

INVESTIGATION OF COCONUT SHELL AS A REPLACEMENT OF COARSE AGGREGATE IN CONCRETE.

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ABSTRACT: *The rising cost of construction material is a matter of concern. The reason for increase in cost is high demand of concrete and scarcity of raw material. Hence most of the researchers have focus on use of the waste materials in concrete according to their properties. In this study, M 20 grade of concrete was produced by replacing by coconut shell. 8 cubes and 8 cylinders were casted and their compressive strength and tensile strength were evaluated at 28 days. The compressive strength and tensile strength of concrete reduced as the percentage replacement increased. Concrete produced by 0%, 10%, 15%, 20% replacement of coarse aggregate by coconut shell attained 28 days compressive strength and split tensile strength. The results showed that coconut shell concrete can be used in concrete construction. Its utilization is cost effective and eco-friendly.*

INTRODUCTION

The three basic needs of man are food, clothing and shelter. Civil Engineer has relevance with all basic needs of man directly or indirectly. Man has progressed a lot in developing the method of constructing shelter. Initially man used to stay in huts and time passed it developed into house that is load bearing. In this constructed environment, the rising cost of building construction materials is the factor of great concern. The cost of building materials are raising day by day. Nowadays most of the researchers have focus on use of the waste materials in concrete according to their properties. Fly ash, Rice husk, Slag and Sludge from the treatment of industrial and domestic waste water has been found suitable as partial replacement for cement in concrete. The coconut shell is a material which can be a substitute for coarse aggregate.

Coconut shell concrete has better workability because of the smooth surface on one side of the shell. The impact resistance of coconut shell concrete is high when compared with conventional concrete[7]. Moisture retaining and water absorbing capacity of coconut shell are more compared to conventional aggregate. Using alternative material in place of natural aggregate in concrete production makes concrete as sustainable and environment friendly Construction material.

LITERATURE SURVEY:

Dewanshu Ahlawat et al. (2014) were investigated the Coconut shell as partial replacement of coarse aggregate in concrete. The aim of this research is to spread awareness of using coconut shell partial replacement of coarse aggregate in concrete and determining its compressive strength and density. The conclusions for the research are the compressive strength of the concrete decreased as the percentage shell substitution increased. Also increased in percentage replacement by coconut shell increase workability of concrete. Coconut shell can be used as partial replacement of coarse aggregate in R.C.C. concrete.

B. Damodhara Reddy ET al. (2014) were investigated the use of coconut shell as coarse aggregate. In this study, coconut shell is used as light weight aggregate in concrete. The project paper aims at analyzing flexural and compressive strength characteristics of with partial replacement using M30 grade concrete. The project also aims to show that coconut shell aggregate is a potential construction material and simultaneously reduces the environment problem of solid. The conclusions for the result are, CSC where 25% of the coarse aggregate is replaced, shows properties similar to the nominal mix and 50% replaced CSC shows properties similar to light weight concrete which can be used as filler materials in framed structures, flooring tiles, thermal insulating concrete etc.

Amarnath Yerramala et al. (2012) from structures and materials laboratory of Civil Engineeringr, Intell Engineering College, Anantpur, India were Properties of concrete with coconut shell (CS) as aggregate replacement were studied. Control concrete with normal aggregate and CS concrete with 10-20% coarse aggregate replacement with CS were made. Two mixes with CS and fly ash were also made to investigate fly ash effect on CS replaced concrete. Constant water to cementitious ratio of 0.6 was maintained for all the

concrete. In this research properties like compressive strength, split tensile strength, water absorption and moisture migration were investigated in the laboratory. The aim of this work is to provide more data on the strengths of coconut shell concrete at different coconut shells replacement and study the transport properties of concrete with CS as coarse aggregate replacement. The result showed that, addition of CS decreases workability and addition of fly ash either as cement replacement or aggregate replacement increases workability of CS concrete and also compressive strength and split tensile strength also decreased with increase in CS replacement. Furthermore, for 28 days of curing addition of fly ash as cement replacement reduced overall split tensile strength of CS concrete and fly ash addition as aggregate replacement showed no major difference with corresponding CS replaced concrete.

MATERIALS AND METHOD

The raw materials used in this experimentation were locally available and these included Ordinary Portland Cement as binding agent, river sand as fine aggregate and coarse aggregate and coconut shell as a coarse aggregate. Potable tap water was used for mixing and curing throughout the entire investigation.



Fig 1. Crushed coconut shell aggregate.

PREPARATION OF SPECIMENS

Concrete mix design: M 20 grade of concrete was designed by IS 10262-1982 method. The natural coarse aggregate were replaced as 0%, 10%, 15%, 20%. The test results were analyzed and compared with conventional concrete. Due to high water absorption of coconut shell, they were pre soaked in water for 24 hours, prior to mixing.

Batching and Mixing: weigh Batching was practiced with the help of electronic weigh balance. Batching was done as per mix proportions. Mixing was done by manually.

Placing and Compaction: Cubes are cleaned and oiled to prevent the formation of bond between concrete and moulds. Place the fresh concrete in cubes in three layers, tamping each layer 25 times. The entrapped air in concrete is removed by table vibrator.

Demoulding: After placing fresh concrete in moulds, it was allowed to set for 24 hours. It was marked with some permanent identification mark. Concrete cubes are now kept in curing tank for 28 days. After 28 days, concrete cubes were removed from curing tank to conduct tests on hardened concrete

RESULTS AND DISCUSSION

Compressive Strength:

Compressive strength is defined as resistance of concrete to axial loading. Cubes were placed in Universal Testing Machine (U.T.M), and load was applied. The readings on dial gauge were recorded and compressive strength was calculated. $\text{Compressive Strength} = \text{Maximum load} / \text{Cross sectional area}$

The maximum compressive strength of 31.75 N/mm^2 was attained at 0% replacement, while the minimum strength of 9.75 N/mm^2 at 20% less than 20 N/mm^2 . The strength decreased as the percentage replacement increased. As the coconut shell increased, the surface area increased, thus requiring more cement for proper bonding. Since cement content was constant, there was no extra bonding and strength reduced.

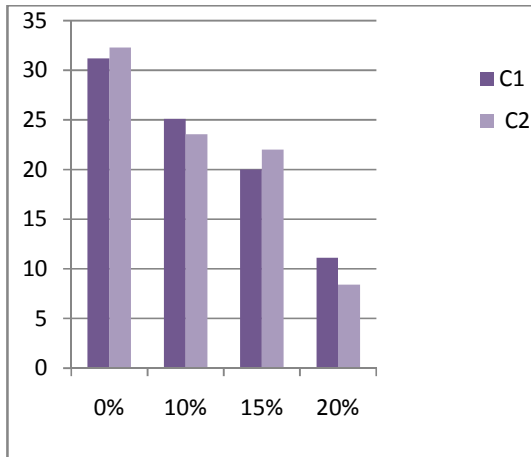


Fig.2 compressive strength result.

Split Tensile Strength:

Tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The Universal testing machine (UTM) was used for the splitting tensile strength of the concrete cylinders.

The split tensile strength of the specimen calculated from the following formula

$$T_{sp} = (2P/(\pi dL))$$

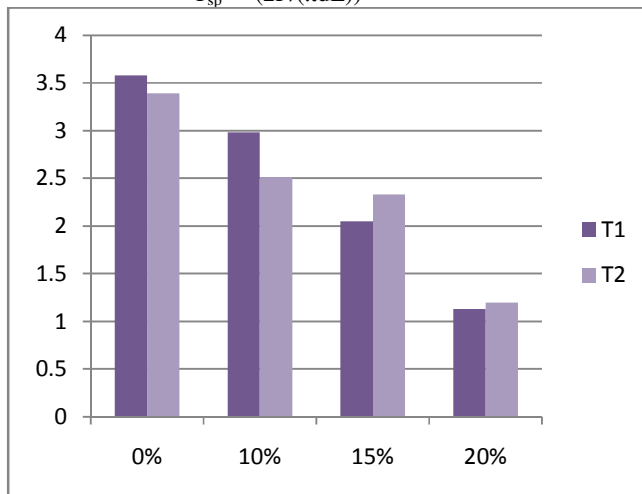


Fig.3 split tensile strength result

CONCLUSION:

The following conclusion drawn from the work:

1. Increase in percentage replacement by coconut shell reduces compressive strength and split tensile strength of concrete.
2. The reduction in compression strength is less in comparison with the split tensile strength with the replacement of conventional material.
3. Using the coconut shell as coarse aggregate in concrete can reduce the material cost in construction because of the low cost.

RECOMMENDATION:

Our study had many limitations, of which the time was a major concern. The strength properties of CSC depends on the aggregate properties of coconut shells and its individual strength characteristics. Experiments on impact value, crushing value etc can be done in order to analyze the strength properties of coconut shells. When CSC is used along with reinforcement, the surface bonding between coconut shell aggregates and steel comes

into play. Therefore study about bond properties of these can be useful. Furthermore the 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 kernel shells, coir pith, volcanic debris, etc.

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% Replaced by	Coconut shell	0%	10%	15%	20%
Compressive Strength(N/mm ²)	C1	31.2	25.11	20	11.11
	C2	32.31	23.55	22	8.4
	Avg.	31.75	24.33	21	9.75

Table No.1 Results of compressive strength of coconut shell concrete after 28 days (N/mm²)

% Replaced by	Coconut shell	0%	10%	15%	20%
Split tensile Strength(N/mm ²)	T1	3.58	2.98	2.05	1.13
	T2	3.39	2.51	2.33	1.20
	Avg.	3.48	2.74	2.19	1.16

Table No. 2 Result of Split tensile strength of coconut shell concrete after 28 days.