

Comparative Study on Strength of Concrete Structures Using Human Hair and Nylon Fiber in Concrete

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Abstract— Fiber can be defined as a small piece of reinforcing material possessing certain dimensional characteristics. The properties of fiber reinforced concrete are very much affected by the type of fiber. The properties of fiber reinforced concrete are very much affected by the type of fiber. Fibers are secondary reinforced material and acts as crack arrester. Prevention of propagation of cracks originating from internal flaws can result in improvements in static and dynamic properties of matrix. Fiber reinforced cement and concrete materials (FRC) have been developed progressively since the early work by Romualdi and Batson in the 1960s. By the 1990s, a wide range of fiber composites and FRC products were commercially available and novel manufacturing techniques were developed for use with high fiber content. In parallel with the commercial development of FRC materials and products, an extensive research programme was undertaken to quantify the enhanced properties of FRC materials and more specifically to allow comparisons to be made between various types of fibers. Fiber reinforced concrete is one among those advancements which offers a convenient, practical and economical method for overcoming micro cracks and similar type of deficiencies. Since concrete is weak in tension hence some measures must be adopted to overcome this deficiency. Human hair is generally strong in tension; hence it can be used as a fiber reinforcement material. Human hair Fiber is an alternative non-degradable matter available in abundance and at cheap cost. It also reduces environmental problems. Also addition of human hair fibers enhances the binding properties, micro cracking control, Imparts ductility and also increases swelling resistance. The experimental findings in our studies would encourage future research in the direction for long term performance to extending this cost of effective type of fibers for use in structural applications. Experiments were conducted on concrete cubes, cubes and beams of standard sizes with addition of various percentages of human hair fiber and nylon fiber. Experiments were conducted on concrete cubes, cubes and beams of standard sizes with addition of various percentages of human hair fiber and nylon fiber i.e., 0%, 0.7%, and 1.4% by weight of cement, fine & coarse aggregate and results were compared with those of plain cement concrete of M-30 grade. For each percentage of human hair and nylon fiber are added separately in concrete, cubes and beams were tested for their respective mechanical properties at curing periods of 7 and 28 days. slump cone test were undertaken as well as hardened concrete test is compressive strength and Flexural Strength at the age of 7 and 28 days was obtained.

Keywords: Human Hair, Nylon Fiber, FRC

I. INTRODUCTION

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. Fiber reinforced concrete (FRC) is a composite material consisting of cement, sand, coarse aggregate, water and fibers. In this composite material, short discrete fibers are randomly distributed throughout the concrete mass. The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of equal cost. Due to this benefit, the use of FRC has steadily increased during the last two decades and its current field of application includes: airport and highway pavements, earthquake-resistant and explosive-resistant structures, mine and tunnel linings, bridge deck overlays, hydraulic structures, rock-slope stabilization, etc. Extensive research work on FRC has established that addition of various types of fibers such as metallic and non-metallic fiber like (steel), glass, synthetic, and carbon, in plain concrete improves strength, toughness, ductility, post-cracking resistance.

A. Human Hair Fiber

Human hair is good in tension; hence it can be used as a fiber reinforcing material. Hair Fiber (HF) is a non-degradable matter available in abundance and at a very cheap cost. Human hair is considered as a waste material in most parts of the world and is a common constituent found in municipal waste streams which cause enormous environmental problems from its degradation. Also the high tensile strength, unique chemical composition, thermal insulation etc. makes the hair fiber suitable to be used as a reinforcing material. Experiments were conducted on concrete specimens with various percentages of human hair fiber i.e. 0%, 0.7% and 1.4% by weight of cement. Researchers found that there is an increment in the various properties and strength of concrete which makes it a suitable additive for concrete to enhance its mechanical properties.

B. Objectives of Project

- Waste Management of non-biodegradable Human Hair as a fiber reinforcement.
- Investigation of utilization of human hair waste as additional material in concrete mixes to be used for various construction projects, ensuring that the resulting concrete has proper compressive strength.

- To prepare mixes containing various proportions of the human hair waste and nylon fiber.
- Comparison of results of various characteristics with control mix.
- To minimize the cost of production of concrete by adding human hair waste with concrete mix.
- To control cracking due to both plastic shrinkage and drying shrinkage.
- To obtain abrasion and shatter resistance in concrete.

C. Scope of Project

Amid investigate work we likewise confronted the issue of uniform appropriation of hair in the concrete. So a productive technique for blending of hair fiber to the concrete blend is to be discovered. A wide report on fractional substitution of bond utilizing fine hair fiber is to be done. It is important to think about the impact of length of fiber on high quality cement generally. The investigation of admixtures and super plasticizer which could disseminate the hairs without influencing the properties of cement The exploration can be additionally stretched out to consider the impact of hair fiber on different properties of composites such physical, warm properties and appearances.

II. MATERIAL USED

A. Cement:

Cement is a well-known building material and has occupied an indispensable place in construction work. There is a variety of cement available in market and each type is used under certain condition due to its special properties such as colour and composition of cement. The function of cement is first to bind the sand and coarse aggregates together and second to fill the voids. Although cement constitutes only about 10 percentage of the volume of the concrete mix, it is the active portion of the binding medium and the only scientifically controlled ingredient of concrete. Locally available cement is used. Like PPC (PARASAKTI- Cement).

B. Aggregate :

1) Fine Aggregate:

Vertical Shaft Impactor (V.S.I.) Sand is also known as Artificial Sand or Crushed Sand. Only sand manufactured by V.S.I. Crusher is cubical and angular in shape. There is standard specification for Fine Aggregates (Sand). It is divided in four gradations Zone-I, Zone-II, Zone-III & Zone-IV. Generally the size of the aggregate lesser than 4.75 mm is considered as Fine Aggregate.

2) Coarse Aggregate:

The broken stone is generally used as a coarse aggregate. Aggregate occupies most of the volume of the concrete. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. Locally available Coarse Aggregate used of 20 mm and down size. Testing is done as per Indian Standard Specification IS: 383-1970. The size of the aggregate bigger than 4.75 mm is considered as Coarse Aggregate. The coarse aggregate passing through 20 mm sieve and retained on 4.75 mm sieve & specific gravity 2.68

C. Water:

Water fit for drinking is generally considered fit for making concrete. Water should be free from acids, oils, alkalis, vegetable or other organic impurities. Water is used for mixing, curing purpose should be clean and portable, fresh and free from any bacteria and desire matter conforming to IS 3025-1964 is used for mixing. Soft water also produces weaker concrete. Water has two functions in concrete mix. Firstly, it reacts with the cement to form a cement paste; secondly it serves as a vehicle or lubricant in the mixture of fine aggregate and cement. Water is a key ingredient in the manufacturer of concrete. Ordinary tap water is used for concrete mix.

D. Human Hair:

The hair needed for the preparation of concrete cubes was collected from salons. It needs treatments before to be added in the concrete specimens. human hair was used as a admixture in various percentages i.e. 0%, 0.7%, 1.4% by weight of cement for making concrete specimens.

Property	Value
Hair diameter	100 to 120µm
Hair length	60mm
Aspect ratio	500-600
Tensile strength of human hair fibre	380Mpa
Ultimate tensile strength	50.16%

Table 1: Properties of Human Hair

E. Nylon Fiber:

A Nylon Fiber was used as a admixture in various percentages i.e. 0%, 0.7%, 1.4% by weight of cement for making concrete specimens.

Properties	Values
Appearance	Off- White Powder
pH (10% solids)	4.1 - 5.2
Bulk Density (Kg/l)	0.4 - 0.6
Specific Gravity	2.5
Loss on Ignition (%)	1.6

Table 2: Properties of Nylon Fiber

III. CASTING SPECIMEN

Test specimens of Cubes of size 150mm x 150mm x 150mm, beam with 700mm x 150mm x 150mm will prepared using the standard moulds. The samples are cast. The samples are remoulded after 24hrs of casting and kept in a water tank for 7 and 28 days curing. A total of 45 specimens cast for testing the properties such as compressive strength, and flexural strength. 30 cube samples of size 150mmx150mmx150mm for different percentages of human hair and nylon fiber separately is used as a admixture in various percentages i.e. 0%, 0.7%, 1.4% by weight of cement for making concrete specimens. All cubes will casted in one lift and consolidated using machine vibrator. After final setting of cubes, the cube moulds will be removed and cubes will kept in water tank for curing up to 7 and 28 days.

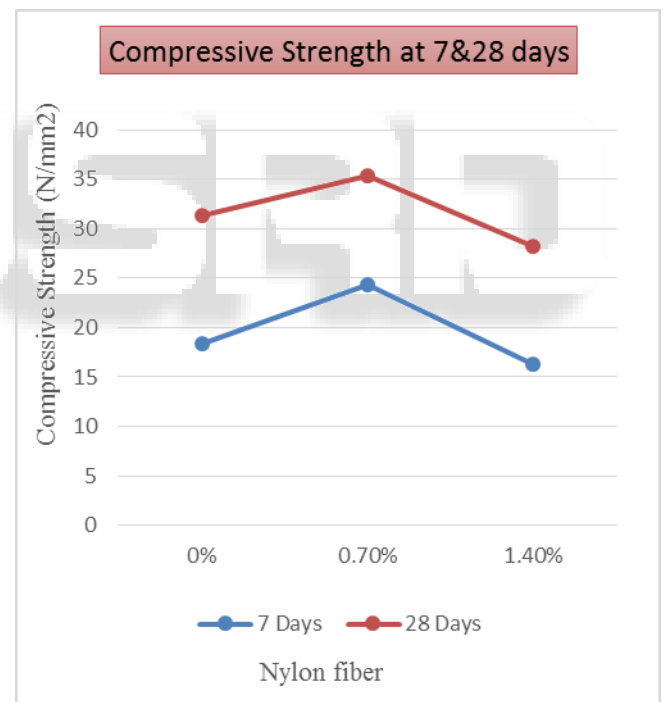
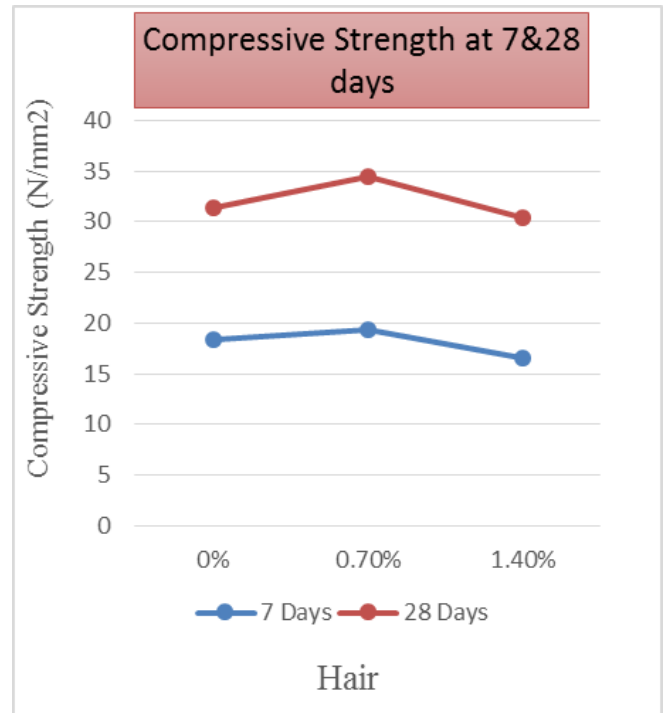
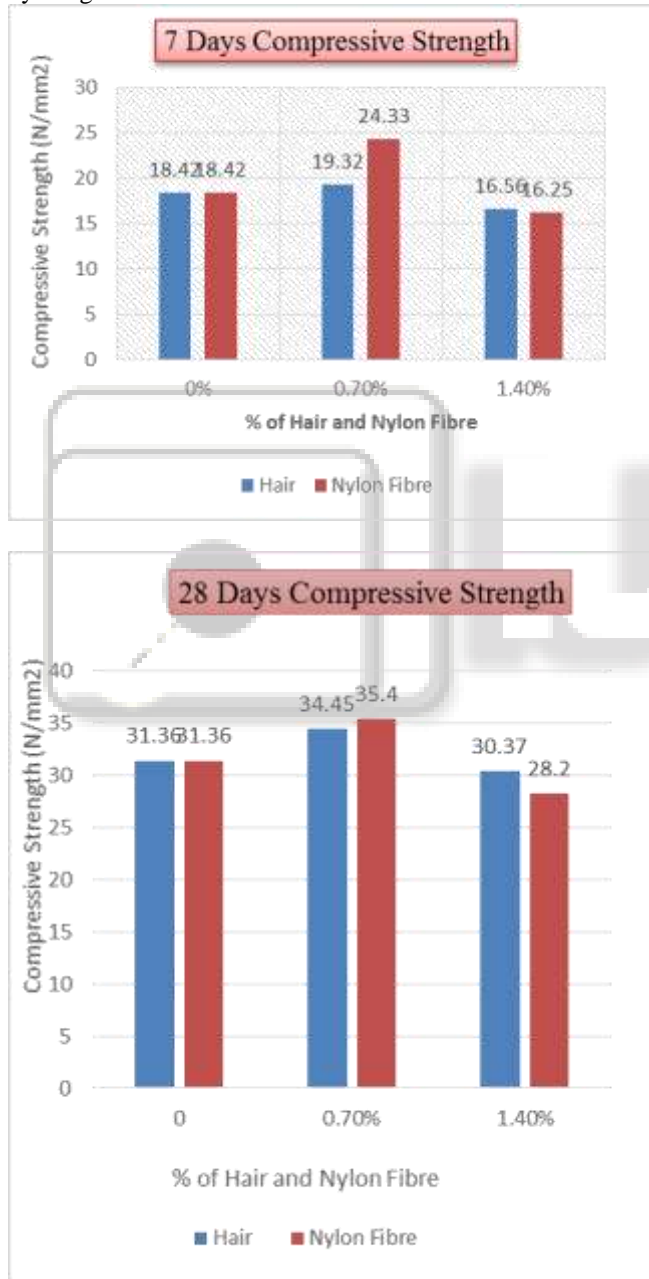
All specimen beams size 700mm × 150mm × 150mm will casted with optimum compressive strength for the specific mix in single lift and consolidated using tamping rods. After setting, the beams will covered with wet gunny bags. The burlap will be kept for 3days. At the end of the third

day, the forms will be stripped and beams will be kept for curing up to 28 days.

IV. EXPERIMENTAL METHODOLOGY:

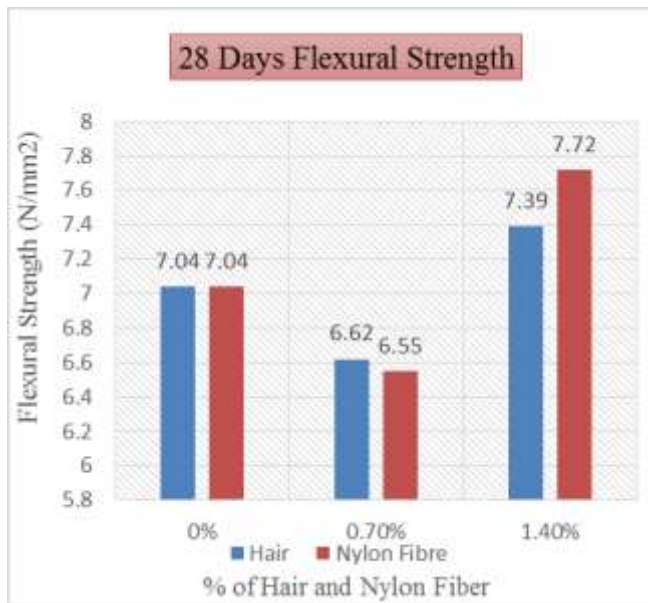
A. Compressive Strength Test

The result of compressive strength after 7 days and 28 days are recorded. Results indicate that as we increase the percentage of human hair and nylon fiber from 0% to 0.7%, the compressive strength increases. After a further increment in the percentage of human hair and nylon fiber, there is a loss in compressive strength. That means we can replace up to 0.7% by weight of cement in concrete.



B. Flexural Strength Test

Testing of all beam specimens with two points loading for flexural strength. Results indicate that if we increase the percentage of Human Hair and Nylon fiber from 1 to 1.4% will give us good results and help to increase flexural strength of concrete.



V. CONCLUSION

Addition of human hair (natural fibres) and nylon fibres (artificial fibres) to the concrete mix can increase the compressive strength and flexural strength than normal concrete. the compressive strength of concrete is one of the most important and useful properties of concrete. the results indicate that the concrete properties were significantly influenced by using fibre. From this result, it is evident that for improving the properties of concrete, the percentage increment of compressive strength using nylon fibre than normal concrete. In the present investigation, though the available results clearly imply the influence of nylon fibre on the properties of fresh and hardened concrete.

The major conclusions derived from this study are as follows:

- For cubes, at 0.7% use of mix nylon fibre get 8% more compressive strength comparatively use of human hair which is also 18% more than normal concrete after 28 days of curing.
- For cubes, at 1.4% use of mixing nylon fibre get less compressive strength comparatively use of human hair after 28 days of curing.
- For beams, at 0.7% use of mixing nylon fibre get less flexural strength comparatively use of human hair after 28 days of curing.
- For beams, at 1.4% use of mixing nylon fibre get 5% more flexural strength comparatively use of human hair which is 10% more than normal concrete after 28 days of curing.

Addition of human hair (natural fibers) and nylon fibers (artificial fibers) to the concrete mix can increase the compressive strength and flexural strength of normal concrete.

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