Concrete Made Using Coconut Shell As A Coarse Aggregate

Motale Sanket Santosh[1],

[1]Lecturer Dept. of Civil Engineering Kai.Sau.Sunitatai Eknathrao Dhakane Polytechnic College, Shevgaon, District-Ahmednagar, Maharashtra, India

---***---

Abstract - *There have been numerous experimental studies done to see if adding additional components to the concrete mix, whether they be synthetic, recycled, or natural resources, would improve the qualities of the concrete. The cost of building is the main determining factor. Most building projects employ concrete, which is made of cement, sand, coarse aggregate, and water. In the modern era, natural resources like natural rocks and other materials are used to produce coarse aggregate. Coconut is widely used in India for a variety of uses, including industry and devotion.*

When coconuts are used, their shell is left behind as a byproduct that can replace coarse material in construction projects.

Given that coconut shells are naturally strong and do not quickly decay when linked in concrete, In our experiment, coconut shell replaces 10% or 15% of the coarse concrete materials.

All cement, sand, aggregate, and concrete tests were carried out in accordance with IS regulation.

The compressive strength, water absorption, and cost of the concrete blocks made with coconut shells of grade M20 were all compared to conventional concrete of the same grade.

***Key Words*: Concrete, aggregate, strength, and coconut shells**

1.INTRODUCTION

Now-a-days numerous engineers and scientists are in process to develop various natural as well as modernised approaches for the manufacture of construction materials especially concrete.

They are also concerned about keeping its quality and strength, thus different materials are utilised in place of specific materials while creating concrete. Construction experts have long understood the advantages of adding a cementation binder to concrete during repair or construction to increase its strength and durability over the long term.

There have been numerous experiments done to alter the qualities of soil by incorporating new elements, whether they be organic, recycled, or synthetic.

In the majority of tropical nations, particularly in Asia, a large volume of agricultural waste was dumped.

Environmental and social problems will result from improper trash disposal.

So, by adding coconut shell to concrete, its engineering features are increased for better application in various construction projects as needed.

1.1 Necessity To Utilize Waste In Concrete:

Research has been conducted to meet society's demand for an efficient and cost-effective way to dispose of garbage.

• Recycling waste materials protects the environment by preserving natural resources and landfill space.

• The concrete buildings as they are now cannot last.

• Waste resources such as rubber tyres, e-waste, waste plastic, and waste water have all been the subject of experiments.

• At the moment, India produces 960 million tonnes of solid waste annually as a byproduct of agriculture, mining, municipal services, and other sources.

• Only from agricultural sources, India has generated almost 600 million tonnes of garbage.

• The largest quantity of agricultural waste are sugarcane baggase, paddy and wheat straw and husk , jute fibres, groundnut shells , coconut husk etc.

• Each year, coconut trees are grown on 12,280 hectares of land, yielding 62.8 billion tonnes of nuts.

• A coconut's shell makes up 15% of its overall weight.

• Reports from 2018 indicate that India produces 11.9 million tonnes of coconut.

1.78 million tonnes of coconut shells were therefore produced.

Because lignocelluloses are present in coconut shells, the process of decomposition is extremely slow.

So, we can utilise it to create concrete.

1.2 OBJECTIVES

1. To research the advantages of using coconut shells in concrete.

2. Take steps to use an alternative substance as concrete aggregate.

3. To compare the prices of plain concrete and concrete with coconut shells added, as well as the results of tests on compressive strength, water absorption, and slump cone.

4. To make concrete constructions more resilient and effective over the long run.

1.3 LITERATURE REVIEW

According to research by B.Damodhara Reddy, S.Aruna Jyothy, and Fawaz Shaik, coconut shell aggregate is a promising building material that also minimises environmental pollution.

According to Tomas U. Ganiron Jr., replacing the necessary amount of coconut shell with concrete can generate a product with adequate strength.

When coconut shell was added, the concrete's strength was increased, making it stronger than other types of concrete.

According to Vijay Kumar Shukla, Bharti Sharma, and Amarnath Gupta, coconut shell concrete can be utilised to manufacture lightweight concrete and is suitable for low strength structures.

2. METHODOLOGY

Material Used :-

Cement - 53-grade Ordinary Portland Cement (OPC), which meets the standards of IS:12269-1987 regulations, was the cement used in the experiment.

It is made up of a combination of ferrites, aluminates, and calcium silicates (alite, belite), which are compounds that combine calcium, silicon, aluminium, and iron in ways that will react with water.

Table -1: Properties of Cement

SR NO	Property	Value
1	Specific Gravity	3.15
2	Fineness test	5.35%

GGBS - Ground granulated blast-furnace slag (GGBS) can boost the abilities to avoid water penetration and chloride penetration, and it can improve the durability of concrete building.

Also, the usage of GGBS for concrete materials helps to reduce CO2 emissions and environmental effect while saving energy and natural resources during the cement manufacturing process.

Crushed Sand- A Quarry is where the crushed sand is produced.

In a plant or quarry, boulders, quarry stones, or bigger aggregate pieces are crushed into particles the size of sand.

Because of its strong texture and cubical and angular shape, crushed sand is preferable for concrete.

In comparison to natural sand, it has less of an adverse effect on the environment.

Crushed sand has a specific gravity of 2.73.

Coarse Aggregates- 10mm and 20mm crushed stone aggregates were employed in experiments.

Water- Throughout the experiment, ordinary water free of salts, turbidity, and organic content was used for mixing and curing.

Coconut Shells- The experiment's coconut shells were exposed to the sun for 29 to 30 days to dry them off.

We gathered coconut shells from the neighbourhood and temples.

MIX DESIGN

Concrete Mix Design For M20 Grade Concrete Mix ratio is 1 : 1.55 : 3.09

PREPARATION OF CUBE SPECIMENS:

This part described how to create and cure concrete compression test specimens.

In a lab setting where precise measurement of the materials' amounts and testing conditions is available, and when the aggregates' maximum nominal size is 20 mm.

The approach is notably relevant to the making of preliminary compression test to evaluate the compatibility of the available materials or to find optimal mix proportions.

Sampling Of Materials:-

Careful sampling must be used to get representative samples of the concrete materials to be used for the specific concrete building project.

A tiny fraction of cement test samples must be gathered from each of the site's many bags.

Aggregate test samples must be quartered from bigger batches for collection.

Preparation Of Materials -

Before starting any testing, all materials must be brought to room temperature, preferably between 27 and 30 degrees Celsius.

When the cement samples are first brought to the lab, they must be completely dry-mixed, either by hand or with a suitable machine, to guarantee the greatest blending and uniformity in the components, while taking care to prevent the introduction of extraneous elements.

The cement must be kept in a dry environment.

For each batch of concrete, aggregate samples must be of the required grade and must have undergone air drying.

Proportioning:-

The proportioning of the components, including water in concrete mixes used to assess how acceptable the materials are, must be identical in every way to the materials that will be used in the job.

The percentage, by weight utilized in the test cubes, and the unit weights of the components must be computed when the proportion of the elements of the concrete is to be indicated on the site by volume.

Weighing-

For each batch, the amounts of cement, each size of aggregate, and water must be calculated using weights with an accuracy of 0–1% of the batch's total weight.

Mixing Concrete:-

Concrete must be mixed manually, or ideally in a laboratory batch mixer, in order to prevent the loss of water or other ingredients.

Machine Mixing:-

When a power loader replaces the mixing drum, all of the mixing water must be added before the solid materials are placed into the skip: roughly one-half of the coarse aggregates, followed by the fine aggregates, the cement, and then the remaining coarse aggregates on top.

When all the elements are in the drum, the mixing process must last at least 2 minutes and continue until the finished concrete is consistent in appearance.

Workability:-

Immediately following mixing, each batch of concrete must undergo one of the IS code-recommended consistency tests.

The concrete used for consistency testing may be re-mixed with the balance of the batch prior to creating the test specimens, provided that care is taken to ensure that no water or other ingredients are lost.

Size Of Test Specimen:-

If the aggregates' biggest nominal size does not exceed 2 cm, 10 cm cubes may be utilized in place of the specimen's required 15*15*15 cm cubic form.

The length of cylindrical test specimens must be twice as large as the diameter.

Moulds:-

Metal moulds, ideally made of cast iron or steel, must be thick enough to avoid deformation.

When they are built and prepared for usage, the dimensions and internal faces must be correct to within the following tolerances. They are manufactured to make it easier to remove the moulded specimen without damaging it.

Compaction :-

The test cube specimens are created as quickly as possible after mixing and in a manner that results in complete compaction of the concrete without segregation or undue laitance.

Three layers of concrete, each one about 5 cm thick, are poured into the mould.

Either by vibration or by hand, each layer is compressed.

A trowel is used to finish levelling the concrete's surface with the top of the mould after the top layer has been compressed.

Compacting By Vibration :-

Until the required condition is met, each layer in this process is vibrated using an appropriate vibrating table, an electric or pneumatic hammer, or vibrator.

To prevent segregation from occurring in the mould, which results in poor strength when the cubes are crushed, precautions must be taken.

Curing :-

The test sample is kept for 24 to 1 1/2 hours after the addition of water to the dry components in an area free from vibration, in moist air with at least 90% relative humidity, and at a temperature of 27° to 2°C.

The specimens are then labeled, pulled out of the moulds, and kept immersed in clean, fresh water until they are retrieved for the test.

CONCRETE TEST

Slump Cone Test :-

Trial	0%	10%	15%
Slump (inmm)	110	80	60

Slump Cone Test Results

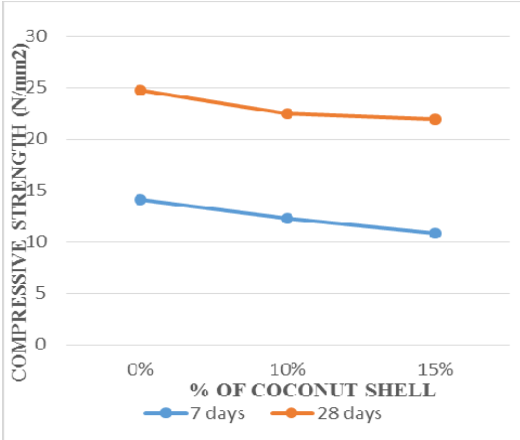
Compression Test On Cubes :-

compressive strength of cubes after 7 days.

Sr No	% of Coarse Aggregate replaced by CS	Age of Specimen (days)	Weight of Specimen (Kg)	Load (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	0%	7	8.432	320	14.22	14.07
			8.429	320	14.22	
			8.445	310	13.77	
2	10%+GGBS	7	8.294	270	12	12.3
			8.242	280	12.4	
			8.208	280	12.4	
3	15%+GGBS	7	8.130	250	11.1	10.8
			8.122	240	10.7	
			8.09	240	10.7	

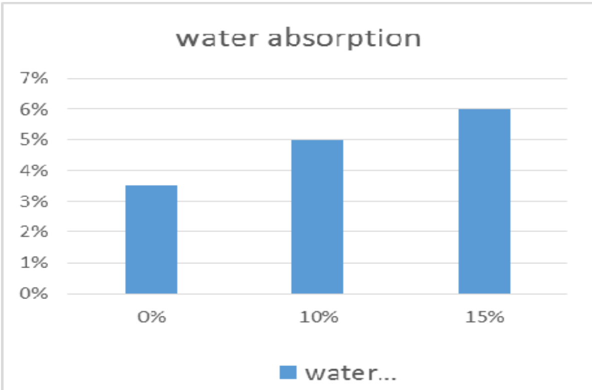
Compressive Strength Of Cube After 28 Days.

Sr No	**% of Coarse Aggregate replaced by CS**	**Age ofSpecimen (days)**	**Weight of Specimen (Kg)**	**Load (KN)**	**Compressive Strength (N/mm²)**	**Average Compressive Strength (N/mm²)**
1	0%	28	8.495	550	24.44	24.74
			8.884	560	24.89	
			8.912	560	24.89	
2	10%+GGBS	28	8.342	520	23.1	22.5
			8.342	500	22.2	
			8.318	500	22.2	
3	15%+GGBS	28	8.184	500	22.2	21.9
			8.272	500	22.2	
			8.174	480	21.3	



Water Absorption Test :-

Trial	**Wet Weight**	**Dry Weight**	**Water Absorption**
0%	8.65	8.35	3.5%
10%	8.621	8.208	5%
15%	8.583	8.09	6%



3. CONCLUSIONS

According to the experimental findings, coconut shell concrete may be utilized in rural regions and locations where coconuts are readily available, as well as in locations where traditional aggregate is expensive.

It is determined that using coconut shells in place of typical coarse aggregate in the manufacturing of concrete makes them a more appropriate lightweight aggregate.

Moreover, it lowers building costs by lowering the price of coarse aggregate and also lowers environmental pollution brought on by coconut shell.

The slump value of conventional concrete, measured by the slump cone test, was 110 mm, whereas the slump values of coconut shell concrete for 10% and 15% were 80 mm and 60 mm, respectively. Coconut shell concrete's 28-day compressive strength was determined to be 22.5 MPa and 21.9 MPa for 10% and 15% replacement by coconut shell aggregate, respectively, compared to conventional concrete's 28.74 MPa.

We came to the conclusion that while we cannot use this concrete for large constructions, we can use it for smaller ones.

Future Aims

Coconut shells can be used in concrete as a partial replacement for coarse aggregate.

Together with other unconventional aggregates like palm kernel shells, volcanic debris, etc., we may research the utilization of coconut shell aggregates.

REFERENCES

• S. A. Kakade, Dr. A. W. Dhawale (2015) "Light Weight Aggregate Concrete By Using Coconut Shell"

• Sravika. V, G. Kalyan (2017) "A Study on the Partial Replacement of Coarse and Fine Aggregate by Coconut Shell and Quarry Dust Mix"

• R. Ranjith (2017) "Study on Properties of Concrete with Agricultural Waste"

• Manpreet Kaur and Jaspal Singh "Agricultural Waste Utilization in Civil Engineering"

• Ajim S Shaikh, Sagar B Thorat, Rahul V Unde, Prasad Shirse (2015) "Advance Concrete-Aggregate replaced by Coconut Shell"