A DISSERTATION REPORT ON

BEHAVIOUR OF FIBRE REINFORCED LIGHTWEIGHT AGGREGATE CONCRETE UNDER STATIC LOAD

Submitted by

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Acknowledgement

I take this opportunity to express my deep sense of gratitude to each and every one who lend me a helping hand in my research. First and foremost we thank God Almighty for showering his immense blessings upon me throughout this venture.
I am grateful by the patience and concern of my guide **Jimmy Gupta** (Asst. Professor, Department of Civil Engineering). His valuable inputs, constant encouragement and constructive feedback kept me in the right track and motivated, which helped me in timely completion of this work.
I also express my sincere gratitude to other staff members, Department of Civil Engineering and my parents for their encouragement and support.

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Abstract

The construction industry is developing and revolutionizing in terms of equipments and materials used, the cost of construction has also increased significantly with negative impact on the environment. This has resulted many scientist and engineers to come up with a research for the replacement of our raw materials and this has adopted the use of coconut fibres for the enhancement of concrete.

Since concrete is strong in compression and weak in tension there is a need to increase its tensile strength. Coconut fibres have a maximum amount of lignin which improves its tensile strength and durability, which makes it most suitable for use. This paper presents experimental study of fibre reinforced lightweight aggregate concrete using coir as the reinforcement. The experiment is carried out by casting fibre reinforced lightweight concrete and checking for its compressive strength, flexural strength and split tensile strength.

Keywords : Compressive strength**,** split tensile strength, flexural strength, coir, fibre reinforced lightweight aggregate concrete, CFRC

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Chapter-1

Introduction

1.1 General Introduction on Coir

Concrete is one of the most commonly and widely used material for construction. They are weak in tension and strong in compression so they crack easily. When concrete is reinforced with fibres, we get favourable behavior for repeated loads. Adding fibres to concrete has been widely known to improve the energy absorption and crack resistance. Research carried out in various parts of the world has established that addition of fibres improve the static flexural strength, ductility, fatique and fracture toughness of the material.

Concrete are mainly reinforced with steel and synthetic fibres like carbon and glass. Despite of their mechanical advantages their high material costs, high energy consuming process and their adverse effects on the environment has led the research study of new environment friendly and sustainable alternatives. There is a rapid growing in the study of new materials that is environment friendly, annually renewable, cheap agricultural crops and crop residues that is applicable for the reinforcement of concrete. Coconut fibre being the most ductile among all natural fibres has the potential to be used as a reinforcement material in concrete.

Below are the composition of coconut fibre as by **Ramakrishna, et al. (2005)**

Fibre	**Hemi-cellulose(%)**	**Cellulose(%)**	**Lignin(%)**
Coir	31.1	33.2	20.5

Ramakrishna and Sandararajan (2005) investigated for the chemical composition and test their tensile strength of four natural fibres (jute, sisal, coir, hibiscus canabinus fibres), they alternately dry and wet and soak for 60 days in three mediums (water, sodium hydroxide, lime). Chemical compositions change for all fibres and fibres lost their strength. But coconut fibres were tested to have most tensile strength for all tested conditions.

1.2 General Introduction on Lightweight Aggregate Concrete

One of the main disadvantages of conventional concrete is the high self-weight of concrete. The density of normal concrete is from 2200 to 2600kg/m3. The high self-weight of normal concrete will make the material uneconomical. Lightweight concrete was made to reduce the self-weight of concrete and to increase the efficiency of concrete as a structural material. Lightweight concrete have a density varies from 300 to 1850 kg/cm3.

Some of the advantages of having low density concrete are reduction of dead load, increases the progress of building, and lowers haulage and handling cost. The weight of the building on the foundation is important factor in design especially in case of weak soil and tall structures. If floors and beams are made up of lightweight concrete it will result in considerable economy. Most important characteristic of lightweight concrete is low thermal conductivity, a property which improves with increasing density. In extreme climatic conditions and also in case of buildings where air conditions is to be installed, the use of lightweight concrete with low thermal conductivity will be advantageous from the point of view of thermal comforts and lower power consumptions. Also the adoption of lightweight concrete gives an outlet for industrial wastes such as clinker, fly ash, slag etc. which otherwise create problem for disposal.

A particular type of lightweight concrete called structural lightweight concrete is the one which is comparatively lighter than conventional concrete but at the same time strong enough for the use of structural purposes. It therefore combines the advantages of normal weight concrete and discards the disadvantages of normal weight concrete. Sintered Fly ash Lightweight aggregate are commonly used.

1.3 Objectives

The aim of this study is to investigate the behaviour of fibre reinforced lightweight aggregate concrete under different loading conditions.

The objectives of this work is to find the compressive strength, tensile strength and split tensile strength of fibre reinforced lightweight aggregate concrete.

Chapter-2

Literature Review

2.1 Overview

This chapter deals with various research works done on coir fibre reinforced concrete and how coir fibred reinforced is advantageous over normal concrete.

2.2 Reviews

(Ramaswamy et al., 1983) paper shows that vegetable fibres such as jute, coir, and bamboo can be used with advantage in concrete in a similar manner to other fibres. Improvement in impact strength of over 25% and increased static loading and considerably lower shrinkage characteristics of the order of 50-70% compared to those of plain concrete are noted as positive features of vegetable fibre additions.

(Ramakrishna et al., 2005) states that with the reinforcement of mortar slabs with four natural fibres such as coir, jute, sisal and hibiscus cannebinus the impact resistance are found to be 3-18 times higher than that of plain cement mortar slabs. Coir fibre reinforced mortar slabs have absorbed the highest impact energy (i.e. 253.5J at 2% fibre content and fibre length = 40mm).

(Majid Ali, 2010) concluded that coir are most ductile and energy absorbent among all natural fibres tested. Coir have the capability to be used as composites for different purposes. And many have investigated and concluded that reinforcing concrete with coir give a better properties than plain concrete. He also stated that in civil engineering, coconut fibres have been used as reinforcement in composites for non-structural components and that there is a need of investigating the behaviour of coconut fibre reinforced concrete to be used in main structural components like beams and columns.

(Hasan et al., 2012) states that in all cases, the compressive strength of concrete decreased as the volume percentage of coir increased in the concrete mix. Test results shows that for plain concrete the compressive strength is 31.57 MPa while concrete with 3% coconut fibre compressive strength is 18.85 MPa which satisfies the structural requirement of lightweight concrete. He also states that coconut fibre reinforced concrete can enhance higher toughness.

(Jerin Antony, 2014) states that at 5% addition of coir with water cement ratio of 0.5, compressive strength tests yielded best results. However, compressive strength decrease with further addition of coir. The split tensile strength and flexural strength is highest at 5% of fibre content**.** The tensile properties and cracking pattern of coir fibre reinforced concrete shows that it can be useful in construction activities in seismic zones due to its high tensile strength and post peak load behavior.

(Tanmay Shah, 2016) states that the compressive strength of fibre reinforced concrete is nearly 13% more than that of normal or plain concrete. The tensile strength and flexural strength of CFRC is 15% more than that of plain concrete. It also states that 5% by weight of cement can be saved if the strength of CFRC and plain concrete was to be kept same.

(Nitin Sam, 2016) states that the durability for coir fibre reinforced concrete such as acid attack, sulphate attack and water absorption shows improved durability properties when compared to concrete with no fibre content.

The next chapter is methodology which gives the overview aspects of this research.

Chapter-3

Methodology

3.1 Literature review

Based on the previous research work, the strength of coconut fibre reinforced lightweight aggregate concrete will be achieved by casting the concrete and testing the compressive strength, split tensile strength and flexural strength for 7^{th} and 28^{th} day after curing. Test are to be conducted by adding coir of 1%, 2% and 3% of cement weight, using lightweight aggregates as coarse aggregates and adding superplasticizer with 0.6% of water content.

3.2 Collection of raw materials

The materials used in this study are :

Cement : Ordinary Portland Cement

Sand : M-sand or river sand

Coconut Fibre : From the market where it is available as waste

Water : Available fresh local water

Coarse Aggregate : Sintered fly ash lightweight aggregate

Admixture : Superplasticizer

3.3 Materials test

3.3.1 Tests on cement

The test done are :

1. Standard Consistency : Experiment will be done as per IS 4031-PartIV
2. Initial setting time : Experiment will be done as per IS 269:1989
3. Final setting time : Experiment will be done as per IS 269:1989

3.3.2 Test on coarse aggregate

To determine the various properties of aggregates different test are done. They are :

1. Specific Gravity : Experiment will be done as per IS 383:1970
2. Sieve Analysis : Experiment will be done as per IS 383:1970

3.3.3Test on fine aggregate

To determine the various properties of fine aggregates various test are done.

1. Specific Gravity : Experiment will be done as per IS 383:1970
2. Sieve analysis : Experiment will be done as per IS 383:1970

3.4 Mix Design

Mix design is defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as possible.

A mix design will be conducted as per IS 10262:2009 to arrive at M30 mix concrete.

3.5 Mixing of Concrete

The concrete mix will be same as that of plain concrete except for adding of coir and superplasticizer. During mixing the speed should be at maximum so that the fibre do not tangled up and form a ball. Superplasticizer will be added in its fresh state before mixing. The mould is placed at a vibration table and vibrations were stopped as soon as slurry appeared on the top surface of the mould.

3.6 Casting and Curing

These specimens will remain in the mould for 24hrs. at ambient condition. After that they will be demoulded with care so that no edges are broken and are placed in the tank at ambient temperature for curing. After demoulding by loosening the screws of the steel mould, the cubes are placed in the water for 7 days and 28 days.

3.7 Testing of Specimen

The remoulded specimen after being cured for sufficient time period will be taken out and dried in sunlight and tested under standard testing apparatus.

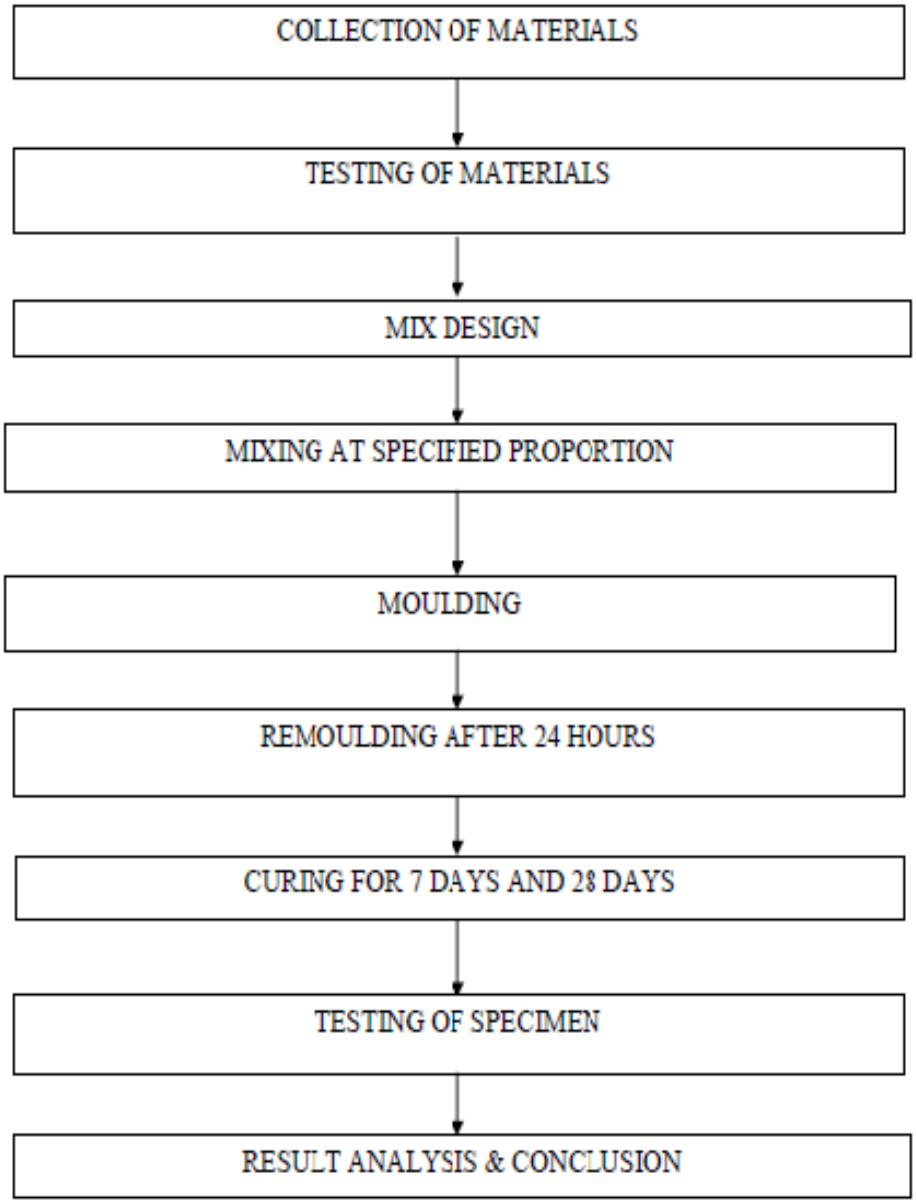

Figure 1 Schematic Representation of Methodology

Chapter 4

Conclusion

Coconut fibre have been used as a material for making mattress and ropes, but since has been used as a reinforcement for concrete. It acts as a source of income for the coconut producer who will get the benefit generated by the construction industry. It also saves the environment and the waste generated will be lesser which is be essential for living things.

4.1 Future scope

Although there has been a significant study on the reinforcement of concrete using coir, they are not as sufficient as steel or carbon fibre. A further study on this will be very revolutionary in the terms that if we can alter this coir for reinforcement that will give us the same properties as that of steel or carbon fibre.

Chapter 5

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