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EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY COCONUT SHELLS IN CONCRETE

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Abstract - In the construction, the cost of building materials are rising day by day.the use of alternative material is a partial replace of coarse aggregate in solving part of natural aggregate. The various waste materials are used such as coconut shell, cockle shell, periwinkle shell, foundry sand etc. so here in our project we will use coconut shell waste as replacement of coarse aggregate by different percentage for making concrete of different grade like M-25. Concrete made from coconut shell waste as coarse aggregate will be studied for compressive strength, tensile strength, impact test and flexural strength. the percentage replacement will be 0%, 10%, 20%, 30% and 40% with natural coarse aggregates. We will prepare cubes, cylinders, beams and finally slump test, tensile strength test, compressive strength test, split tensile strength test, impact test strength and flexural strength test will be conducted to obtain the results. A large no. of trial mixes are required to select the desired optimum replacement of coarse natural aggregate by coconut shell waste material.

Keywords: Coconut Shell, Coarse Aggregate, Light Weight Concrete, Light Weight Material, Compressive Strength, Split Tensile Strength, Flexural Strength and impact strength.

I. INTRODUCTION

Concrete is the widely used first number of structural material in the world today. Infrastructure developed across the world created demand for different construction materials. Different waste materials and industrial by products such as fly ash, recycle aggregates, foundry sand, bottom ash, glass ware and coconut shell were replaced with natural aggregate. Using the alternative materials in place of natural aggregate in concrete as sustainable and environmentally friendly construction materials. In India demand of construction aggregate in 2010 was 2210 million metric tons.(in 2015 it will be expected as 3330 million metric tons and after 2020 it will be more than 5075 million metric tons.

II. DESCRIPTION OF MATERIALS

A. Cement

Ordinary Portland cement grade 43, conforming to I.S.12269-1987 was used. The physical property of cement is shown as per table 1.

Table – 1

Basic Result Of Ordinary Portland Cement (OPC)

TEST	RESULT
Initial setting time	45
Final setting time	430
Standard consistency	29
Specific gravity	3

B. Coarse Aggregate:

As coarse aggregate in concrete consist 35 to 70% of volume of the concrete. An aggregate with specific gravity more than 2.55. The physical properties of coarse aggregate are shown in table 2.

Table – 2

Sieve Analysis of Coarse Aggregate (20mm)

Sl. No.	I.S sieve designation	Wt. retained(gms)	Cumulative percentage of wt. retained	percentage of passing
1	20mm	1070	21.4	78.6
2	10mm	3772	96.84	3.16
3	4.75mm	152	99.88	0.12

Table – 3

Test Value of Coarse Aggregate (20 Mm)

S.NO	PROPERTIES	VALUES
1	Size of aggregates	Passing 20mm sieve and 12.5mm retained
2	Specific gravity	2.75
3	Fineness modules	7.38
4	Impact test	8.49%
5	Crushing value test	19.91%

C. Coconut Shell:

Table – 4

Physical Properties of Coconut Shell

TEST	RESULT
Specific gravity	1.13
Water absorption	24.03%

D. Fine aggregate

The fractions from 4.75 mm to 150 microns are termed as fine aggregate. Locally available natural river sand conforming to grading of IS: 383 1970 with specific gravity 2.77 was used as fine aggregate.

Table – 6

Sieve Analysis of Fine Aggregate

Sl. No.	I.S sieve sizes	Weight Retained(gms)	Cumulative percentage of wt. retained	Percentage of passing
1	4.75mm	0	0	0
2	2.36mm	14	1.4	98.6
3	1.18mm	288	30.2	69.8
4	600µ	299	60.1	39.9
5	300µ	281	88.2	11.8
6	150µ	90	97.2	2.8
7	Pan	24	99.6	0.4

Table – 7
Test Value Result of Fine Aggregate

S.NO	PROPERTIES	VALUES
1	Size of Aggregates	Passing through 4.75mm sieve
2	Fineness Modulus	2.77
3	Specific Gravity	2.63
4	Zone	II

III. WORKABILITY TESTS

Slump test is the most commonly used method of measuring workability of concrete which can be employed either in laboratory or at site of work. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of the playability of the concrete. However, it is used conveniently as a control test and gives an indication of the uniformity of concrete from batch to batch. Repeated batches of the same mix, brought to the same slump, will have the same water content and water cement ratio; provided the weights of aggregate, cement and admixtures are uniform and aggregate grading is within acceptable limits. Additional information on workability and quality of concrete can be obtained by observing the manner in which concrete slumps. Quality of concrete can also be further assessed by giving a few tamping or blows by tamping rod to the base plate. The deformation shows the characteristics of concrete with respect to tendency for segregation. The size of slump cone mould is Bottom diameter: 20 cm, Top diameter: 10 cm and Height: 30 cm In slump test of fresh concrete, the each layer of concrete was compacted 25 times with the help of steel rod 0.6m long and 16mm in diameter. The slump cone is removed carefully in the vertical direction without affecting the shape of concrete slump.

IV. TESTS FOR CONCRETE

A. Test for Compressive Strength of Concrete Cubes:

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. The cube specimen is the sizes 100x100x100 mm are used for compression test. These specimens are tested by compression testing machine after 7 days and 28 days curing. The compressive strength test on hardened concrete will be performed on a 2000 KN capacity compression testing machine. Compressive strength=maximum load/area =P/A

B. Test for Split Tensile of Concrete Cylinder:

The tensile strength is one of the basic and important properties of the concrete. The tensile strength test on hardened concrete is performed on a 2000 KN capacity testing machine. Specimen of concrete cylinder is 150 mm diameter x 300 mm height. In the splitting tension test a 150 mm x 300 mm concrete cylinder is subjected to compression loads along two axial lines which are diametrically opposite. In these tests in general a compressive force is applied to a concrete specimen in such a way that the specimen fails due to tensile stresses developed in the specimen. Direct tension test of concrete are seldom carried out, mainly because the specimen holding devices introduce secondary stresses cannot be ignored. The steel plates were placed at the top and bottom between the platens of testing machine and the cylinder. The test consists of applying a compressive line load along the opposite generators of a concrete cylinder place with its axis horizontal between the compressive platens. The measured splitting tensile strength fc, of the specimen shall as below.

$Fc=2p / \pi l d$

Where p= Maximum load in Newton applied to specimen.

l= Length of the specimen.

d=Cross sectional dimension of the specimen.

C. Test for Flexural Strength of Concrete Beams:

Flexural strength is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete beam or slab to resist failure in bending size of concrete beam specimen is 100 mm breadth x 100 mm depth x 500 mm length or 150 mm breath x 150 mm depth x 700 mm length. The flexural strength is expressed as modulus of rupture in Mpa and is determined by standard test methods third point loading or centre point loading. In the central point loading, maximum fibre stress will come below the point of loading where the bending moment is maximum. In case of symmetrical two point loading, the critical crack may appear at any section, not strong enough to resist the stress within the middle third, where the bending moment is maximum. It can be expected that the two point loading will yield a lower value of the modulus of rupture than the centre point loading. I.S. 516-1959, specifies two points loading. The flexural strength of the specimen shall be expressed as the modulus of rupture fb, which, if "a" equals the distance between the line of fracture and the nearer support, measured on the centre line of the tensile side of the specimen, in cm, shall be calculated to the nearest 0.5 kg/sq cm as follows.

Fb = pl / (bd2)

Where b = measured width in cm of the specimen, d = measured depth in cm of the specimen at the point of failure, l = length in cm of the span on which the specimen was supported, p = maximum load in kg applied to the specimen

D. Test for Impact strength

In order to study the Impact Resistance of Concrete a specimen of 150mm diameter and 60mm height is casted with cement; coarse aggregate, fine aggregate and coconut shells. The impact test was carried out using drop weight hammer for cylindrical disc. In drop weight hammer test, the cylindrical discs of 150 mm diameter were placed on the base plate of impact testing machine and then struck with repeated blows. The impact load was applied with a 44.5 N hammer dropped repeatedly from a height of 457 mm onto the discs. In each test recording number of blows to produce first crack (N1) and ultimate crack (N2).

V. RESULTS

The mix proportion for M 25 is and W/C ratio of 0.45 was casted. Slump test was tested when the concrete in fresh concrete. The cubes, beams and cylinders were tested for compressive strength, split tensile strength, Impact strength and flexural strength. These tested were carried out at age of 7 days and 28 days.

A. Workability Test Results:

1) Slump Test:

Table – 8

Slump test

Slump (mm)	
0% coconut shells	120 mm
10% coconut shells	112 mm
20% coconut shells	103mm
30% coconut shells	92 mm
40% coconut shells	81 mm

B. Strength Results:

2) Compressive Strength Test Results:

Table – 9

Compressive Strength Test Results

% REPLACEMENT	CUBE STRENGTH AT 7 DAYS (N/mm2)	% DECREASE IN STRENGTH AT 7 DAYS	CUBE STRENGTH AT 28 DAYS (N/mm2)	% DECREASE IN STRENGTH AT 28 DAYS
0	21.7	-	34.5	-
10	18.25	16	31.5	9
20	15.56	28	29.4	15
30	13.27	39	27.5	20
40	11.5	47	25.3	26

3) Flexural Strength Test Results:

Table – 10

Flexural Strength Test Results

% REPLACEMENT	STRENGTH AT 28 DAYS (N/mm2)	DECREASE IN STRENGTH (N/mm2)
0	5.5	-
10	4.72	14
20	3.29	29
30	2.75	44
40	2.19	50

4) Split Tensile Strength Test Results:

Table – 11

Split Tensile Strength Test Results

% REPLACEMENT	STRENGTH AT 28 DAYS (N/mm2)	DECREASE IN STRENGTH (N/mm2)
0	2.11	-
10	2.01	5
20	1.82	14
30	1.44	32
40	1.29	39

5) Impact test:

Table – 12

Impact Test Strength Results

% REPLACEMENT	Average No. of Drops at First Crack (N1)	Average No. of Drops at Failure Crack (N2)	(N2-N1)
0	14	19	5
10	11	15	4
20	8	12	4
30	7	10	3
40	5	8	3

6) Shear strength test:

Table - 13

Shear strength test results

% REPLACEMENT	STRENGTH AT 28 DAYS (N/mm2)	DECREASE IN STRENGTH (N/mm2)
0	16.21	-
10	14.5	11
20	12.39	23
30	10.56	35
40	8.35	48

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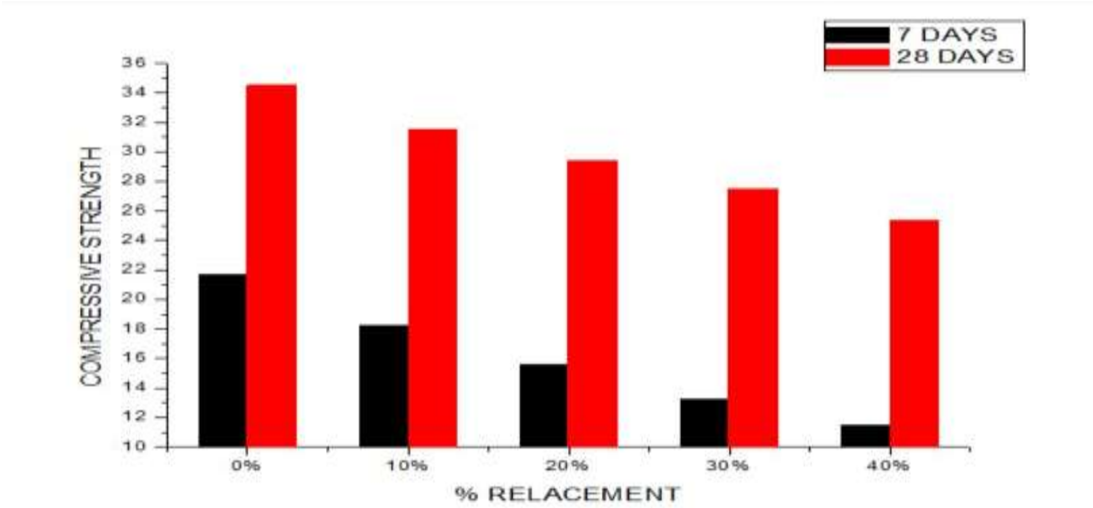
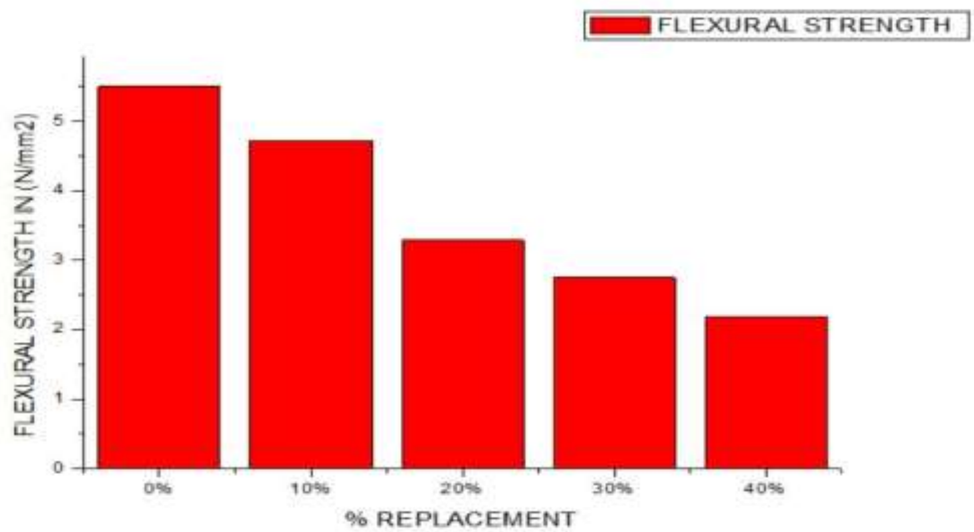
C. Bar Charts:

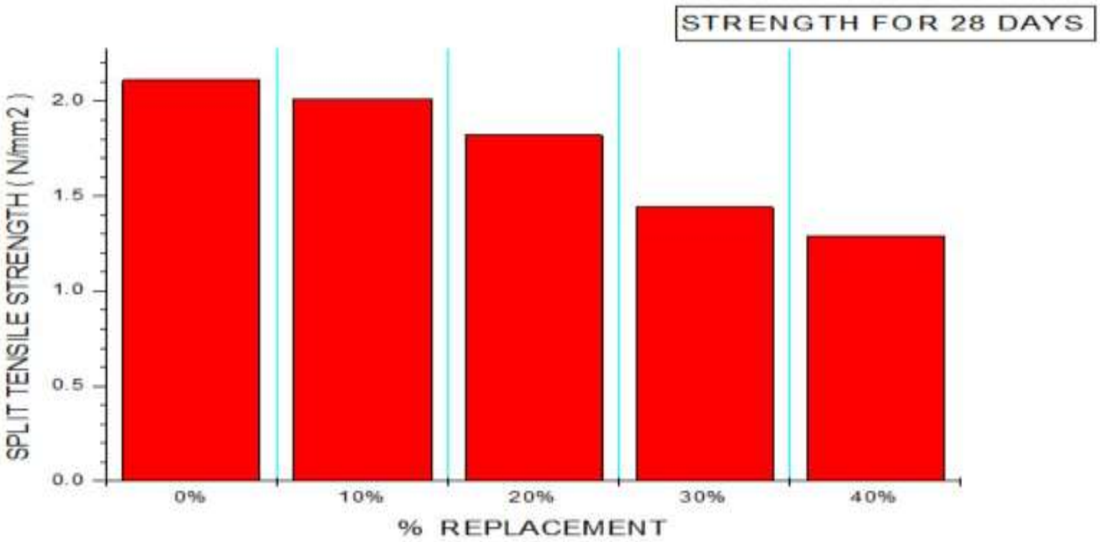
Graph 1: Slump Test Results For Conventional And % Cs



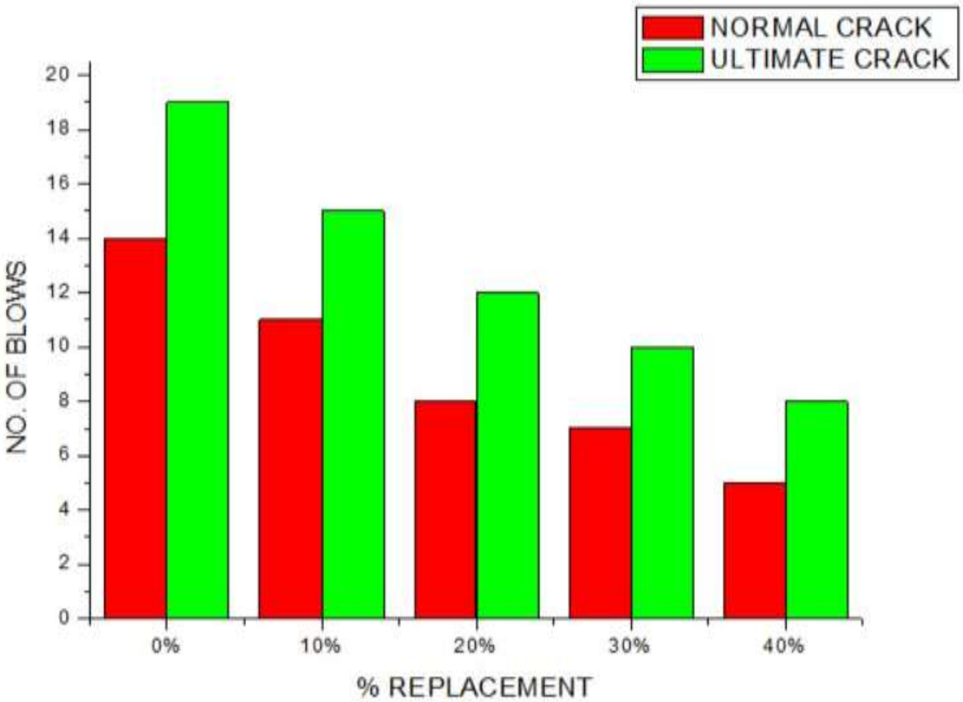
Graph 2: Compressive Strength Results For M 25 At 7 and 28 days



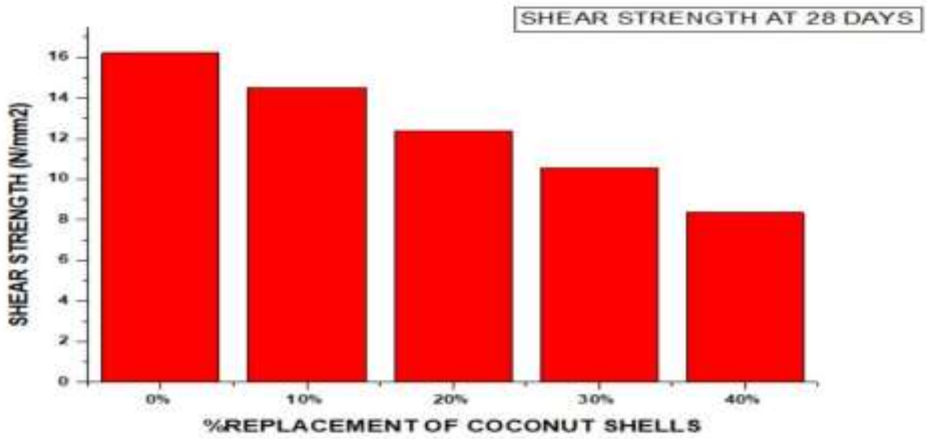
Graph 3: flexural strength at 28 days



Graph 4: Split tensile strength at 28 days



Graph 5: Impact Strength test At 28 days



Graph 6: Shear Strength test At 28 days

VI. CONCLUSIONS

In this study the strength characteristics of concrete produced by volume replacement of 10%, 20%, 30%, and 40% replacement of crushed aggregate with coconut shells were investigated:

- It was observed that compressive strength was found to be descending for replacements, the compressive strength decreased by 47% for 7 days and 27% for 28 days.
- It was observed that split tensile strength was found to be descending for replacements, the split tensile strength decreased by 39% for 40% replacement.
- It was observed that flexural strength was found to be descending for replacements, the flexural strength decreased by 50% for 40% replacement.
- As the % of coconut shell increases the number of blows for normal and ultimate crack decreases.
- For increase in the percentage of coconut shells, the difference in number of blows between initial and ultimate crack reduces.
- It was observed that shear strength was found to be descending for replacements, the shear strength decreased by 48% for 40% replacement.
- It was observed that all three parameters i.e. Compressive strength ,split tensile strength and flexural strength decreased with increasing the coconut shell content in aggregates.

FUTURE SCOPE

- Durability tests on CS which may take around a year to complete can be conducted as a future work.
- Experiments on impact value and crushing value etc can be done in order to analyse strength properties of coconut shells.
- Action of coconut shell aggregates in cement matrix is also an area requiring future research.
- We can also study about the use of coconut shell aggregates along with other non conventional aggregates like palm kernal shells, volcanic debris etc.

VII. REFERENCES

- Amarnath Yerramala Ramachandrudu C, Properties of Concrete with Coconut Shells as Aggregate Replacement, International Journal of Engineering Inventions, vol.1, Issue 6, October 2012.
- Concrete technologyA.M. Neville. Properties of concrete, Person Edition 2006.

- A. Vishwas P. Kukarni. Volume 2, 12, June (2013), "Comparative study on coconut shell aggregate with conventional concrete".
- IS 10262:1982, "Recommended Guidelines For Concrete Mix Design".
- Adeyemi AY.,(1998) ," An investigation into the suitability of coconut shells as aggregates in concrete production" ,Journal of Environment, Design and Management
- J. P. Ries, J. Speck, (2010), "Lightweight Aggregate Optimizes the Sustainability of Concrete", Concrete Sustainability Conference, National Ready Mixed Concrete Association.
- Dewansu Ahlawat and L.G.Kalurkar, "coconut shell as partial replacement of coarse aggregate in concrete,"IOSR journal of mechanical and civil engineering, vol.4, issue 6,December 2014.