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An Experimental Study on Concrete by Using Coconut Shell as Partial Replacement of Coarse Aggregates

A Parthiban[1], A Swetha[2], B Jyothi[3] , C Naga Murali Krishna[4], G Aswini[5], P Ramadevi[6],S P Manikanta[7].

[1]*Assistant Professor in Civil Engineering Dept. Sanskrithi School of engineering.*
[2]*Studying final year in Sanskrithi School of engineering.*
[3] *Studying Final Year in Sanskrithi School of engineer.*
[4]*Studying Final Year in Sanskrithi School of engineer.*
[5]*Studying Final Year in Sanskrithi School of engineer.*
[6] *Studying Final Year in Sanskrithi School of engineer.*
[7]*Studying Final Year in Sanskrithi School of engineer.*
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ABSTRACT

Coconut shell is a waste, generated by industrial and agricultural processes. The waste coconut shell is utilized to replace natural coarse aggregate. In this project, using coconut shell as a partial replacement of coarse aggregate. Making of cubes (150*150*150) and cylinders (150*300) by partial replacement of coconut shell as a coarse aggregate. Analyzing the compressive strength of concrete for M20 Grade concrete by using coconut shell as a substitute for conventional coarse aggregate with 10%, 15% and 20%of partial replacement. The tests on concrete can be conducted on 7,14, and 28 days. The main purpose of this research study was to observe the compressive strength of concrete with various properties of coconut shell.

Keywords: Coconut shell, Coarse aggregates, Fine aggregates, Compressive strength

1. Introduction

Concrete is one of the most versatile construction materials. With more than 10 billion tons of concrete produced annually, it is considered to be the most important building material. Consequently, the concrete industry is going to use a considerable amount of natural resources to produce concrete. Production of concrete is increasing due to the high growth of infrastructure development and construction activities in the world. Also, the demand for concrete is expected to grow to approximately 18 billion tons a year by 2050. Moreover, the cost of construction materials is increasing day by day because of high demand, scarcity of raw materials, and the high price of energy. From the standpoint of energy saving and conservation of natural resources, the use of alternative constituents in construction materials is now a global concern. For this, extensive research and development works towards exploring new ingredients are required for producing sustainable and environmentally friendly construction materials. Coconut is grown in more than 93 countries and South East Asia is regarded as the origin of coconut. By using agricultural waste, namely the coconut, replacing the stone aggregate in concrete, a concrete has been developed which possesses the potential of being used in lightweight construction. Structural lightweight aggregate concrete is a significant and resourceful material in up-to-date construction. This types of concrete has various applications such as construction of multistory building frames and floors, bridges, offshore oil platforms, and prestressed or precast elements. Moreover, it solves weight and durability problems in buildings and exposed structures. According to Expanded Clay, Shale and Slate Institute, structural lightweight concrete provides.

2. Literature Review

Miss. ANJALI S. KATTIRE (2017): In 2015 published a paper where they studied a total of 16 specimen casted 8 cubes and 8 cylinders and their compressive and tensile strength were measured after 28 days. Coconut shell was used as a partial replacement and the percentage at which it was replaced were 0%,10%,15%,20% respectively. Although with increasing replacement the above mention mechanical properties started to show decrement, some of them were still good for construction of light weight members.

DANIEL YAW OSEI (2013): In 2013 presented a paper that paper concerns with the study of M20 concrete with partial replacement of aggregate with coconut shell in an increasing fashion which is 20%,30%,40%,50% and 100% and the day compressive strength were found out to be

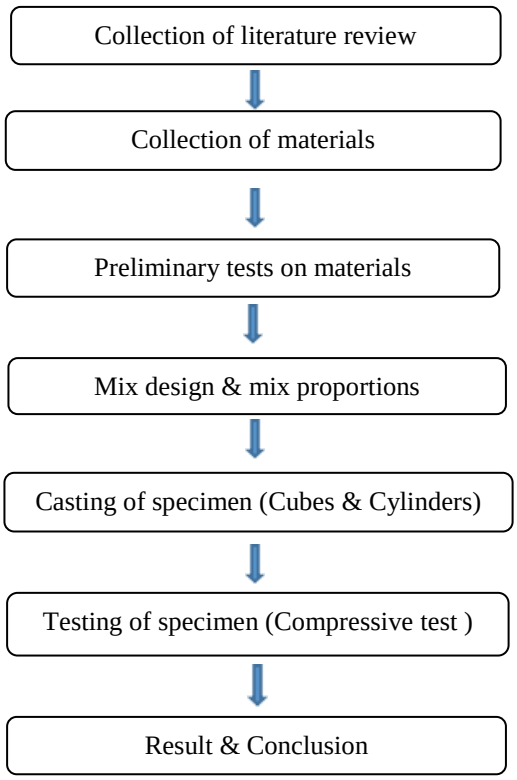
19.7N/mm2,18.68N/mm2,17.57N/mm2,16.65N/mm2 and 9.29N/mm2.This shows that concrete replaced by 20% gives the closest value to desired value.

APEKSHA KANOJA (2017) In 2017 published a paper on execution of coconut shell as coarse aggregates in concrete. This experimental examination was intended to evaluate the partial replacing of coarse aggregates with coconut shell to create concrete. Results uncovered that 40% substitution of ordinary coarse aggregates by coconut shell, 7 days compressive strength of concrete diminished by 62.6% where, as decline in 28 days was just 21.5%.40 % substitution makes the concrete lighter by 7.47%.

3. OBJECTIVES

- To collect the raw materials like coconut shell, cement, fine aggregate & coarse aggregate.
- To conduct various tests on raw materials.
- To use 10%, 15% & 20% of the coarse aggregate with coconut shell in concrete. To compare the cost of conventional concrete and concrete with partial replacement of coarse aggregates by coconut shell

4. METHODOLOGY



A. Materials

The following materials were used in our project.

- Fine aggregates
- Coarse aggregates
- Cement
- Coconut shell
- Water

1.Fine aggregates

Fine aggregates used were available on site and are tested, the results are as per Indian standards BIS: 383:1970. Use of fine aggregate improves the compressive strength of concrete. Use of fine aggregates provides better bonding or interlocking of both fine and coarse aggregates. The test conducted on fine aggregate are specific gravity, water absorption.

Table 1. Physical Properties of Fine aggregate

Name of the tests	**Test results**
Specific gravity	2.69
Water absorption	3.0%

2.Coarse aggregates

The aggregates used were 20mm nominal maximum size and are tested as per Indian standards and the results are within permissible limits (BIS: 10262, BIS: 383). The test conducted on coarse aggregate are specific gravity, water absorption, flakiness index, elongation index.

Table 2. Physical Properties of coarse aggregate

Name of the tests	**Test results**
Specific gravity	2.9
Flakiness index	10.16
Elongation	28.46

3.Cement

Cementitious material used was OPC 53 grade, Is the main ingredient used for bonding of concrete. OPC 53 sets quicker than OPC 43 and has a quite low initial setting time. It is used in structures where rapid strength gains required like large load bearing structures like bridges, huge buildings etc.

Table 3. Physical Properties of Cement

Name of the tests	**Test result**
Normal consistency	28%
Initial setting of cement	48min
Final setting of cement	5h22min

4.Coconut shell

The coconut shell is the strongest part covered in coconut fruit. The coconut shell is located in between the coconut flesh and coconut husk. This shell is naturally created to product the inner part of coconut. Most of the handmade decorative are created by using coconut shell due to their strength. There is huge demand for these types of natural handcraft in all over the world. The coconut shell is high potential material due to its high strength and modulus properties.

Table 4. Physical Properties of coconut shell

Name of the tests	**Test results**
Specific gravity	1.17
Water absorption	14.72

5.Water

Potable tap water was used for mixing and curing of specimens. The water reacts with the cement and sand, which bonds the other components together, creating a solid like material.

B. Concrete Mix Proportion

The mixes were designated in accordance with IS 10262-2009 mix design method. Based on the results, the mix proportions M 20 was designed. Concrete mix with w/c ratio of 0.4 was prepared.

Table 4. Quantity of materials

Material name	**Quantity**
Cement	315 Kg/m3
Fine aggregate	901.4 Kg/m3
Coarse aggregate	1182 Kg/m3
Water	157 L

Fig 1 : Compressive strength test on cubes

Fig 2 : Compressive strength test on cylinders

C. Testing of specimens

Compressive strength is defined as resistance of concrete to axial loading. It was tested in compressive testing machine and reading were recorded of the final crack. It is determined by using the formula:

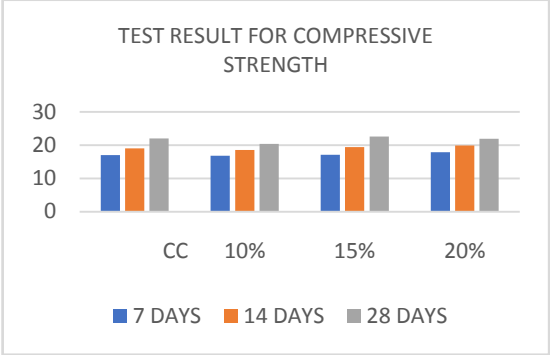
compressive strength = maximum load/cross sectional area

$$=P/A$$

Table 5. Compressive strength on cubes

S.NO	MIX	Compressive strength n/mm^2		
		7 Days	14 Days	28 Days
1	0	17	19	22
2	10	16.85	18.6	20.4
3	15	17.1	19.4	22.6
4	20	17.9	19.9	21.9

From Table 5: Compressive Strength for 7 days ,14 days & 28 days of Replacement Concrete cubes obtained 65% of strength successfully. The results obtained for M1 to M9 are mentioned in the above table. The highest compressive strength for 28 days of curing cubes value by using 15% of coconut shell is 22.6 N/mm^2 is obtained respectively.

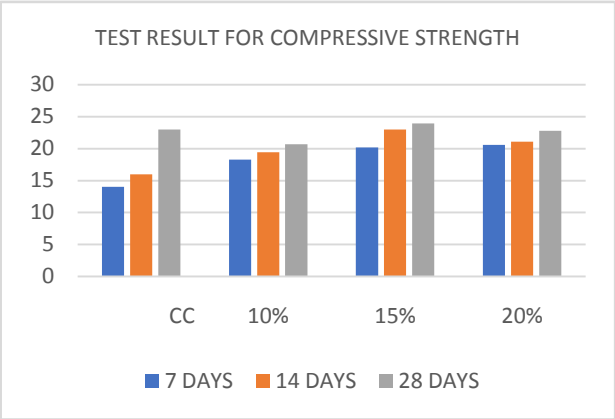


Compressive strength graph on cubes

Table 6. Compressive strength on cylinders

S.NO	MIX	Compressive strength n/mm^2		
		7 Days	14 Days	28 Days
1	0	14	16	23
2	10	18.3	19.45	20.7
3	15	20.17	22.97	23.94
4	20	20.56	21.1	22.78

From Table 5: Compressive Strength for 7 days, 14 days & 28 days of Replacement Concrete cylinders obtained 65% of strength successfully. The results obtained for M1 to M9 are mentioned in the above table. The highest compressive strength for 28 days of curing cylinders value by using 15% of coconut shell is 23.9 N/mm^2 is obtained respectively



Compressive strength graph on cylinders

5. CONCLUSION

From the test results, the following conclusions:

1) According to the tests performed, it is observed that there is remarkable increment in the properties of concrete on replacement of coarse aggregates by coconut shell.

2) When the coconut shell aggregates was added to concrete by replacing coarse aggregates up to 20% in M20 concrete, it is found that there is considerable increase in work ability and increase in compressive strength, when compared with plain cement concrete of M20 grade.

3) It can be concluded that the optimum amount of coconut shell replacement for coarse aggregate for M20 Concrete is

10% -20%.

4) When the cost comparison of plain cement concrete of M20 grade and concrete with 10%-20% replacement of coarse aggregate by coconut shell, it is found that there is a significant reduction in cost for one cubic metre of concrete

6. REFERENCES

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