

# IMPROVING THE STRENGTH PARAMETERS OF CONCRETE BY PARTIAL REPLACEMENT WITH COCONUT SHELL AS COARSE AGGREGATE

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**ABSTRACT:** Coconut shell and Fly ash are the natural waste materials which are abundantly available in our country. Wastes generated by industrial and agricultural processes have created disposal and management problems which pose serious challenges to efforts towards environmental conservation. A considerable amount of coconut shells and fly ash remain in the environment as waste, so utilization of these materials for construction will be an important step to improve sustainability and eco-friendly construction. In addition to that it will help to produce light weight and economically profitable materials in construction field. The current study examined the suitability of partial replacing of coarse aggregate with coconut shell and fly ash with cement. Compressive strength, splitting tensile strength sample were performed to carry out the test. A study on the economic aspects was also carried out. The addition of fly ash helps to increase the strength and workability of concrete. The results obtained from the above test will be compared with conventional concrete for the mix M<sub>30</sub> grade concrete.

**KEYWORDS:** Concrete, coconut shell, Fly ash, split tensile strength, compressive strength.

## 1. INTRODUCTION

The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources. These include the use of by-products and waste materials for building construction.

The high cost of conventional building materials is a major factor affecting construction in India. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used for various purposes in construction industry. This will have double the advantages, reduction in the cost of construction material and also as a means of disposal of wastes. Thus the approach is logical, worthy and attributable. Therefore an attempt has been made in this study to utilize the coconut shell and fly ash as partial replacement of coarse aggregate and cement in the development of light weight concrete. so a study on various strength and durability properties of these materials is required. Also suitable measures have to be adopted for attaining the target strength.

Coconut Shell (CS) are not commonly used in the construction industry but are often dumped as agricultural wastes. Coconut is grown in 92 countries with a global production of 51 billion nuts of which India produces 9500 kilo ton of coconut. In India, industries and informal sectors recycle about 15-20% of solid waste in various building material. In developing countries, coconut shell type waste material can be used as a construction material. It has the advantage of reduction of cost and it also serve as a means of disposal or say recycling of waste. In this paper normal coarse aggregates are replaced by crushed coconut shell pieces and cubes have been casted to their designed compressive strength and other physical properties.

## 2. Objective

Objectives of the experimental investigation are as follows:

It is aimed to study the performance of coconut shell concrete with respect to the strength and durability properties.

1) To study the properties of fresh coconut shell concrete.

2) To study mechanical properties such as compressive and split tensile strength at the end of 7,14 and 28 days of curing by partially replacing cement by fly ash and coarse aggregate by coconut shell under normal curing with no chemical admixture.

3) To investigate the feasibility of the combination of coconut shell and coarse aggregate in concrete by determining its compressive and split tensile strength.

4) To reduce environmental pollution by utilizing waste material in concrete.

## 3. MATERIAL AND METHODOLOGY

The materials used in this experiment were Cement, fly ash, Sand, coarse aggregate, coconut shell and water.

**A. Cement:** OPC 53 grade cement from a single batch will be used throughout the course of the project work. The properties of cement used are shown in table below.

**Table 1. Cement properties**

SL NO	PHYSICAL PROPERTIES	TEST RESULTS
1.	Specific Gravity	3.10
2.	Standard Consistency	33%
3.	Initial Setting Time	33 minutes.
4.	Final Setting Time	356 minutes.
5.	Fineness of Cement	2%

**B. Fly Ash:** Fly ash used in this investigation was procured from local suppliers. The physical properties of fly ash are shown in table below.

**Table 2. Properties of Fly Ash**

S.NO	PHYSICAL PROPERTIES	TEST RESULTS	Specification As per IS: 3812-1981
1	Bulk density(Kg/M <sup>3</sup> )	1010	1120
2	Specific gravity	2.22	2.42

**C. Fine Aggregate:** Locally available river sand belonging to zone II of IS 383-1970 will be using in this project work. The physical properties of fine aggregates used are shown in table below.

**Table 3. Properties of Fine Aggregates**

S. NO	PHYSICAL PROPERTIES	TEST RESULTS
1	Specific Gravity	2.73
2	Water absorption	0.87%
3	Bulk density(g/cc) (loose condition)	1.53 g/cc
	(compacted condition)	1.61 g/cc
4	Silt content	2.67%
5	Fineness Modulus	3.82

**D. Coarse Aggregate:** Crushed ballast stone of size 12mm and 20mm down size conforming to IS 383-1970. Physical properties of coarse aggregate are shown in table below.

**Table 4. Properties of Coarse Aggregate**

SL NO	PHYSICAL PROPERTIES	TEST RESULTS
1.	Specific Gravity	2.81
2.	Water absorption	2.22%
3.	Bulk density(g/cc) (loose condition)	1.53 g/cc
4.	Bulk density(g/cc) (compacted condition)	1.68 g/cc
5.	crushing value	13.98%
6.	Impact value	12.71%
5.	crushing value	13.98%

**E. Coconut Shell (CS):** Coconut shells which were already broken into two pieces were collected from local area, air dried for five days approximately at the temperature of 25 to 30°C. Crushed shells were washed

to remove fibers, mud, husk etc from them. The washed shells were dried in sunlight for another 5 days.

The crushed edges were rough and spiky. The surface texture of the shell was fairly smooth on concave and rough on convex faces. The coconut shells were crushed manually using hammers to a size such that it passes through a 12.5mm sieve and retained on 4.75mm sieve. The material passed through 12.5 mm sieve was used to replace coarse aggregate with CS. As Coconut shell having high water absorption, it is immersed in water for 7 days and were used in saturated surface dry (SSD) condition before casting.

The physical properties of coconut shells are shown in table below.

**Table 5. Properties of Coconut shell**

S NO	PHYSICAL PROPERTIES	TEST RESULTS
1.	Specific Gravity	1.97
2.	Specific Gravity	1.97
3.	Bulk density(g/cc) (loose condition)	0.49g/cc
4.	Bulk density(g/cc) (compacted condition)	0.58g/cc
5.	crushing value	1.25%
6.	Impact value	1.80%
7.	Fineness Modulus	7.502
8.	Shell Thickness	2-7mm

**F: Processing Of Coconut Shell:**

1. Air drying for 5 days.
2. Breaking of coconut shells manually with hammer.
3. Crushed coconut shell passing 12.5 mm.
4. Saturated surface dry coconut shells before casting.



**Figure 1. Breaking & sieving of coconut shells to required size**



**Figure 2. 15x15x15cm cubes**

#### 4. EXPERIMENTAL INVESTIGATION

S.NO	MIX	% OF FLY ASH	% OF COCONUT SHELL	COMPRESSIVE STRESS (N/MM <sup>2</sup> )			SPLIT TENSILE STRENGTH (N/MM <sup>2</sup> )		
				3 DAYS	7 DAYS	28 DAYS	3 DAYS	7 DAYS	28 DAYS
1	M-30	0.0%	0.0%	18.22	22.04	32.88	1.82	2.4	3.29
2	M-30	0.0%	10%	16.44	20.3	30.22	1.89	2.15	2.72
3	M-30	0.0%	20%	13.33	18.66	27.55	1.75	2.24	2.86
4	M-30	10%	10%	17.77	20.66	32	1.77	2.31	3.23
5	M-30	20%	10%	16.88	19.77	30.66	1.58	1.79	3.10

Results: Optimum value is obtained at 10 %( coconut shell) +10 %( fly ash) of concrete mix.

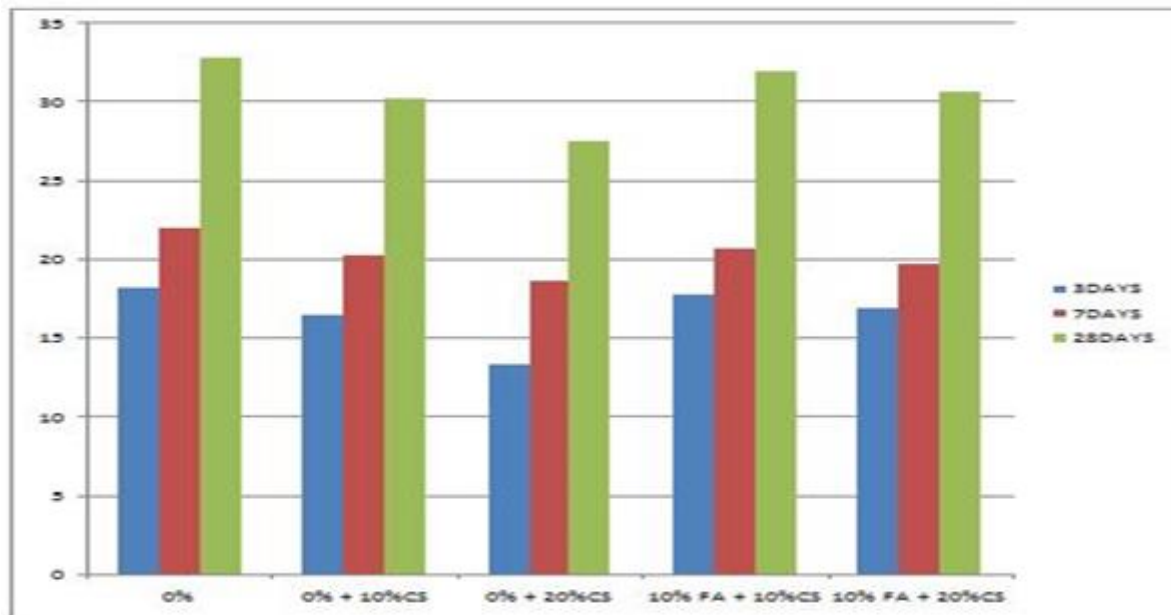


Figure 3: Graph shows the compressive strength of cubes after 3,7,28 days

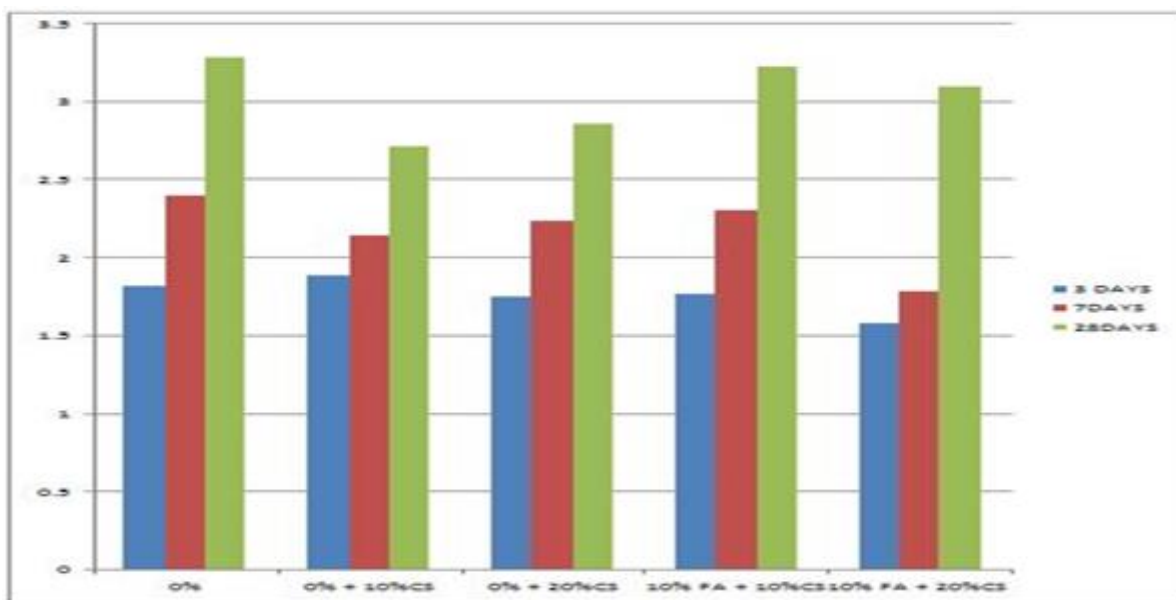


Figure 4: Graph shows the Tensile strength of cylinders after 3,7,28 days

**Conclusion:**

- “Finally we conclude that using coconut shell as partial replacement for coarse aggregate is a good idea for waste disposal
- As the test results are concerned, the compressive strength of concrete will be equal compared to the nominal by 10% replacement with coconut shells.
- We can use this type of concrete in rural areas and according to compressive strength it gave good results at 10% replacement and also by addition of fly ash by 10%”.

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