Comparison of Properties of Conventional Concrete with Light Weight Concrete Mix Prepared by Partial Replacement of Coarse Aggregate

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Abstract— The rising value of construction materials in many countries needs to research and implement of different alternative materials in civil engineering construction. In India concerning 890 million tones of solid wastes are being generated annually as byproducts throughout industrial and agricultural. The above wastes can be used as aggregate in concrete for production of light weight concrete. A mid this study, coconut shell is utilized as light weight mix in concrete. The undertaking paper goes for examining compressive strength characteristics with partially replacement of coarse aggregate combination with coconut shell to supply light weight concrete with partially different percentage (0%, 15%, and 30%) to urge smart strength like standard concrete. 18 concrete cubes are casted with mix proportion (1:1:2) and their mechanical properties are determined and compared with standard concrete.

Key words: Light Weight Concrete, Coconut Shell, Compressive Strength

I. INTRODUCTION

Lightweight concrete is the type of concrete which includes an expanding agent in that it increases the volume of the mixture and lessened the dead weight. It is lighter than the conventional concrete. It was first introduced by the Romans in the second century. Lightweight concrete or reduced density concrete, is defined as a cement based slurry, with a minimum of 20% (per volume) foam entrained into the plastic mortar. The density of this concrete usually varies from 400 kg/m³ to 1600 kg/ m³. Although lightweight concrete has so many advantages and superiorities over ordinary concrete, thus, the usage of this type of concrete is not as common as ordinary concrete. The reasons for low usage of lightweight concrete are the high prices of aggregates in countries whose lightweight aggregate resources are poor, lack of experience, and knowledge of workers about lightweight concrete.

II. LITERATURE REVIEW

P.C.Taylor, presently a professor at Wuhan University of Technology (2014) has said that mineral admixtures affect the physical and mechanical properties of High Strength Structural Light Concrete. Addition of Fly Ash enhances the Compressive strength when fly ash was more than 20% in cementitious materials.

N.P. Rajamani and P.S. Ambily, scientist, SERC, Chennai(2012)carried out the research work on "Selection of mortar for light weight aggregate concrete made with fly ash based aggregate". They concluded that conversion of fly ash with aggregate is technically feasible and are found to be light weight in nature. They found fly ash aggregate concrete up to 20Mpa can be used for production of concrete blocks for masonry construction in structures.

Prof. JayeshkumarPitroda, Dr. L.B.Zala, Dr. F. S. Umrigar (2013) carried out the research work on "Experimental investigations on partial replacement of cement with fly ash in design mix concrete". They found that Compressive strength reduces when cement replaced fly ash. Use of fly ash in concrete can save the coal & thermal industry disposal costs and produce a 'greener' concrete for construction.

AmarnathYerrmalla (2012) studied the strength of coconut shells (CS) replacement and different and study the transport properties of concrete with CS as coarse aggregate replacement. They concluded that

- Increase in CS percentage decreased densities of the concrete.
- With CS percentage increased the 7 days strength gain also increased with corresponding 28 days curing strength.

Jyoti Kamal, Proff. J.P. Singh, P.G Student , Dept of Civil Engg, B.I.T Sindri, Dhanbad, (2015) carried out the 1Experimental Study on "Strength Characteristics of M25 Concrete with Partial Replacement of coarse aggregate with coconut shell and cement with Fly Ash". They concluded that

- Increase in percentage Replacement of coconut shell reduces compressive, tensile and Flexural Strength of concrete.
- Increase in percentage of coconut shell, decreases densities of concrete.

III. TEST PERFORMED ON MATERIAL

Cement, sand, coarse aggregate, coconut shell has been used in the study. Physical properties of these materials are studied before casting if the specimen is carried out. The test results are summarized below:

A. Sieve Analysis Test

This test is used to check Properties of Aggregates using IS-Sieves. This procedure is applicable for checking properties of aggregate like Fineness modulus, grading & zone of fine aggregates.

B. Specific Gravity Test

This test is carried out with the help of pycnometer. It helps in determining the quality of soil.

C. Slump Test

This test is used to check Slump of Concrete using Standard Slump Cone.

D. Fineness Modulus Test

This test is used to check the quality of cement. Finer cement offers a great surface area for hydration and hence faster the development of the strength.

E. Consistency of Cement

The basic aim is to find out the water content required to produce a cement paste of standard consistency as specified by the IS: 4031 (Part 4) – 1988. The principle is that standard consistency of cement is that consistency at which the Vicat plunger penetrates to a point 5-7mm from the bottom of Vicat mould Initial & Final Setting Time-Initial setting time is that time period between the time water is added to cement and time at which 1 mm square section needle fails to penetrate the cement paste, placed in the Vicat mould 5 mm to 7 mm from the bottom of the mould.

F. Aggregate Impact Value

This test is done to determine the aggregate impact value of coarse aggregates as per IS: 2386 (Part IV) – 1963. IS Sieves of sizes 12.5mm, 10mm and 2.36mm, a cylindrical metal measure of 75mm dia. and 50mm depth, a tamping rod of 10mm circular cross section and 230mm length, rounded at one end and Oven.

S. no.	Name of the test	Results	Remarks
1	Consistency of Cement	31% of weight of Cement sample	
2	Initial Setting Time	29 minute	Stand. for OPC is 30 min.
3	Final Setting Time	620 minute	Standard for OPC is 600 min.
4	Compressive Strength of Cement	at 7 days= 31N/mm^2 at 28 days = 43N/mm^2	
5	Fineness Modulus of Sand	2.582	Medium sand
6	Grading of Sand	zone II	
7	Fineness Modulus of Coarse Aggregate	3.83	
8	Aggregate Impact Value	18.46%	Strong / Very Tough

Table 1: Results of tests performed on materials used

IV. PHYSICAL PROPERTIES OF COCONUT SHELL

The coconut shells were collected and were stacked in the amity university campus and well-seasoned manually by removing the fiber presented over the shells. The coconut shell aggregate were soaked for 24 hours in water and then taken from water, to allow dry under room temperature. After crushing the coconut shell, they were sieved and the aggregate passing 20mm and retaining 10mm sieve size was used in this investigation.

Physical Properties	Test results
Specific Gravity	2.8
Fineness	2.85

Table 2: Physical properties of coconut shells

V. EXPERIMENT PERFORMED TO DETERMINE MIX PROPERTIES

A. Workability of Coconut Shell Mix Concrete

Slump values of conventional concrete and coconut shell replacement are shown in table 3.

Workability test	Conventional concrete	15% replacement of coconut shell concrete	30% replacement of coconut shell concrete
Slump values	65	55	43

Table 3: Workability of coconut shell mix concrete

B. Compressive Strength

This test is carried out to get compressive strength at the age of 7 and 28 days. The cubes were tested in compression testing machine of capability 1000KN.The properties of coconut shell aggregate concrete is examined and the use of coconut shell aggregate in construction is tested. In this project, Replacement is done in two ways. One is replacement of 15% and the other is 30% of coarse aggregate. The parameters that will be tested are workability, density & compressive strength of concrete cubes. A comprehensive summary of properties of normal, brick aggregates and coconut shells concretes are presented with the help of Table and Graphs.

Age	Conventional concrete (N/mm^2)	15% coconut shells replacement concrete (N/mm^2)	30% coconut shells replacement concrete (N/mm^2)
7 days	16.64	14.26	11.88
28 days	25.5	23.2	18.5

Table 4: Compressive strength values of concrete mix

VI. COMPARISION OF RESULTS

A. Slump Value

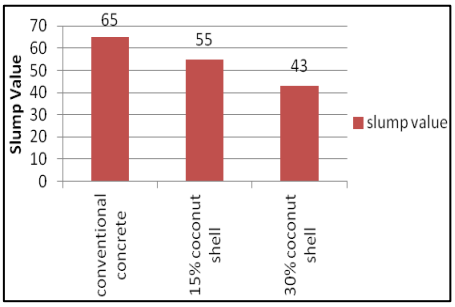

Fig. 1: Variation of slump value with coconut percentage

B. Compressive Strength

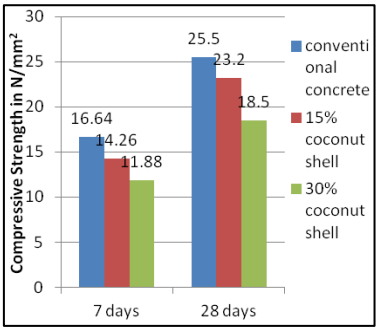

Fig. 2: Variation of compressive strength of coconut shells with age

C. Density

Cube Specimen	Results In (Kg/m^3)
Conventional Concrete	2359.3
15% coconut shell	2216.29
30% coconut shell	2008.69

Table 5: Density of coconut shells

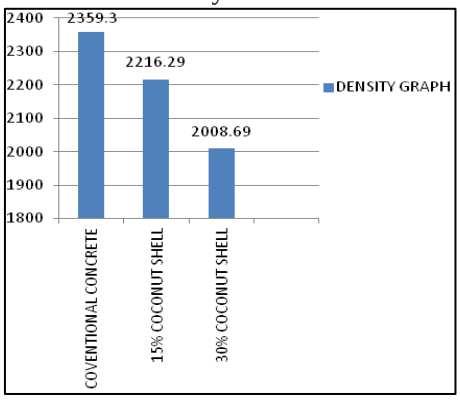

Fig. 3: Density of coconut shells

VII. RESULTS AND CONCLUSIONS

1) Permeable voids and water absorption increases with increase in CS replacement. The coconut shell aggregates have higher water absorption because of higher porosity in its shell structure.
2) The slump of conventional concrete, 15% coconut shell concrete and 30% coconut shell concrete is found to be 65mm, 55mm, 43mm respectively.
3) The 7 days compressive strength of coconut shell concrete was found to be 14.26 N/mm^2 for 15% replacement and 11.88 N/mm^2 for 30% replacement by coconut shell aggregate under full water curing and it satisfies the requirement for structural lightweight concrete. Percentage reduction in the compressive strength of 15 % and 30% coconut shell concrete with respect to conventional concrete comes out to be 14.31% and 28.60% respectively.
4) The 28 days compressive strength of coconut shell concrete was found to be for 23.2 N/mm^2 15% replacements and 18.5 N/mm^2 for 30% replacement by coconut shell aggregate under full water curing and it satisfies the requirement for structural lightweight concrete. Percentage reduction in the compressive strength of 15 % and 30% coconut shell concrete with respect to conventional concrete comes out to be 9.01 % and 9.02% respectively.
5) The density of conventional concrete, 15% coconut shell concrete and 30% coconut shell concrete is found to be 2359.3 kg/m^3, 2216.29 kg/m^3, 2008.69 kg/m^3 respectively. Percentage reduction in the density of 15% coconut shell concrete and 30% coconut shell concrete with respect to the conventional concrete was found to be 6.06 % and 14.86% respectively.
6) It is also seen that the density of concrete reduced as the percentage Replacement with coconut shells increased. As the percentage of coconut shells increased, the mass of the mix reduced since coconut shells are lighter than the granite they replaced. So, Light weight concrete can be prepared by using coconut shell as coarse aggregate.

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