

# LIGHT WEIGHT AGGREGATE CONCRETE BY USING COCONUT SHELL

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**Abstract-** The high cost of materials for any conventional building is a major factor that affects the housing delivery worldwide. This has necessitated research for alternative cost effective materials in construction. The paper aims at analyzing characteristic compressive and tensile strength of coconut shells of concrete produced. By partial replacement using crushed, granular coconut shells as a substitute for conventional coarse aggregate in M20 grade concrete. The cube and cylinder are casted, tested then physical and mechanical properties are determined. In this studies, three different concrete mixes with different the combination of natural material content namely 0%, 25%, 50%. Three samples specimen will be prepare for each concrete mixes. The parameters will be tested are compressive strength, tensile strength.

This paper analyzed an investigation on the behavior of concrete specimens produce from coconut shell aggregate. A total of 36 specimens with varying percentage of replacement were casted and tested. The attempt is made to prove in all respect the serviceability and durability, experimental study is satisfying and can be implemented in rural areas by considering all technical aspect.

**Key Words:** Mix Design, Coconut Shell, Tensile strength, compressive strength.

## I. INTRODUCTION

There were many experimental work conducted to improve the properties of the concrete by putting new materials, whether it is natural materials or recycle materials or synthetic materials in the concrete mix. The additional material can be replacing the aggregate, cement or just as additive is natural material. A large amount of agricultural waste was disposed in most of tropical countries especially in Asia in countries like Thailand, Philippine, Malaysia and India. Also, India is the third largest producer for coconut products in the world. Coconut trees are widely cultivated in the southern India, especially Kerala. The name Kerala is derived from a word, 'kera' meaning 'coconut tree'. The Kerala state is densely populated and major population uses coconut or it's by products in their daily activities.

Thus tough coconut shells accumulated in the mainland gets degraded in around 100 to 120 years. Therefore, there is a serious environmental issue of disposal of these coconut shells. If the waste cannot be disposed properly it will lead to social and environmental problem. The high cost of conventional building materials is a major factor affecting housing delivery in India. This has necessitated research into alternative materials of construction. However, with the quest for affordable housing system for both the rural and urban population of India and other developing countries, various proposals focusing on cutting down conventional building material costs have been put forward. The use of aggregates

for construction is one of the most important parts of construction for it will add strength to the concrete. Finding a substitute for the aggregates used today is a task that is worth studying because the quarrying of aggregates from rivers and mountains harms the environment.

## II. LITERATURE REVIEW

**Vishwas P. Kulkarni and Sanjay kumar B. Gaikwad<sup>[1]</sup>**

Concrete is the widely used structural material in the world today. The demand to make concrete lighter has challenged scientists and engineers all over world. The challenge is to make lightweight concrete which decreases the concrete density while maintaining strength and without adversely affecting the cost. A common way is to introduce anew aggregates into the mix design to lower the concrete density. The familiar lightweight aggregates used in lightweight concrete productions are Pumice, Perlite, expanded Clay or Vermiculite, coal slag, sintered fly ash, rice husk, straw, sawdust, cork granules, wheat husk, oil palm shell, and coconut shell. The coconut shell when dried contains cellulose, lignin and ash in varying percentage.

**GopalCharanBehera and Ranjan Kumar Behera<sup>[2]</sup>**The rapid urbanization and industrialization have increased the consumption of aggregates. So the researchers have to find the alternative for the coarse aggregate. The increase in population increases the industrial by-products, domestic wastes etc. In India that coconut shell (CS) is an agricultural waste, which requires high dumping yards and also is environmental polluting agent. If this can be utilized as a coarse aggregate, then it should be a boom rather than ban for civil engineering society. This study aims in developing the mix design of lightweight aggregate concrete using CS as coarse aggregate together with cement and river sand.

**KulkarniParag P. and SanapSantosh T.<sup>[3]</sup>**The effective way of utilizing crushed coconut shell aggregate in concrete is presented in this paper. As coconut shell is available at a low price in most of the tropical countries. The concrete obtained using coconut shell aggregates satisfy the minimum requirements of lightweight concrete. Hence it is possible to made lightweight concrete making use of coconut shells as an aggregate in concrete. The main objective is to encourage the use of waste products as construction materials in low cost housing. It is will serve the purpose of encouraging housing developers in investing these materials in construction.

## III. METHODOLOGY

The ingredients of concrete i.e. cement, fine aggregate, fine aggregate, coconut shells are tested before producing concrete. As per Indian standard codes various test are

conducted on ingredients materials of the concrete. Firstly the dry ingredients cement, coarse aggregate, fine aggregate and coconut shells are fed in mixer and thoroughly mixed to ensure even distribution. Then the Water is added and the mix is continued. Production of mix (normal concrete of grade M-20) in the laboratory is carried out by IS method of concrete mix design (IS 10262-1982).

Coconut shell concrete is produced by adding coconut shells in different percentage (i.e. 25% and 50%) replacement for coarse aggregate.



Fig.1 Coconut Aggregates

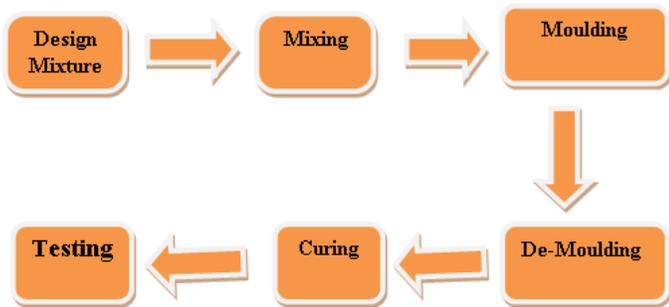


Fig.2 Preparation of Specimen

**Details of Specimens:**

Details of Specimens are given below:

- Cube: For compressive test: 150mm x 150mm x 150mm
- Cylinder: For tensile test: 150mm (diameter) x 300mm (height)

**Schedule of Specimen Preparation**

Sr. No	Concrete	CS Content	W/C Ratio	Compressive Test		Tensile Test	
				7 Days	28 Days	7 Days	28 Days
1.	General	0%	0.46	3	3	3	3
2.	CSC	25%	0.46	3	3	3	3
3.	CSC	50%	0.46	3	3	3	3
<b>Total number of specimen=36</b>							

**IV. RESULTS AND DISCUSSION**

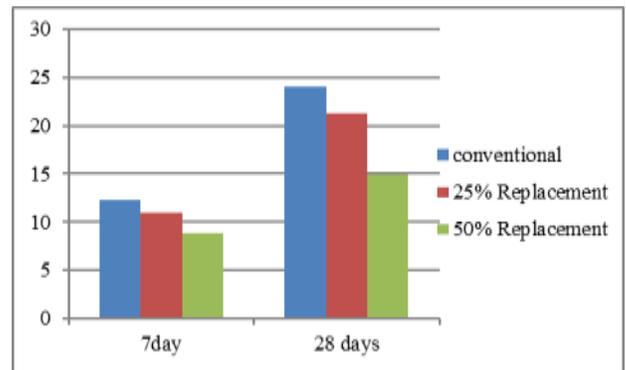
The average moisture content and water absorption of crushed coconut shell was found to be 4.20% and 24% respectively. Since the coconut shells are wood based and organic material and therefore moisture retaining capacity

would be more compared with the crushed stone aggregates. Due to the high water absorption of coconut shells the aggregate were pre-soaked 24 hours in potable water prior to the mixing and were the surface saturated dry condition during mixing to prevent absorption of mixing water.

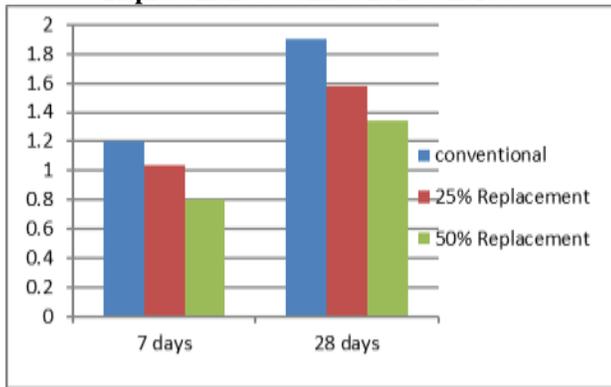
1. The specific gravity under surface saturated dry (SSD) condition of coconut shell was found to be 2.38.
2. It can be observed that the aggregate impact value of coconut shell aggregates are much lower compared to crushed stone aggregate which indicates that this aggregates have good absorbance to shock.
3. The slump obtained for trial mix was 55mm, which has showed that coconut shell concrete has a medium degree of workability .The fresh concrete density and hardened concrete density after 28 days (under SSD condition) using coconut shell was found to be in the range of 1975-2110kg/m<sup>3</sup> and 1880-1930kg/m<sup>3</sup>.The 28 days compressive strength of coconut shell concrete was found to be 21.31 and 14.88 for 25% and 50% replacement by coconut shell aggregate under full water curing.

**DISCUSSION**

From studies which exhibit that Coconut shell is less resistance against crushing, impact and abrasion as compared to conventional aggregate. The Density of coconut ranges 550-650 kg/m<sup>3</sup> and these are within the specified limits for light weight aggregate. So there is no need to treat the coconut shell before use as an aggregate except for water absorption. The presence of sugar content in the coconut shell, does not affect the setting and strength of concrete as long as it is not in a sugar-free form. The Hydration test on coconut shell fines with cement indicates that the inhibitory index for coconut shell fines with cement can be classified as 'low' and no pre-treatment is required for such condition. The continual increase in strength indicates that the coconut shell aggregate does not deteriorate once coconut shell aggregates are encapsulated into the concrete matrix. In a short term study, for 28 days, properties of coconut shell aggregate concrete viz. Split tensile strength, Impact resistance and Elastic modulus were determined and are compared with conventional concrete. After conducting the above test the observations that are as follow. These observations shows the percent replacement of aggregate there will be decrease in strength.



**Fig. 3 Comparison between compressive Strength of Conventional Concrete And 25% and 50% Replacement Coconut Shell Concrete**



**Fig.4 Comparison between Tensile Strength of Conventional Concrete And 25% And 50% Replacement Coconut Shell Concrete**

#### V. CONCLUSION

1. The coconut shell aggregates have higher water absorption because of higher porosity in its shell structure. The aggregate impact value of coconut shell aggregates are much lower compared to crushed stone aggregate which indicates that this aggregates have good absorbance to shock.
2. After 28 days the fresh concrete density and hardened concrete density (under SSD condition) using coconut shell was found to be in the range of 1975-2111kg/m<sup>3</sup> and 1880-1930kg/m<sup>3</sup>.

3. The 28 days compressive strength of coconut shell concrete was found to be 21.31 for 25% replacement by coconut shell aggregate under full water curing and it satisfies the requirement for structural lightweight concrete.
4. The 28 days compressive strength of coconut shell concrete was found to be 14.88 for 50% replacement by coconut shell aggregate under full water curing and it can be used for less important work.
5. Reduction in weight found to be 15% and 25% for replacement by coconut shell aggregate 25% and 50% respectively. Our project introduced the multiplying factor 0.88 with conventional result gives 25% replacement CSC result and the multiplying factor 0.61 with conventional result gives 50% replacement CSC result.

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