COMPRESSIVE STRENGTH OF CONCRETE USING COCONUT SHELLS AND NATURAL FIBER AS PARTAIL REPLACEMENT OF COARSE AGGREGATES

B. Bhanu Prasad

Assistant professor Department of Civil Engineering St.Martins engineering college

Dhulpally, Hyderabad

N. Vijay Kumar

Assistant professor Department of Civil Engineering St.Martins engineering college

Dhulpally, Hyderabad

P. Guruwamy Goud

Assistant professor Department of Civil Engineering St.Martins engineering college

Dhulpally, Hyderabad

ABSTRACT

Concrete is an artificial material similar in appearance and properties to some natural lime stone rock. It is a man- made composite, the major constituent being natural aggregate such as gravel or crushed rock, sand and fine particles of cement powder all mixed with water. The concrete as time goes on through a process of hydration of the cement paste, producing a required strength to withstand the load. The use of coconut shell as coarse aggregate in concrete has never been a usual practice among the average citizens, particularly in areas where light weight concrete is required for non- load bearing walls, non-structural floors, and strip footings. Coconut is grown in more than 93 countries. South East Asia is regarded as the origin of coconut. Indonesia has the largest cultivation of coconut about 18 million tones production yearly with 3 million hectares area. India is the third largest, having cultivation on an area of about 2.132 million hectares. Annual production is about 10.56 million tonnes in India. The overall production of coconut in 2012 was 60.04883715 million tones and total area was 12.1 million hectares. In this study, M 30 grade of concrete was produced by replacing coarse aggregate by coconut shell. Twelve cubes were casted and their compressive strength is evaluated at 7, 14 and 28 days. The compressive strength of concrete reduced as the percentage replacement increased. Concrete produced by0%, 5%, 10%, 15% replacement attained 28 days compressive strength of 27, 23, 24.11, 25.67 N/mm^2 respectively.

Keywords: coconut shell, compressive strength of concrete, coarse aggregates.

1.0 Introduction

In the world there are many countries in which coconut is cultivated at a big level. Here some data is provided according to production of coconut an area under the coconut cultivation. The coconut industry in India accounts for over a quarter of the world's total coconut oil output and is set to grow further with the global increase in demand. However, it is also the main contributor to the nation's pollution problem as a solid waste in the form of shells, which involves an annual production of approximately 3.18 million tones. Coconut shell represents more than 60% of the domestic waste volume. Coconut Shell, which presents serious disposal problems for local environment, is an abundantly available agricultural waste from local coconut industries. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used as potential material or replacement material in the construction industry. This will have the double advantage of reduction in the cost of construction material and also as a means of disposal of wastes. The concrete obtained using Coconut Shell aggregates satisfies the minimum requirements of concrete. Concrete using Coconut Shell aggregates resulted in acceptable strength required for structural concrete. Coconut Shell may offer itself as a coarse aggregate as well as a potential construction material in the field of construction industries and this would solve the environmental problem of reducing the generation of solid wastes simultaneously. The Coconut Shell-cement composite is compatible and no pre-treatment is required. Coconut Shell concrete has better workability because of the smooth surface on one side of the shells. The impact resistance of Coconut Shell concrete is high when compared with conventional concrete. Moisture retaining and water absorbing capacity of Coconut Shell are more compared to conventional aggregate. The amount of cement content may be more when Coconut Shell are used as an aggregate in the production of concrete compared to conventionalaggregate concrete.

Objectives of the Study

1. To study the properties of coconut shells, compatibility of coconut shells with cement and to produce coconut shell aggregate concrete with 28-day compressive strength more than 20 N/mm2.
2. To study the strength properties of concrete in replacement of coarse aggregate.
3. To study the behavior of compressive strength and workability.

2.0Materials

Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement that hardens over time. Most concretes used are lime-based concretes such as Portland cement concrete or concretes made with other hydraulic cements, such as cement fondue. However, asphalt concrete, which is frequently used for road surfaces, is also a type

of concrete, where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer Materials used in this study are:

Cement - OPC

Fine aggregate - R-sand

Coarse aggregate - aggregates passing through 20 and 12mm sieve

Coconut shell - coconut shell passing through 20 mm to 10mm

Water - potable water

Natural fiber - sugarcane waste (Bagasse)

4.0 Methodology

The basic properties of coconut shells such as physical, chemical, mechanical properties, and the compatibility of coconut shells with cement were studied. Based on the standard procedures and methods followed for the production of conventional LWC, the coconut shell aggregate concrete was produced. Numerous trial mixes were conducted by varying cement content, sand, coconut shells and water-cement (w/c) ratio. The acceptable trial mixes were then identified and finally, the workability, strength, density and durability requirements for different applications of LWC were taken into consideration during the selection of the optimum coconut shell aggregate concrete mix. Also, the concrete mix was optimized for coconut shells cement ratio and w/c ratio. This optimum mix was then used throughout the entire investigation for the production of coconut shell aggregate concrete specimens. Control concrete (CC) using crushed granite stone aggregate concrete (normal weight concrete – NWC) was also produced for comparison purposes. Comparison studies between CC and coconut shell aggregate concrete were conducted only on the fresh concrete properties, compressive strength, basic and mechanical properties. The behavior of NWC, namely the structural bond, durability and temperature properties are well established. Therefore, these properties were not investigated for CC in this study. Structural properties such as flexural and shear behavior of reinforced coconut shell aggregate concrete beams were studied by

making prototype elements and the results are compared with the other LWA used in concrete. Comparisons of some properties for coconut shell aggregate concrete were made using some codes of practice and other LWC. Also, tests conducted on temperature characteristics of coconut shell aggregate concrete are studied.

5. Experimental Analysis

5.1 Casting of Cubes

The cube mould plates should be removed, properly cleaned assembled and all the bolts should be fully tight. A thin layer of oil then shall be applied on all the faces of the mould. It is important that cube side faces must be parallel.

150 x 150 x 150 cm size shall be cast, 3 for 7-days testing and 3 for 28days testing. A sample consists of 3 cube specimens and their average compressive strength represents the test result of that sample. The individual variation of a set of 3 cubes should not be more than ± 15% of the average.

Fig.1. Shows Casting of Cubes in field

5.2 Sieve Analysis

Table1. Shows Fineness Modulus

Sieve Size	Cumulative Mass Retained	Cumulative % Retained
4.75MM	31.5G	6.3
2.36MM	99.1G	19.8
1.18MM	195.6G	39.1
0.6MM	306.7G	61.3
0.3MM	367.2G	73.4
0.15	482.8G	96.5

5.3 Properties of Cement

Table2. Shows properties of cement

Properties	value obtained	limits as per IS

		4031
Initial setting time	70 mins	>30
Soundness (expansion)	1 mm	<10mm
Density	3.09g/cc	3.15
Fineness	7%	<10%

5.4 Properties of Fine Aggregates

Sieve analysis of fine aggregate is done using standard set of IS Sieves. The results of testsconducted on sample are tabulated in table

Properties	value obtained	Limits as per IS 2386
Bulk density	1.78 g/cc	1.2-1.8 g/cc
Specific gravity	2.706 g/cc	2.6-2.8 g/cc

Table.3 Properties of Fine Aggregate .

5.4 Properties of Coarse Aggregate

Properties	Value obtained	Limits as per IS 2386
Bulk density	1.37 g/cc	1.2-1.8 g/cc
Specific gravity	2.96	2.6-2.8

Table.4 Properties of coarse aggregate

5.5 Compaction factor test

Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199 – 1959. The apparatus used is Compacting factor apparatus.

Table .5 Compaction Factor Test

Test	0%	5%	10%	15%

Compaction (kgs)	8.5	7.97	7.35	7.20

5.6 Compressive Strength of Cube:

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during production of concrete etc.

Test for compressive strength is carried out either on cube or cylinder. Various standard codes recommend concrete cylinder or concrete cube as the standard specimen for the test. American Society for Testing Materials ASTM C39/C39M provides Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

5.7 Non Destructive Test

Non-destructive testing of concrete is a method to obtain the compressive strength and other properties of concrete from the existing structures. This test provides immediate results and actual strength and properties of concrete structure.

6.0 Result and Discussions

In this study the density and strength characteristics of concrete produced by volume replacement of 5%, 10%, 15% replacement of crushed granite with coconut shells were investigated. 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.

The following recommendations are made at the end of the study.

- Further studies should be carried out to ascertain the possibility of using coconut shell concrete as a structural material.
- Durability studies on coconut shell concrete should be carried out its beh.

- Developing countries like Ghana should encourage the use of agricultural wastes in construction as an environmental protection and cost reduction measure
- 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 come

The Following Values are the Compressive Strength of Cubes after 7,14,28 Days of Curing

%0f coconutshell	Compressive strength at 7 days (mpa)	Compressive strength at 14 days (mpa)	Compressiveat strength 28 (mpa)
0 %	23	25	27
5%	18.5	20.3	21.2
10%	21	22.3	23.2
15%	23	24.1	25.67

Table.6 Cube Strength

CONCLUSION

- To increase the speed of construction, enhance green construction environment we can use lightweight concrete.
- The possibility exists for the partial replacement of coarse aggregate with coconut shell to produce lightweight concrete.
- Coconut shell exhibits more resistance against crushing, impact and abrasion, compared to crushed granite aggregate.

- Coconut shell can be grouped under lightweight aggregate. There is no need to treat the coconut shell before use as an aggregate except for water absorption.
- Coconut shell is compatible with the cement.
- The 28-day air-dry densities of coconut shell aggregate concrete are less than 2000 kg/m3 and these are 184 within the range of structural lightweight concrete.

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