise

1.1 Scope of the Work

The aim of this study is to assess the utility and efficacy of coconut shells as a replacement for coarse aggregate and Coir fibre as a replacement for sand as an alternative to natural aggregate in concrete.

1.2 Objectives of the Research

Objectives of the experimental investigation are as follows:

It is aimed to study the performance of coconut shell and coir fiber concrete with respect to the strength and durability properties.

1) To study the properties of fresh coconut shell concrete.

2) To study mechanical properties such as compressive and Flexural strength at the end of 7,14 and 28 days of curing by partially replacing Coarse aggregate by coconut shell and fine aggregate with coir fibre under normal curing with no chemical admixture.

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3) To investigate the feasibility of the combination of coconut shell and coir fiber in concrete by determining its compressive and Flexural strength.
4) To reduce environmental pollution by utilizing waste material in concrete.

II. MATERIALS

Cement: OPC 53 grade cement from a single batch will be used throughout the course of the project work. The properties of cement used are shown in table below.

Table 2. The properties of cement

S NO	PHYSICAL PROPERTIES	TEST RESULTS
1.	Specific Gravity	1.97
2.	Water absorption	31.06%
3.	Bulk density(g/cc) (loose condition)	0.49g/cc
4.	Bulk density(g/cc) (compacted condition)	0.58g/cc
5.	crushing value	1.25%
6.	Impact value	1.80%
7.	Fineness Modulus	7.502
8.	Shell Thickness	2-7mm

Coconut Shell: Coconut shell is acquired from sanctuaries and so forth they were sun dried for least 1 month before utilizing pulverized physically. The molecule size of the coconut shell run from 5mm to 12.5 mm. The assimilation of water in the solid won't influence its strength since lesser voids can be shaped. Dampness holding and water engrossing limit of Coconut Shell are more contrasted with ordinary total and furthermore accessibility of coconut shell will be as per the following:

Table 3: The properties of coconut shells

S.NO	PHYSICAL PROPERTIES	TEST RESULTS
1.	Specific Gravity	3.10
2.	Standard Consistency	33%
3.	Initial Setting Time	33 minutes.
4.	Final Setting Time	356 minutes.
5.	Fineness of Cement	2%

Coarse aggregate: The coarse aggregate decided for coconut shell Concrete ought to be very much evaluated and littler regarding the most extreme size than that utilized for customarily vibrated solid (NC). For run of the mill traditional solid (NC) the coarse aggregate might be 20 mm and significantly more all in all.

The adjusted totals and littler size of total particles enhance the Flow capacity, deformability and isolate protection of CSC. The degree is an essential factor in picking a coarse total, where, exceptionally congested fortification examples are utilized and where, little dimensional components are to be delivered. If there should be an occurrence of regular solid (NC), the extent of the coarse total relies on the kind of the development. Like if there should arise an occurrence of traditional solid (NC), size of total has a key note to play in CSC outlines too. Subsequently, thinks about are expected to survey the most extreme size of total for a specific review of cement. More often than not, the greatest size of the coarse total utilized as a part of creation of CSC, extends around in the vicinity of 10mm and 20mm. The pulverized total was utilized from the nearby quarry. In this examination the total was utilized of 20mm down and tried according to Seems to be: 2386-1963(I, II, III) determination. The properties of coarse total are appeared in Table underneath:

Table 4: properties of coarse aggregate

S.NO	PHYSICAL PROPERTIES	TEST RESULTS
1	Specific Gravity	2.70
2	Water absorption	2.22%
3	Bulk Density	1.68
4	crushing value	13.98%
5	Impact value	12.71%
6	Fineness Modulus	7.89

Fine Aggregate: All typical stream sands are appropriate for CSC. Both smashed and adjusted sands can be utilized. Siliceous and calcareous sands can be utilized for creation of CSC. The measure of fines under 0.125mm is to be considered as powder which is essential for the CSC. A base measure of fines must be kept up to keep away from isolation. The measure of fines has an exceptionally noteworthy impact on CSC blend extents. Fine sand requires more water and Super plasticizer (SP), however less filler than coarse sand. The SP measurements, water substance and bond/filler substance could be balanced by treating the fines (>150 um) in sand as a component of the filler. The properties of sand utilized as a part of this investigation are given underneath:

Table 5. Properties of fine aggregate

S.NO	PHYSICAL PROPERTIES	TEST RESULTS
1	Specific Gravity	2.60
2	Water absorption	0.87%
3	Bulk Density	1.61 g /cc
4	Silt Content	2.67 %
5	Impact value	12.71%
6	Fineness Modulus	3.82

Water: The water used for making concrete should be free from undesirable salts that may react with cement and admixture and reduce their efficiency. Silts and suspended particles and undesirable as they interfere with setting, hardening and bond characteristics. Algae in mixing water may cause a marked reduction in strength of concrete either by combining with cement to reduce the bond or by causing large amount of air entrainment in concrete.

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Water conforming to the requirements of BIS: 456-2000 is found to be suitable for making concrete. It is generally stated that water fit for drinking is fit for making concrete.

Coir fibers: Locally available waste materials were collected from different and properly shaped in the form of fibers. Uniform length of fibers was obtained by using cutting machine. Typical properties of fiber shown in table

Table 6: Properties of coir fiber

Properties of coir fiber	
Diameter in mm	**0.47**
Aspet ratio	**104.2**
Specific Gravity	**0.87**
Water absorption	**22.6**
Density in Kg/m3	**2057**

III. MIX DESIGN PROCEDURE

mix proportions M_{30} grade IS
Cement = 438 kg/m3
Water = 197 kg/m3
Fine aggregate = 673 kg/m3
Coarse aggregates = 1093 kg/m3
Water cement ratio = 0.45
RATIO = 1: 1.53 : 2.49
C F.A C.A

Mix Proportion for different samples

1) Normal concrete = 0% Replacement
2) CCC 1 = 5% coconut shell (95% Coarse Agg) + 5% coir fibers (95%Fine Agg)+Cement
3) CCC 2 = 10% coconut shell (90% Coarse Agg) + 10% coir fibers (90% Fine Agg)+Cement
4) CCC 3 = 15% coconut shell (90% Coarse Agg) + 15% coir fibers (90% Fine Agg)+Cement
5) CCC4 = 20% coconut shell (90% Coarse Agg) + 20% coir fibers (90% Fine Agg)+Cement

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Sieving of coconut shell pieces

Figure 3. Breaking & sieving of coconut shells to required size.

IV. EXPERIMENTAL RESULTS

1. Compressive strength of cubes of size 15x15x15cm is tested after 3,7,28 days

Table 7: Compressive strength of concrete cubes for 3,7,28 days

S.No	MIX	% of coir fibres	% of Coconut Shell	Compressive stress (kN/m^2)		
				7 days	14 days	28 days
1	M-30	0.0%	0.0%	19.56	25.82	29.88
2	M-30	5 %	5 %	20.11	27.34	30.22
3	M-30	10%	10 %	20.50	28.06	31.55
4	M-30	15 %	15 %	21.60	29.89	33.21
5	M-30	20%	2 0%	18.63	25.95	29.66

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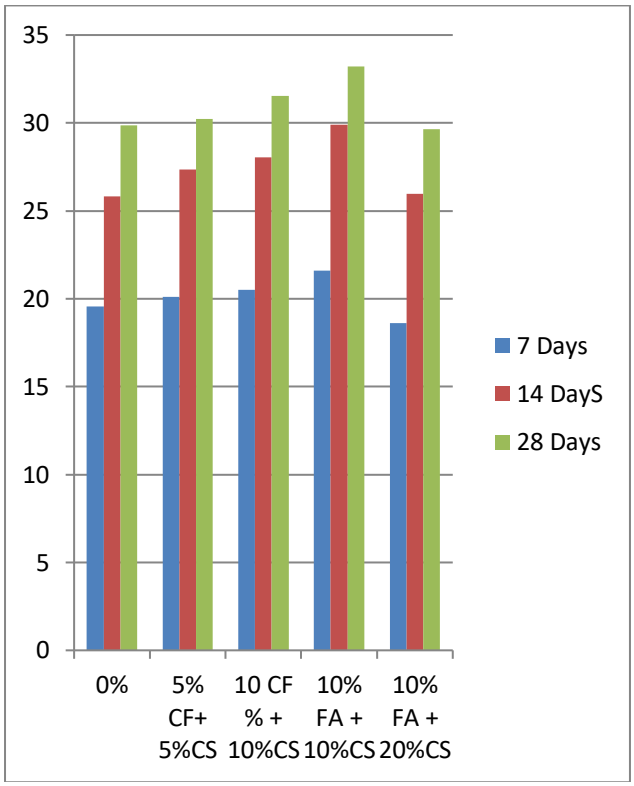

Figure 4. Graph shows the compressive strength of cubes after 7, 14, 28 days

2. Split Tensile Test of Cylinders of Size 15x30 cm after 7 and 28 days

Table 8: Split tensile test results of concrete cylinders for 7, 28 days

S. No	MIX	% of coir fiber	% Of Coconut Shell	Split Tensile strength (N/mm^2)	
				7days	28days
1	M-30	0.0%	0.0%	2.24	3.29
2	M-30	5 %	5 %	2.31	3.72
3	M-30	10%	10 %	2.61	4.07

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4	M-30	15%	15%	2.93	4.86
5	M-30	20%	20%	2.22	3.10

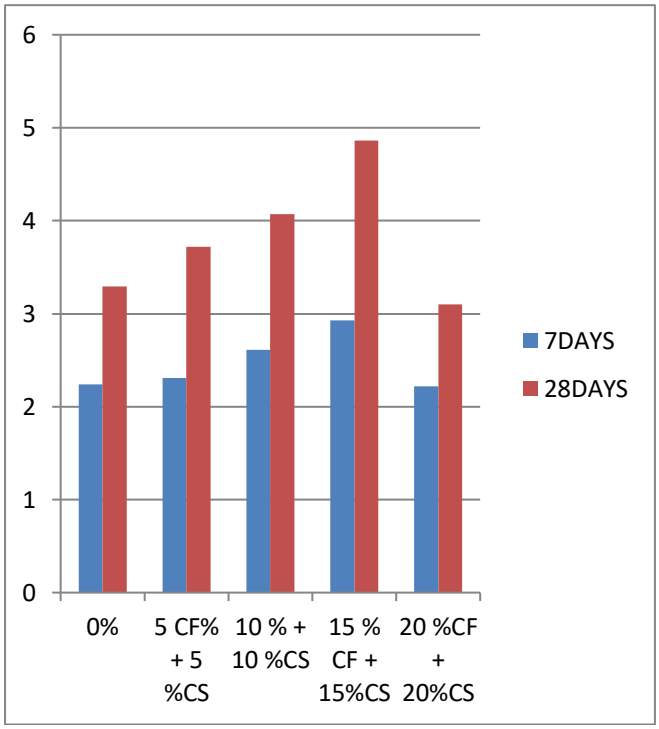

Figure 5. Graph shows the Tensile strength of cubes after 7, 28 days

3. Flexural tests

Table 9. Flexural test results of concrete beam for 7, 28 days

S.No	MIX	% of coir fibre	% of Coconut Shell	Flexural strength (N/mm^2)	
				7days	28days
1	M-30	0.0%	0.0%	3.94	5.38
2	M-30	5 %	5 %	4.12	6.72
3	M-30	10%	10 %	4.61	7.17

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4	M-30	15%	15%	3.93	6.86
5	M-30	20%	20%	3.43	5.87

Results: Optimum value is obtained at 10 %(coconut shell) +10 %(Coir fiber) of concrete mix

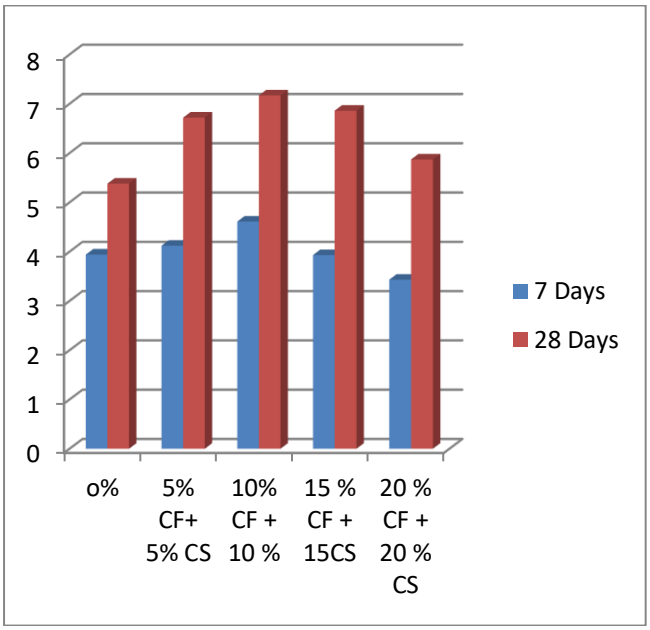

Figure 6. Flexural test results of concrete beam for 7, 28 days

V. CONCLUSION

- "Finally we conclude that using coconut shell and coir fiber as a partial replacement for coarse aggregate and fine aggregate is a good idea for waste disposal
- As the test results are concerned, the compressive strength of concrete for 15 % replacement of coconut shell and 15% coir fiber give High strength.
- We can use this type of concrete in rural areas and according to compressive strength it gave good results at 15% coconut shell and 15% coir fiber replacement.
- The 28-day compressive strength of the concrete using coconut shell and coir fiber aggregate was found to be 33.21 N/mm2 under full water curing and it satisfies the requirement for structural lightweight concrete.
- But the replacement of coconut shells in place of coarse aggregates and replacement of coir fiber in place of fine aggregate will increase the strength properties of concrete
- From the graph it is seen that the compressive strength of concrete will decrease with increase of coconut shell and coir fiber percentage.
- From the graph it is also seen that the Replacement of coconut shell as coarse aggregate and coir fiber with fine aggregate will increase the compressive strength of concrete.

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