FLEXURAL BEHAVIOUR OF REINFORCED CONCRETE BEAM WITH PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH COCONUT SHELL

Ajeeb T[1], Ali Azgar[2], Selma Antony[3], Vishnu S[4], Timi Thomas[5]

[1,2,3,4] *Student, Department of Civil Engineering, KMEA Engineering College, kerala, India*

[5]*Asst. ProfessorDepartment of Civil Engineering, KMEA Engineering College, kerala, India*

ABSTRACT

The rapid development in construction industry increasing demand for new innovative material as a part of construction industry. Coconut is grown in more than 93 countries. India is the third largest, having cultivation on an area about 1.78 million hectors. The properties of coconut shell aggregate concrete are examined and the use of coconut shell aggregate in construction is tested. Experimental studies are conducted on the flexural effect of coconut shell used in proportions of 5%, 10%, 15%, 20%, 25%, to replace coarse aggregate in conventional concrete M20 grade. This study will therefore focus on reinforced concrete beams with partial replacement of coarse aggregate by coconut shell for M20 grade. Eighteen specimens having a size of 600 x 150 x 150 mm were casted. Possibility and feasibility of flexural strength of coconut shell for beam specimens are determined respectively. The obtained results are compared with that of conventional mix. From study, we find out the optimum percentage for replacement of coarse aggregate by coconut shell and we can encourage the use of these seemingly waste products as construction material in Civil Engineering.

Keywords: – *Coconut shell, concrete, aggregate*

1.INTRODUCTION

1.1 General Background

The high demand for concrete in the construction using normal weight aggregates such as gravel and granite drastically reduces the natural stone deposits and this has damaged the environment thereby causing ecological imbalance. Therefore, there is a need to explore and to find out suitable replacement material to substitute the natural stone. Coconut Shell (CS) are not commonly used in the construction industry but are often dumped as agricultural wastes. It was concluded that the CSs were more suitable as low strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production. The concrete obtained by using coconut shell aggregates satisfies the minimum necessities of concrete because of the smooth surface on one side of the shells. The impact resistance of coconut shell concrete is high when compared with conventional aggregate concrete. Moisture retaining and water absorbing capacity of coconut shell are more compared to conventional aggregate. India produces about 20% of coconut produced in the world. Within India, Kerala produces 45% of that. Aggregates made of crushed coconut shell can be effectively used in concrete by partly replacing normal aggregate to a certain amount. This will not only reduce the unit weight of concrete made, but also offers an efficient resolution to the discarded coconut shells

1.2 Objectives

The objectives of this study is as follows

- To find economical materials for high cost construction.
- To prepare lightweight concrete structure by using coconut shell as a coarse Aggregate.
- To reduce the solid waste by using coconut shell as a coarse aggregate.
- To prove that aggregate replaced concrete which often are lightweight can end up being for structural applications with equivalent strength on concrete.

1.3 Scope

Now days, there is lot of development in construction field. The high cost of conventional building materials is a major factor affecting construction fields all over the world. This has necessitated research into alternative materials for construction. The project aims to at coconut shell as substitute for conventional coarse aggregate with partial replacement in M20 grade concrete. Using coconut shell as replacement should be urged as a priority in environmental concerns and construction cost reduction measure.

2.MATERIALS USED AND PROPERTIES

2.1 Materials used

Concrete is the construction material composed of cement, fine aggregate, coarse aggregate and water. In this project we are partially replacing coarse aggregate with coconut shell from 5% to 15%.

2.1.1 Cement

Cement is the binder used for construction that sets, hardens and adheres to other materials to bind them together. Different types of cement are available in the market. In this study we had used 53 grade ordinary Portland cement.

2.1.2 Fine aggregate

Aggregates are passing through 4.75mm IS sieve and retaining on 75µ IS sieve are called fine aggregates. The purpose of fine aggregate is to fill the voids in the coarse aggregate to act as a workability agent. In this study manufactured sand is used as fine aggregates.

2.1.3 Coarse aggregate

Coarse aggregate are particles that retain on 4.75mm IS sieve. They are crushed gravel or stone which is formed as a result of natural disintegration. The function of coarse aggregate is to act as the main load bearing component of concrete. Aggregates are passing through 20mm IS sieve is used as coarse aggregate in this study.

2.1.4 Coconut shell

Coconut shell is the strongest part of coconut that is located between coconut flesh and coconut husk. Coconut shell is composed of lignin, cellulose, pentosans etc. In this study coconut shell is broken into small chips of size varying from 10mm to 20mm.Coconut shell is soaked in water for 24 hours before mixing.

2.1.5 Water

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, etc. Potable water is generally used for mixing. pH of water using should be less than 6.Sea water should not be used for mixing or curing.

Table 2.1: Properties of cement

Sl No	Tests	Obtained value
1	Specific gravity	3.1
2	Fineness of cement	1%
3	Standard consistency	34%
4	Initial setting time	40 minutes
5	Compressive strength of cement 7^{th} day 28^{th} day	 N/mm^2 N/mm^2

Table 2.2: Properties of fine aggregate

Sl. No	Tests	Obtained value
1	Specific gravity	2.6
2	Bulk modulus	1748 kg/m^3
3	Bulking of sand	17.80%
4	Fineness modulus	3.6

Table 2.3: Properties of coarse aggregate

Sl No	Tests	Obtained value
1	Specific gravity	2.73
2	Water absorption	0.352%
3	Bulk modulus	1633kg/m^3
4	Fineness modulus	0.51

Table 2.4: Properties of coconut shell

Sl No	Tests	Obtained value
1	Specific gravity	1.27
2	Water absorption	19.8
3	Bulk density	523kg/m^3
4	Shell thickness	2-7

2.3.4 Workability test

Workability of concrete is the property of freshly mixed concrete which determines the ease and homogeneity with which it can be mixed, placed, consolidated and finished. Water cement ratio has much effect in the workability. Workability is directly proportional to water cement ratio. An increase in water-cement ratio increases the workability of concrete. Workability of concrete can be determined by slump test and compaction factor test. It is carried out with the freshly prepared concrete.

Fig-1: compaction factor test

Fig-2: slump test

Table 2.5: Results of workability test

Percentage of coconut shell in specimen	Slump Test	Compaction factor
0%	12	0.88
5%	11	0.85
10%	9	0.81
15%	8.5	0.79
20%	7	0.77
25%	5.5	0.75

3. EXPERIMENTATION

To determine various properties of concrete, specimens are casted and test is done. The specimens casted as beams. Tests are conducted to determine properties of flexural strength.

3.1 Mix design

The mix proportion for specimen 1(0% coconut shell), specimen 2(5% coconut shell), specimen 3(10% coconut shell), specimen 4 (15% coconut shell), specimen 5 (20% coconut shell), specimen6(25%coconut

shell) as per the order of Cement:FA:CA:CS:water are 1:1.5:3:0:0.5,1:1.5:2.85:0.15:0.5,1:1.5:2.70:0.30:0.5,1:1.5:2.55:0.45:0.5,1:1.5:2.40:0.60:0.5, 1:1.5:2.25:0.75:0.5 respectively

3.2 Casting

Casting is the process of mixing the required amount of materials according to the mix design. In our project work 18 set of specimens were casted in which each six sets which are to tested after 7th,14th,and 28th days of curing . The beams of 150 x 150 x 600 mm size which are reinforced with 4 No main bars having 8 mm diameter and 4 No of stirrups of 6mm diameter with a spacing of 100mm**.** The grade of concrete mix is M20.
Specimen 1(Control Mix): 0% CS
Specimen 2: 5% CS
Specimen 3:10% CS
Specimen 4:15% CS
Specimen 5:20% CS
Specimen 6:25% CS

Fig 3: moulds

3.3 Curing

Curing of Concrete is a method by which the concrete is protected against loss of moisture required for hydration and kept within the recommended temperature range. Curing will increase the strength and decrease the permeability of hardened concrete. The concrete specimens are unmoulded after 24 hours and put in curing tank.

Fig 4: Curing of specimen

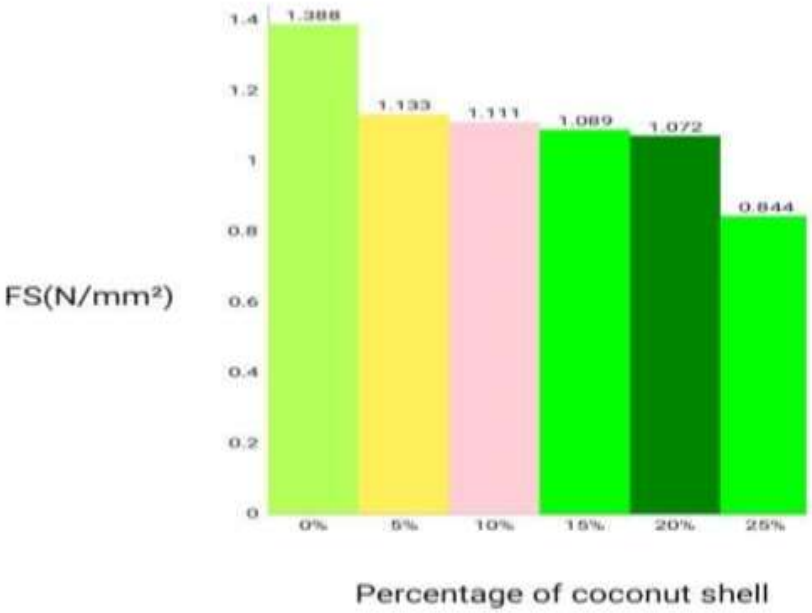
3.4. Result and discussions

From the observations it shows gradual decrease of flexural strength in all the combinations of concrete mix. The small variation takes place in the result of flexural strength of 5% to 20%. This project suggested for 20% of coconut shell in concrete mixing time.

Table 3.1: Result of flexural strength test

Percentage of coconut shell in specimen	Average 14 day's flexural strength (N/mm^2)
0% Coconut shell	1.388
5% Coconut shell	1.133
10% Coconut shell	1.111
15% Coconut shell	1.089
20% Coconut shell	1.072
25% Coconut shell	0.844

Chart 1: Flexural strength of coconut shell



4.CONCLUSIONS

From the observations it shows gradual decrease of flexural strength in all the combinations of concrete mix. The small variations in result of flexural strength in 5% to 20%. This project suggested for 20% of coconut shell in concrete mixing time

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