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Experimental study on natural fibre in concrete

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ABSTRACT

The rising cost of construction material is a matter of concern. The reason for increase in cost is high demand of concrete and scarcity of raw material. Hence the concrete technologists are researching on alternative materials in the construction world. In this study, M_{25} grade of concrete was produced by adding coconut fibre (coir). Forty five cylinders were casted and their split tensile strength and workability's were evaluated at 7and 28 days. The workability and tensile strength of concrete increased to some extent as the coir increased. Concrete produced by 2%, 2.5%, & 3% addition attained 28 days tensile strength. These results showed that Coir Fiber Concrete can be used in reinforced concrete construction. Its utilization is eco-friendly.

Keywords: Cement, Coconut Fibre, M_{25} grade concrete, Mechanical Properties.

INTRODUCTION

Concrete is world's most widely used construction material. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities. The coconut fiber, termed as coir, when dried contains cellulose, lignin, pentosans and ash in varying percentage .In Asia, the construction industry is yet to realize the advantages of light weight concrete in high rise buildings. Coconut fibers are not commonly used in construction industry and are often dumped as agricultural waste. The aim of this research is to spread awareness of using coconut fibre as fifth ingredient in concrete and determining its tensile strength and workability. Until now, Industrial by products and domestic wastes has been utilized in concrete, but the use of agricultural waste in concrete is in its infancy stage. Coconut fiber is an agricultural waste. The materials are proportioned by their weights. The water cement ratio is obtained by conducting various workability tests. The obtained results are compared with that of conventional mix. Tests are as per the specified procedure of Indian Standard Codes. [1, 2]

Advantages of Coir Fibre

- The addition of coconut-fibres significantly improved many of the engineering properties of the concrete, notably torsion, toughness and tensile strength.
- The ability to resist cracking and spalling were also enhanced.
- However, the addition of fibers adversely affected the compressive strength. [3-6]

Scope of this project

- To control the environmental pollution.
- To produce low cost concrete.
- Economical and profitable substitute to landfills, incinerator.

MATERIALS AND PROPERTIES

The materials used in research are:

1. Ordinary Portland Cement (53 grade)
2. Fine Aggregate(4.75mm)
3. Coarse Aggregate(20mm)

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4. Coir Fibre
5. Water

Cement

Cement is made by grinding calcined limestone and clay into a very fine, grey powder. Cement is one of the binding agent in this project. The cement and water forms a paste and binds the other materials together. The Ordinary Portland Cement (53grade) conforming to IS: 8112-1989 is being used. Many tests were conducted on cement. [7-12]

S.No	Property	Result
1.	Specific Gravity	3.12
2.	Consistency	31%
3.	Initial setting time	30 min
4.	Final setting time	410 min
5.	Fineness	6%

Fine aggregate

Fine aggregate used throughout the work comprised of clean river sand with maximum size of 4.75mm conforming to Zone I as per IS 383-1970. Sand is naturally occurring granular material composed of finely divided rock and mineral particles. The physical properties of fine aggregate like specific gravity, fineness modulus and water absorption are tested in accordance with IS:2386.

S.No	Property	Result
1.	Specific Gravity	2.65
2.	Fineness modulus	4.64%
3.	Water absorption	1.0%

Coarse aggregate

Coarse aggregate consists of crushed granite or basalt rock, conforming to IS: 383. Coarse aggregate are used in the size of 20mm.The physical properties of coarse aggregate like specific gravity, fineness modulus and water absorption are tested in accordance with IS:2386

S.No	Property	Result
1.	specific gravity	2.8
2.	Water absorption	0.5%

Coir fibre

Coconut fiber is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fiber is coir, Cocos nucifera and Arecaceae (Palm), respectively. There are two types of coconut fibers, brown fiber extracted from matured coconuts and white fibers extracted from immature coconuts. Brown fibers are thick, strong and have high abrasion resistance. White fibers are smoother and finer, but also weaker.

However, steel reinforcement is still expensive for many people who want to build earthquake resistant houses. To overcome the difficulty, an economical but safe constructional material is

needed. Natural fibers can be one possible material, as they are cheap and locally available in many countries. In this present work, the natural Coir fiber using in concrete.

***Fig.* 1 Coconut Fibres**

Natural fibers such as jute, sisal, pineapple, abaca and coir have been studied as a reinforcement and filler in composites. Growing attention is nowadays being paid to coconut fiber due to its availability. The coconut husk is available in large quantities as residue from coconut production in many areas, which is yielding the coarse Coir fiber. Coir is a lingo-cellulose natural fiber. It is a seed-hair fiber obtained from the outer shell, or husk, of the coconut. It is resistant to abrasion and can be dyed. Total world Coir fiber Production is 250,000 tonnes. The Coir fiber industry is particularly important in some areas of the developing world. Over 50% of the Coir fiber produced annually throughout the world is consumed in the countries of origin, mainly India. Because of its hard-wearing quality, durability and other advantages, it is used for making a wide variety of floor furnishing materials, yarn, rope etc. However, these traditional coir products consume only a small percentage of the potential total world production of coconut concrete.

Table No. 1 Physical properties of Coir Fibres

S. NO	Property	Coir Fibre
1.	Specific Gravity	1.42
2.	Density(g=cm^3)	1.2
3.	Tensile Strength(MPa)	175
4.	Elongation to failure	30
5.	Water absorption	130-180
6.	Modulus(GPA)	1.2

Water

Water cement ratio (w/c) of 0.45 was used in the preparing of concrete and for this purpose portable water used for mixing and curing purpose.

Mix design

The concrete mix design was proposed by using IS 10262:2009.The grade of concrete used was M30 with water to cement ratio 0.45. The mix design proportions for 1 m^3 of concrete.

EXPERIMENTAL INVESTIGATION

Test on fresh concrete

Slump cone test determines the consistency and workability of all concrete mixtures. Slump cone test utilizing a metallic slump mould. The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.

Table No.2 Slump Value

% of Replacement	Slump value (mm)
10	180
15	189
20	190
25	170
30	175

Casting of moulds

Casting of conventional concrete of M_{25} mix ratio and also casting of 10%,15%,20%,25% and 30% replacement of cement by Coir Fibre. The concrete specimens were cured under normal conditions as per IS 516-1979 and were tested at 7 days and 28 days for determining compressive strength and split tensile strength.

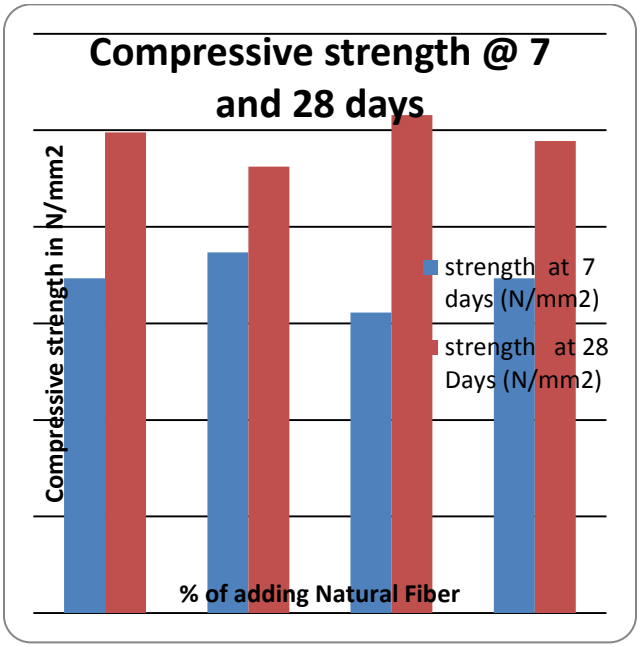
Fig.2Casting of Moulding

Compressive strength

Compressive strength Test results for cube specimens of size 150mm×150mm×150mm. In this test, the cubes are subjected to compressive force in a compression testing machine and the ultimate load at which the failure occurs is noted. Then the compressive stress is ultimate load by area exposed to load and stress value is obtained in $N/mm^{2.}$

Fig.3 Compression strength test

Table No.3 Comparison of Compressive strength @ 7 and 28 days



S. No	Coir Fibre	Compressive strength at 7 days (N/mm^2)	Compressive strength at 28 Days (N/mm^2)
1.	0%	17.33	24.89
2.	2 %	18.67	23.11
3.	**2.5** %	15.56	25.78
4.	3 %	17.33	24.44

Split tensile strength

This test is carried out in a cylindrical specimen of 150 mm diameter and 300 mm length. The cylindrical specimen is placed horizontally between the loading surface of a compression-testing machine and the load is applied until failure of cylinder occurs along the vertical diameter. The split tensile strength is given by the formula 2P/ (ΠDL) and the stress value is obtained in N/mm^2.

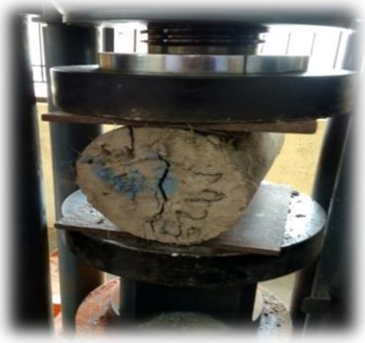


Fig.4 Split tensile strength

CONCLUSION

It is concluded that

- Increase in percentage addition by coir increased tensile strength. But, if coir added is 5%, then strength decreases.
- Coconut Fiber increased the slump value and compaction factor value of Concrete.
- The following recommendations are made at the end of the study.
- Effect of different admixtures can be studied on Coir Fiber Concrete.
- Evaluating Bond Strength of Coir Fiber Concrete.
- Coconut Coir- Cement compatibility.

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