Human Hair Fiber Reinforced Cement Concrete

Ramya.T[1] and Tamilamuthan.B[2]

[1]Ramya.T, Civil Engineering/C.K.College of Engineering and Technology, Cuddalore, TamilNadu, India/ramyatharmaraj@yahoo.com

[2]Tamilamuthan.B2, Civil Engineering/ C.K.College of Engineering and Technology Cuddalore, TamilNadu, India / b.tamilamuthan@gmail.com

ABSTRACT

Fiber reinforced concrete can offer a convenient, practical and economical method for overcoming micro-cracks and similar type of deficiencies. Since concrete is week in tension hence some measures must be adopted to overcome this deficiency. Human hair is strong in tension; hence it can be used as a fiber reinforcement material. Hair fiber is an alternate non-degradable matter is available in abundance and at a very cheap cost. It also creates Environmental problems for its decompositions. Present studies has been undertaken to study the effect of human hair on plain cement concrete on the basis of its compressive, crushing, flexural strength and cracking control to economies concrete and to reduce environmental problems. Experiments were conducted on concrete cubes with various percentages of human hair fiber i.e.0%,0.5%, 1% and 1.5%,by weight of cement.

Keywords: Fibre Reinforced Concrete, Hair fibre, Compressive strength, Flexural Strength

1. INTRODUCTION

1.1. GENERAL

Almost everybody has heard about the concrete and knows that it is something which is used in construction of structures. And also very few of us have heard about the hair fiber reinforced concrete. But what exactly is it?

The strict Environmental regulations and economical purpose recycling of saloon waste hair the use of alternative Eco-friendly Natural reinforcements to produce advanced composite materials. The large quantities of human & animals hair fiber are not always well managed or utilized. In India, Three to four tons of human hair fiber wasted annually. These composites are having low density and cost as well as satisfactory mechanical properties make them an attractive due to easy availability and renewability of raw materials.

1.2. Introduction

1.2.1. Fiber Reinforced Concrete

Fiber Reinforced Concrete (FRC) was invented by French gardener Joseph Monier in 1849 and patented in 1867. The concept of using fibers as reinforcement is not new. This can be proved by the following: Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks. In the early 1900s, asbestos fibers were used in concrete, and in the 1950s the concept of composite materials came into being and fiber reinforced concrete was one of the topics of interest. There was a need to find a replacement for the asbestos used in concrete and other building materials once the health risks associated with the substance were discovered. By the 1960s, steel, glass (GFRC), and synthetic fibers such as polypropylene fibers were used in concrete, and research into new fiber reinforced concretes continues today.

Fiber Reinforced Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers.

Fiber is a small piece of reinforcing material possessing certain characteristics properties. The fiber is often described by a convenient parameter called aspect ratio. The aspect ratio of the fiber is the ratio of its length to its diameter.

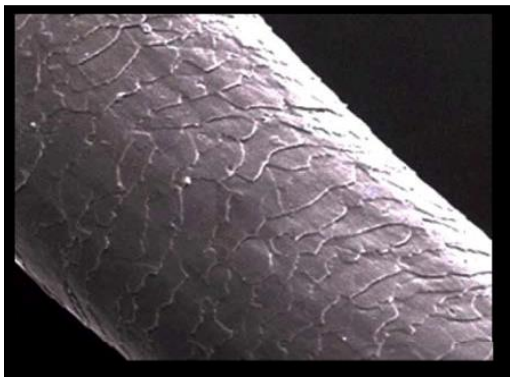


Fig 1.1: Details of External Surface Hair

Hairs are used as a fiber reinforcing material in concrete to study its effects on the compressive, crushing, flexural strength and cracking control to economies concrete and to reduce environmental problems created by the decomposition of hair. Concrete as one of the most widely used building materials, it is composed of three main elements: cement, sand and fillers in which they are bonded together by cement and formed concrete that is in fact a man-made stone. Its compressive strength is acceptable and tensile strength is very low (about ten percentage of compressive strength). This weakness has plumbing problems, including concrete shrinkage and cracking Shrink age of concrete depends on too many factors including: the ingredients, temperature and relative humidity of concrete, concrete age, size and structure. In fresh concrete due to shrinkage concrete dimension has changed and created cracks and these cracks in concrete increase perme ability, loss of concrete surface, reinforcement corrosion.

To compensate such weak tensile strength of concrete with construction materials like concrete, reinforced with fibers was invented. Man waste hair as natural fibers is used. With reinforcing fibers within the concrete its tensile strength extremely increases. This composite has suitable integrity, continuity and provide appropriate use of concrete as a flexible material to produce high levels of curvature resistant surfaces. Concrete fiber also has high energy absorption and under impact loads is not easily torn apart.

1.2.2Fibers are used in Concrete

Fibers are usually used in a concrete for the following reasons:

- To control cracking due to both plastic shrinkage and drying shrinkage.
- They also reduce the permeability of concrete and thus reduce seepage of water.
- Some types of fibers also produce greater impact, abrasion and shatter resistance in concrete.

The fineness of the fibers allows them to reinforce the mortar fraction of the concrete, delaying crack formation and propagation. This fineness also inhibits seepage in the concrete, thereby reducing permeability and improving the

1.3 Aim of the Project

To determine the strength and to reduce the crack of the concrete using human hair as a fiber material in reinforced concrete.

1.4 Objectives of the Project

- To increase the strength of the concrete
- To reduce the cracks on the concrete
- To reduce the Environmental problem by using Non-Degradable fiber hair as an ingredients.

2. LITERATURE REVIEW

2.1Fiber Reinforced Concrete (FRC)[11]

"Kamran M. Nemati, (2015)"Concrete is relatively brittle, and its tensile strength is typically only about one tenths of its compressive strength. Regular concrete is therefore normally reinforced with steel reinforcing bars. For many applications, it is becoming increasingly popular to reinforce the concrete with small, randomly distributed fibers. Their main purpose is to increase the energy absorption capacity and toughness of the material, but also increase tensile and flexural strength of concrete. Concrete containing hydraulic cement, water, fine or fine and coarse aggregate and discontinuous discrete fibers is called fiber reinforced concrete (FRC). It may also contain pozzolans and other admixtures commonly used in conventional concrete.

2.2 Fiber Reinforced Concrete – Behavior Properties and Application (17)

"Nataraja.M,(2015)"The weak matrix in concrete, when reinforced with steel fibers, uniformly distributed across its entire mass, gets strengthened enormously, thereby rendering the matrix to behave as a composite material with properties significantly different from conventional concrete. Because of the vast improvements achieved by the addition of fibers to concrete, there are several applications where Fibers Reinforced Concrete (FRC) can be intelligently and beneficially used. These fibers have already been used in many large projects involving the construction of industrial

floors, pavements, highway-overlays, etc. in India. The principal fibers in common commercial use for Civil Engineering applications include steel (SFRC/SFRS), glass and carbon. These fibers are also used in the production of continuous fibers and are used as a replacement to reinforcing steel. High percentages of steel fibers are used extensively in pavements and in tunneling. This invention uses Slurry Infiltrated Fiber Concrete. Fibers in the form of mat are also being used in the development of high performance structural composite. Continuous fiber-mat high performance fiber reinforced concrete called Slurry Infiltrated Mat Concrete is used in the production of High performance concrete. Use of basalt fibers are picking up in western countries. Steel fibers are also used in the production new generation concretes such as Reactive Powder Concrete Ductile and Compact Reinforcing Concrete. Properties and applications of SFRC and some of these new generation fiber concrete materials are discussed.

3. MATERIALS AND METHODS

3.1 Material Properties

The properties of different materials used namely cement, fine aggregate, coarse aggregate, Cement mortar, human hair fiber were studied. As per IS 383-1970, Sieve analysis was done for fine aggregate, Coarse aggregate to test their suitability.

3.2 Materials Used

Sl.no	Properties	Values
1.	Cross-section	Circular
2.	Diameter	18-100µm
3.	Elongation	1.6 times its dry length
4.	Length	6-50mm
5.	Specific gravity	Nil

Table 3.1 Properties of Human Hair

In most of construction projects, ordinary Portland cement with standard specifications of fine granulated sand with softness factor of 2.76 water absorption of 2.8 percent and specific weight 2.71 percent and maximum size sand aggregate of 2.36 mm were used. Water used in this project for making and curing concrete and growing samples is drinkable water. Also two different lengths of hair fibers 15 and 60 mm were used. The property of hair is discussed in following section and the reason of its usage as an amplifier in mortar is expressed.

3.3 Fine Aggregate

The gradation of fine aggregates affects the workability and finish ability of concrete. In the present study locally available river sand was used.

Fig: 3.1 fine aggregate

3.4 Coarse Aggregate

In this study, locally available coarse aggregate was used.

3.5 Human Hair

A human hair was used to partially replace by cement for making concrete specimens.

Fig 3.2 - Human Hair Used As A Fiber

3.6 Compacting

The test specimens is made as soon as practicable after mixing and in such a ways as to produce full compaction of the neither concrete with neither segregation nor excessive Latinate. The concrete is filled into the mould in layers approximately 5cm deep. In placing each scoop full of concrete, the scoop is moved around the top edge of the mould as the concrete sides from it in order to ensure a symmetrical distribution of the concrete within the mould. Each layer is compacted by hand compacting. After the top layer has been compacted, the surface of the concrete is finished level with the top of the mould using a trowel.

Fig: 3.3 compacting

4. RESULTS AND DISCUSSION

4.1General

A Concrete mix is prepared with the proportions arrived by mix design as 1:1.46:2.58 with water cement ratio of 45% by mechanical mixer. The cube mould cleaned and greased or oiled thinly. Metal moulds are sealed to their base plates to prevent loss of water. The Cubes are filled with concrete in three layers, tamping each layer with 35 strokes using a tamping rod, square in cross-section with 2.54cm side and 38.1cm length, weighing 1.818kg. While filling the moulds, occasionally stir and scrape together the concrete remaining in the mixer to keep the materials from separating. Fill the moulds completely, smooth off the tops evenly, and clean up any concrete outside the cubes. Mark the specimen by a slip of paper on which is written the date and the specimen identification. The specimens are leaved in the curing room for 24 hours. After that open the moulds and immersed the concrete cubes in a water basin for 7days, 14days and 28days. After Curing period, the specimens take out into the water and place it separately for analyzing compressive test.

4.2 Slump Cone

The concrete slump test is an empirical test that measures the workability of fresh concrete. More specifically, it measures the consistency of the concrete in that specific batch. This test is performed to check the consistency of freshly made concrete. Consistency is a term very closely related to workability. It is a term which describes the state of fresh concrete. It refers to the ease with which the concrete flows. It is used to indicate the degree of wetness. Workability of concrete is mainly affected by consistency i.e. wetter mixes will be more workable than drier mixes, but concrete of the same consistency may vary in workability. It is also used to determine consistency between individual batches and to ascertain the effects of plasticizers on their introduction. In India this test is conducted as per IS specification.

The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as true slump, shear slump or collapse slump.

If a shear or collapse slump is achieved, a fresh sample should be taken and the test repeated. A collapse slump is an indication of too wet a mix. Only a true slump is taken for the test.

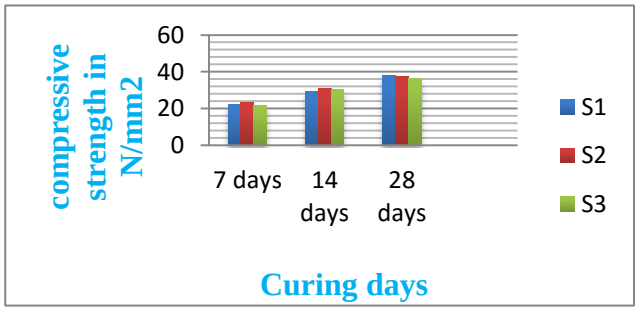
A collapse slump will generally mean that the mix is too wet or that it is a high workability mix, for which slump test is not appropriate. Very dry mixes; having slump 0 – 25 mm are used in road making, low workability mixes; having slump 10 – 40 mm are used for foundations with light reinforcement, medium workability mixes; 50 - 90 for normal reinforced concrete placed with vibration, high workability concrete; 100 mm.

Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199 – 1959. The apparatus used is Compacting factor apparatus.

Table: 4.1 Slump value

Designation (sample – S)	Human hair fiber in %	Slump value in mm
S1	0	75
S2	0.5	78
S3	1	80
S4	1.5	83

Cubes vs Compressive strength for hair fiber concrete cubes (0.5%)



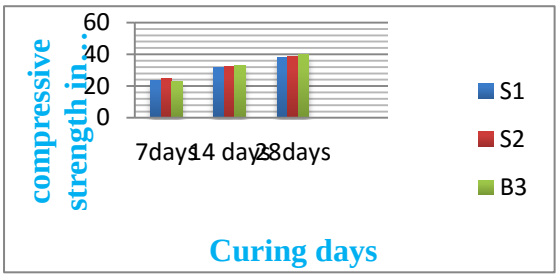


Fig 5.4(a): Cubes vs Compressive strength for hair fiber concrete cubes (0.5%) (graph)

5. CONCLUSION

According to the compressive performance test performed it is observed that there is remarkable increment in mechanical properties of concrete according to the percentages of hair fiber increased in concrete. The detailed observation of strength result is discussed below with the rate of percentage of human hair fiber.

- When M 35 concrete with 0.5% of hair is compared with the plain cement concrete, it is found that there is an increase of 1.34 N/mm^2 in compressive strength.
- When M 35 concrete with 1% of hair is compared with the plain cement concrete, it is found that there is an increase of 1.48 N/mm^2 in compressive strength.
- When M 35 concrete with 1.5% of hair is compared with the plain cement concrete, it is found that there is an increase of 2.67 N/mm^2 in compressive strength.
- When the percentage of human hair added in concrete the workability of concrete can be increased which has been analysed by slump cone test. From the study it was found that the percentage of human hair increases, the workability also increases.
- Through the investigation it was found that the shrinkage cracks get reduced when the human hair fiber is added in concrete.

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