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Study of Partial Replacement of Coarse Aggregate with Coconut Shell

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Abstract: ***Infrastructure development across the world created demand for construction materials. Concrete is the premier civil engineering construction material. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water and admixture(s). Among all the ingredients, aggregates form the major part and thus its demand is increased. Use of natural aggregate in a very high rate leads to a question about the preservation of natural aggregates sources. Now, it becomes essential to find out a new source of aggregates. In the present work, coconut shell is selected as a partial replacement of coarse aggregate. This project deals with the concrete with partial replacement of Coarse Aggregate with 5%, 10%, 15% of Crushed Coconut Shells. Design mix used is M20 and testing of specimen was conducted after 7 and 28 days of curing.***
Keywords: Coarse aggregate, Coconut Shell, Fly Ash, Compressive Strength, Admixture.

I. INTRODUCTION

With increased population and modern living habits, production of waste material is increasing at fast pace and its disposal has become a genuine problem. To resolve the problem, solution is either, to minimize the waste at production level or to utilize the waste materials for some positive activity. Different alternative waste materials and industrial by products such as fly ash, bottom ash, recycled aggregates, foundry sand, china clay sand, crumb rubber, glass were replaced with natural aggregate and investigated properties of the concretes. Apart from above mentioned waste materials and industrial by products, few studies identified that the agricultural by product can also be used as aggregate in concrete and one of those agricultural by product is coconut shells. From such studies, it may be believed that innovation in the construction industry will mainly focus on use of industrial and agro wastes or by-products that are suitable for partial replacement of conventional ingredients of concrete.

Thus, the aim of this work is to provide more data on the strengths of coconut shell concretes at different coconut shells replacements and study the physical properties of concrete with coconut shells as coarse aggregate replacement. Furthermore, in this study, the effect of fly ash as cement replacement and aggregate replacement on properties of the coconut shell concrete was also investigated and durability of coconut shell aggregate concrete is also tested.

II. LITERATURE SURVEY

A. S. A. Kakade a lecturer at Dept. of Civil Engineering, Imperial College of Engineering, Pune and Dr. A. W. Dhawale an Associate Professor: They found out that coconut shells are light in weight and cost effective and it exhibits more resistance against crushing, impact and abrasion compared to conventional aggregates. It has density in range from 550-660 kg/m3 and are within specified limit It also has better workability due to smooth surface on one side of coconut shells. They satisfy the minimum requirement of coarse aggregates and sufficient acceptable strength for concrete required for concrete as per studies. Strength of concrete remains using coconut shells once the shells are encapsulated into concrete and it does not deteriorate. Long term investigation up to 365 days on compressive strength of coconut shell aggregate concrete is also studied.

B. Apeksha Kanojia and Sarvesh K. Jain from Madhav Institute of Technology & Science, Gwalior 474005: This experimental investigation was aimed to quantify the effects of replacing partially the conventional coarse aggregate by coconut shell to produce concrete. The research work was divided into two parts. First part was aimed to observe the effect of such replacement on compressive strength and density of concrete. In the second part, the aim was to find out the additional quantity of cement required to compensate for reduction in strength of concrete resulted due to this replacement. It was found that with increasing proportion of coconut shells, there is decrement in compressive strength. Results revealed that with 40% replacement of conventional coarse aggregate by coconut shell, 7 days compressive strength of concrete decreased by 62.6%; whereas decrease in 28 days compressive strength was only 21.5%. 40% replacement makes the concrete lighter by 7.47%. Further, it was revealed that for mix design of concrete of 20 N/mm2 characteristic strength, no additional cement is required for 5% replacement and only 3.6% additional cement was required for 10% replacement. The results confirm that although there is an

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increase in cost due to additional cement requirement, the advantages being many, including efficient utilization of waste coconut shell, reduction in natural source depletion etc, the use of coconut shell in concrete seems to be a feasible option.

C. K. Gunasekaran, R. Annadurai, P.S. Kumar from Department of Civil Engineering, Faculty of Engineering and Technology :They studied the pore structure of coconut shell through scanning electron microscope(SEM) and found that the pore structures in coconut shell behave like a reservoir. The results showed that Intermittent curing produced the highest coconut shell aggregate concrete strength, followed by full water, and then by air- dry curing. Biological decay was not evident as the concrete cubes gained strength even after 365 days. Up to an age of90 days, the samples under all types of curing conditions showed improved response on the pulse velocity and subsequently an insignificant drop. The ultimate bond strength of coconut shell aggregate concrete under all types of curing conditions was much higher compared to the theoretical bond strength as per BS 8110 and IS 456. Bonding between the cement paste and the coconut shell aggregate has been studied by measuring fissure between the coconut shell and the cement paste through SEM analysis. It shows a tendency of narrowing the fissure due to its age, which shows that the bond appears to be better between the coconut shell and the cement paste.

D. K. Gunasekaran, P.S. Kumar, and M. Lakshmipathy from the Department of Civil Engineering, Faculty of Engineering and Technology, SRM University, Kattankulathur603 203, TamilNadu, India: The properties of concrete using coconut shell as coarse aggregate were investigated in an experimentalstudy. Compressive, flexural, splitting tensile strengths, impact resistance and bond strength weremeasured and compared with the theoretical values as recommended by the standards. For theselected mix, two different water–cement ratios have been considered to study the effect on the flexuraland splitting tensile strengths and impact resistance of coconut shell concrete. The bond propertieswere determined through pull-out test. Coconut shell concrete can be classified under structurallightweight concrete. The results showed that the experimental bond strength of coconut shell concreteis much higher than the bond strength as estimated by BS 8110 and IS 456:2000 for the mixselected.

III. METHODOLOGY

A. Overview

M20 grade of concrete was mix design according to IS 10262:2009 and IS 456:2000.

B. Collection of Materials

1) *Cement:* Ordinary Portland cement 53 grade by Ambuja Cement was used in concrete. The experiments conducted to cement includes consistency of cement, initial setting time of cement, and specific gravity of cement. Specific gravity of cement got as 3.08.
2) *Fine Aggregate:* The size of the fine aggregate used was 4.75 mm and below size. Crushed sand was used for experimental work. The different tests did on fine aggregate were specific gravity and water absorption. The specific gravity of fine aggregate used was 2.68.
3) *Coarse Aggregate:* Size of coarse aggregate adopted is 10mm and 20mm. Test performed on aggregate were specific gravity, water absorption and sieve analysis. The specific gravity of coarse aggregate is 2.8.
4) *Coconut Shell:* Coconut shell were obtained from hanuman temples nearby the college and were crushed manually to obtain the size of 10mm and 20mm. Various test were performed on coconut shell- water absorption, specific gravity, Impact value, crushing value and sieve analysis. The specific gravity of the coconut shell obtained is 1.13.
5) *Water:* Potable water was used for the experimental work.
6) *Mix Proportions:* In order to investigate properties of coconut shell concrete, three mixes of coconut shell M20 concrete were made. Each mix containing 6 cubes of coconut shell concrete. The natural coarse aggregate were replaced as 0%, 5%, 10%, 15% by coconut shells. The mixes of M20 were having the following proportion of coconut shell :-

Table -1: Proportion of coconut shell used in concrete

Designation	Proportion of coconut shell	Proportion of aggregate	Number of Cubes
A	5%	95%	6
B	10%	90%	6
C	15%	85%	6
Nominal Mix	0%	100%	3

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IV. RESULTS

Cubes Designation	Compressive strength In KG/cm^2	Compressive strength In N/mm^2	Average In N/mm^2
A	197 196	19.7 19.6	19.65
B	188 189	18.8 18.9	18.85
C	180 178	18 17.8	17.85
D	210 208	21 20.8	20.9

1) *Compressive Strength:* The strength of all the concretes increased with curing age. The compressive strength of concrete is determined by testing the cubes under compressive testing machine. The results of compressive strength are shown in the Table-2.

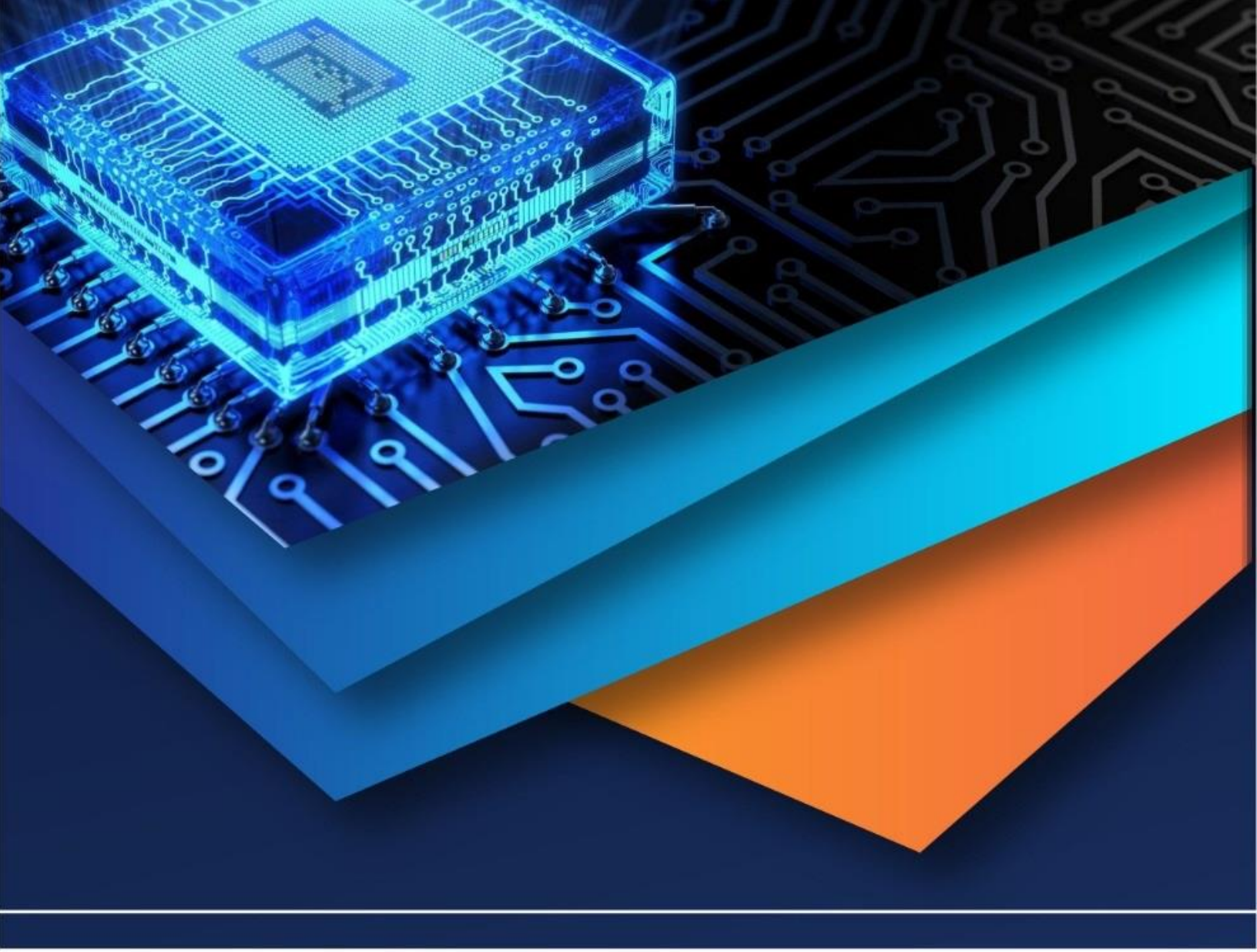
V. CONCLUSION

1) Increase in percentage replacements by coconut shells reduced the strength and density of concrete.
2) It helps in reducing up to15% pollution in environment.
3) This can be useful for construction of low cost housing society.
4) Slump of concrete increases as percentage of coconut shell increases.

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