An Experimental Study on Compressive Strength of Concrete Using Coconut Fiber

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Abstract- *Concrete is probably the most extensively used construction material in the world. The main ingredient in the conventional concrete is Portland cement. The amount of cement production emits approximately equal amount of carbon dioxide into the atmosphere. Cement production is consuming significant amount of natural resources. That has brought pressures to reduce cement consumption by the use of supplementary materials. Availability of mineral admixtures marked opening of a new era for designing concrete mix of higher and higher strength. coconut fibre is a admixture, whose potential is not fully utilized The study focuses on the compressive strength performance of the coconut fiber reinforced concrete containing different percentage by the weight of cement4%,5%, 6%.*

This study aimed toward analyzing the variation in strength of coconut fiber concrete at variable fiber contents and to establish it with that of conventional concrete. The various strength aspects analyzed are the compressive. Result data clearly shows percentage increase in compressive strength for M20 grade of concrete in7 days &28 days with respect to the variation in % addition of coconut fibers. This research is based on the use of coconut fibers in structural concrete to enhance the mechanical properties of concrete.

Keywords- Concrete, Coconut fibre, CompressiveStrength,

I. INTRODUCTION

Concrete is the most widely used construction material all over the world. With innovations in science and technology in construction industry, the scope of concrete as a structural material, has widened. Coconut fibre being the most ductile among all natural fibres and it is potential to be utilized as reinforcement substantial in concrete. In present days coconut shell is one of the genuine waste removal issues all around the globe. At the point when we consume coconut shell it discharges hurtful gases like carbon dioxide and methane which will legitimately effect on our environment. Use of coconut fibre can lead to improvement in properties of cement concrete in addition to providing a proper solution for disposal of this natural waste. This study will comprise of the comparative statement of properties of coconut fibre concrete with conventional concrete.

The following tests are performed on concrete blocks reinforced with coconut fibre:

1. Materials Testing
2. Workability
3. Compressive strength

Mostly these coconut fibres are dumped as agricultural waste, so that it is easily available in large quantity and also cheap. The purpose of this is to conduct experimental studies for enhancement of properties of concrete by reinforcing with coconut fibres determined by compressive strength. Another advantage of using coconut coir in concrete is that it is a renewable resource, unlike traditional concrete additives that are often made from non-renewable materials. Additionally, coconut coir is biodegradable, meaning it can be composted after use, reducing waste. Overall, the use of coconut coir in concrete has several benefits, including increased strength and durability, improved workability, and sustainability. As a result, it has become a popular choice for environmentally conscious builders and engineers.

Concrete containing cement, water, fine aggregate, coarse aggregate and discontinuous coconut fibers are called fiber reinforced concrete. Coconut fiber reinforced concrete is a composite material having fibers as the additional ingredients, dispersed uniformly at random in small percentage in between 0.3% and 5% volume in plain concrete. CFRC products are manufactured by adding coconut fibers to the ingredients of concrete in the mixture and by transferring the green concrete into mould the product is then compacted and cured by the conventional method.

Segregation or boiling is one of the problems encountered during mixing and compacting CFRC. This should be avoided for uniform distribution of fibers. The energy required for mixing, conveying, placing and finishing of CFRC is slightly higher.

Fig -1: Coconut Fiber Reinforced Concrete

1.1Types of fibers used in construction

Most commonly used types of fibers are:

1. Steel Fiber Reinforced Concrete
2. Plastic fibers
   - Polyester
   - Poly propylene
   - polyethylene
3. GFRC Glass Fiber Reinforced Concrete
4. Asbestos Fibers
5. Carbon Fibers
6. Organic Fibers
   - Bamboo Fiber
   - Coconut Fiber

1.2Areas of Application of fibers

The areas in which the reinforced fiber concrete is generally used:

- Plastering
- Pipes
- Thin sheets
- Shot Crete
- Curtain walls
- Precast elements
- Tiles
- CFRC Boards
- Flat slabs
- Highway and airport pavements
- Canal lining, sewer lining
- Stabilization
- Factories
- Aircraft hangers
- Aprons and taxiways

1.3Requirement of fiber reinforced concrete

- It increases the Compressive strength of the concrete.
- It reduces the air voids and water voids the inherent porosity of gel.
- It increases the durability of the concrete.
- Fibers such as graphite and glass have excellent resistance to creep, while the same is not true for most resins. Therefore, the orientation and volume of fibers have a big influence on the creep performance of rebars/tendons.
- Reinforced concrete itself could be a material, where the reinforcement acts as the strengthening fiber and the concrete as the matrix. It is so imperative that the behavior below thermal stresses for the materials be similar so the differential deformations of concrete and also the reinforcement area unit reduced.

II. FACTORS AFFECTING PROPERTIES OF FIBER CONCRETE

There are few factors which are responsible for the properties of fiber reinforced concrete, which are as follows:

2.1 Relative fiber matrix index

The matrix binds the fiber reinforcement, transfers loads between fibers , gives the composite component its net shape and determines its surface quality. A composite matrix may be a polymer, ceramic, metal or carbon

2.2 Volume of fibers

The strength of the composite for the most part depends on the amount of fibers utilized in it. It can be seen that the increase in the volume of fibers, increase approximately linearly, the tensile strength and toughness of the composite. Higher percentage of fiber is likely to cause segregation and harshness of concrete and mortar.

2.3 Aspect ratio of fiber

One of the most important factor which guides the properties and behavior of the composite is the aspect ratio of the fiber. It has been observed that up to aspect ratio of 75, increase on the aspect ratio increases the ultimate concrete linearly. In various research it is also found that beyond 75, relative strength and toughness is reduced.

2.4 Orientation of fibre

Shape and orientation of fiber is very important as it is found as raw and processed. To see the effect of randomness, mortar specimens reinforced with 0.5% volume

of fibers were tested. In one set specimens, fibers were aligned in the direction of the load, in another in the direction perpendicular to that of the load, and in the third randomly distributed.

2.5 Workability and Compaction of concrete

Incorporation of Coconut fiber decreases the workability considerably. This situation adversely affects the consolidation of fresh mix.

The workability and compaction standard of the mix is improved through increased water/ cement ratio or by the use of some kind of water reducing admixtures.

2.6 Size of coarse aggregate

Coarse aggregates a construction component made of rock quarried from ground deposit.Maximum size of the coarse 20mm and minimum size of coarse aggregate10mm. Fibers also in effect, act as aggregate.

2.7 Mixing

Concrete mix ratio or proportioning is a process that involves selecting the suitable ingredients and determining their quantities to produce a concrete mix of that is easy to work with but also is high in strength and durability. The proportion of the concrete ingredients will depend on their characteristics. The variables in concrete are water, cement and aggregates. To form a concrete mix, the binding agent, i.e., the cement, forms a paste that helps bind the aggregates.

III. METHODOLOGY TO BE ADOPTED

In this process for the preparation of cubes, and beams cement, sand, coarse aggregate, water and coconut fibers are to be used.

3.1 Properties of reinforcement

In addition, coconut fiber has the highest strength among all-natural fibers. These mechanical characteristics reduce cracking, leading to coconut fiber-reinforced concrete with better Compressionbehavior and higher impact resistance than traditional concrete.

Additionally, deformed fibers provide a positive mechanical bond within the concrete matrix to resist pull-out. Locally available waste materials were collected from different and properly shaped in the form of fibers. Uniform length of fibers was obtained by using cutting machine. Typical properties of fiber shown in table:

S.No.	Property	Values
1.	Diameter	0.40 mm
2.	Length of fiber	50 mm
3.	Appearance	Brown as thin wire
4.	Deformation	Uneven at both ends
5.	Specific gravity	0.87

Table -1: Properties of coconut fibers

3.2 Mix Proportion

S.No.	Property	Values
1.	Grade Designation	M20
2.	Type of cement	PPC
3.	Maximum nominal size of aggregate	20mm
4.	Maximum water cement ratio	0.50
5.	Workability	100 mm(slump)
6.	Exposure condition	Mild (for reinforced concrete)
7.	Method of concrete placing	Normal
8.	Type of aggregate	Angular aggregate
9.	Maximum cement content	450kg/m3

Table -2: Stipulations for proportioning

3.3 Slump Test

A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished products quality. The test measures consistency of concrete in the specific batch. It is performed to check consistency of freshly made concrete. The test is popular due to the simplicity of the apparatus used and simple procedure. Types of slump are as follows:

- **Collapse shear-** In a collapse slump the concrete collapses completely.
- **Shear slump**- In a shear slump the top portion of the concrete shears off and slips sideways.
- **True slump**-In a true slump the concrete simply subsides, keeping more or less to shape.

IV. RESULT

Compressive strength testare performed on the cube specimen after curing for 7 days and 28 days, respectively. The result of above tests is as follows:

4.1 Compressive Strength

Coconut fiber reinforced concrete was added to concrete at varying proportions (3%, 4%, and 5%, of that of weight of cement) at a water cement ratio of 0.5. The desired slump value and compressive strength was obtained for conventional concrete at this ratio.

Percentage Of Coir	Strengh After 7 Days (N/mm^2	Strength After 28 Days(N/mm^2)
0%	14.2	23.12
4%	14.6	25.7
5%	16.3	28.3
6%	15.02	26.2
Average	**15.03**	**25.83**

Table -3: Compressive strength after different % addition of fiber

V. CONCLUSIONS

In conclusion, the use of coconut coir and coconut shell in concrete can provide several benefits, including enhancing its mechanical properties and reducing its environmental impact. However, it is important to conduct further research to fully understand the effects of these materials on concrete and optimize their use in different applications.

1) Coconut fibre being low in density reduces the overall weight of the fibre reinforced concrete thus it can be used as a structural light weight concrete.
2) By reinforcing the concrete with coconut fibers which are freely available, we can reduce the environmental waste.

VI. FUTURE SCOPE OF STUDY

The effect of coconut fibers on high strength concrete should be studied and thus the use of CFRC can be extended to industrial and commercial buildings. Since the corrosion study is not done, the applicability of CFRC in reinforced constructions could be tested.

Coconut fiber is a good insulator in itself and as such it can improve the thermal properties of concrete. This is particularly useful in a tropical country like India where the mercury levels are quite high for most part of the year, so as to maintain the room temperatures within comfort levels of its inhabitants. It can also reduce the load on air conditioning systems thus reducing the power consumption.

The acoustic properties of concrete reinforced with other natural fibers have been studied in the past using an impedance tube apparatus and the results are fair enough to justify the use of coconut fibers as an alternative which is a good absorbent due to the presence of surface pores.

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