Experimental Analysis and Application of Human Hair as a Fibre Reinforced In Concrete

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ABSTRACT

Fibre reinforced concrete offer a convenient, practical and economical technique for overcoming micro-cracks. Since, concrete is weak in tension hence some procedures must be adopted to overcome this deficiency. Human hair is strong in tension; hence it can be used as a fibre reinforcement material. Hair Fibre (HF) an alternate non-degradable matter is available in abundance and at a very economy cost. It also creates environmental problem 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, flexural strength and cracking control to economies concrete and to moderate environmental problems. Experiments were conducted on concrete beams and cubes with various percentages of human hair fibre i.e. 0%, 1%, 1.5%, 2%, 2.5%, 3%, 3.5%, 4%, 4.5%, 5% by weight of cement. For each grouping of proportions of concrete beam and cubes of standard sizes are tested for their mechanical properties at curing periods of 7, 14 and 28 days. By testing of cubes and beams we initiate that there is an raise in the various properties and strength of concrete by the addition of human hair as fibre corroboration in concrete.

Keywords/ Index Term— Fibre reinforced concrete, hair fibre, compressive strength, flexural strength.

1. INTRODUCTION

Fibre Reinforced Concrete (FRC) improves strength of a concrete as they contain fibrous material. FRC is a mixture of cement, sand, aggregates and fibrous materials that are mixed with concrete. Fibers may be of steel, glass, horse hair, human hair or synthetics. Fibers have been used in ancient time, it is not new thing. Human hairs were used in mortar to improve its inherent properties. FRC reduces crack development. Studies have been done on FRC that have proven it improves compressive as well as flexural strength of concrete.

Hair is used as fiber reinforcing material in concrete for the following reasons:

• Hairs are used as a fibre reinforcing material in concrete to study its effects on the compressive, crushing, flexural strength and cracking control to economies concrete as it is good in tension.

• Fibers are added to increase its tensile strength which is equal to that of copper wire with similar diameter and improve the characteristics of construction materials.

• Hair forms a very rigid structure in the molecular level, which is able to offer the thread both flexible and mechanical resistance.

• Hair fibre has an elastic characteristic, and it may undergo moderate stretching either wet or dry. When dry, the hair thread may stretch 20-30% of its length; and, in contact with water, this may reach up to 50%.

•Human hair fibers in concrete mixture increase concrete workability and decrease shrinkage cracks.

• Hair, a non-degradable matter is creating an environmental problem so it used as fibre reinforcing material can minimize the problem.

• It also available in abundance and at a very low cost.

For this purpose, human hair fibers were used in 0 %, 1.5%, 2%, 2.5%, 3%, 3.5%, 4%, 4.5%and 5% weight percent of cement and the length of the fibers in each case varied between 15 and 60 millimeter. As per research paper considerable amount of hair may reduce in the shrinkage in the hair reinforced concrete.

2. AIM AND OBECTIVE

To check the properties Fibre reinforced concrete can offer 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 strong in tension; hence it can be used as a fibre reinforcement material. Human Hair Fibre (HHF) an alternate non-degradable matter is available in abundance and at a very cheap cost. It also creates environmental problem for its decompositions. Our aim is to study the effect of human hair on Ordinary Portland Cement (OPC) on the basis of its compressive, crushing, flexural strength and cracking control to economies concrete and to reduce environmental problems.

• Waste Management of non- biodegradable Human Hair as a fibre 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.

• To determine basic characteristics of the concrete such as compressive strength, density, water absorption and slump value.

• 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.

• To improve the surface characteristics of the hardened surface.

3. LITERATURE REVIEW

This chapter presents the background information on the issues to be considering in the present research work and to focus the significance of the current study.

Jain.D and Kothari.A,[3] It is detected that there is significant increment in properties of M25 concrete with 1% hair is equated with the plain cement concrete, it is found that there is an increase 4.6% in compressive strength and 3% in flexural strength. When M25 concrete with 1.5% hair is equated with the plain cement concrete, it is found that there is an increase of 11% in compressive strength and 4% in flexural strength.

Nila V. M, Raijan K. J, Susmitha Antony, RiyaBabu M, Neena Rose Davis [4] According to the test performed it is detected that there was an overall increase of 1 - 12% in the compressive strength of concrete and up to 5% in the flexural strength of concrete test specimens by the addition of hair fibers in different quantities. Maximum increase is perceived in the addition of 2% hair fiber, in all the mixes.

Yadollah Batebi, AlirezaMirzagoltabar, Seyed Mostafa Shabanian and Sara Fateri [5] Use of fibers in concrete mixtures modifies concrete workability and decreases cracks. Nano cross-section of hair and its proper tensile strength this project investigates to reduce the shrinkage of concrete mixtures. Human hair fibers were used in 0.4 and 0.8 and 1.2 weight percentage and the length of the fibers in each case varied between 15 and 60 millimeters.

Tomas U. Ganiron Jr. [6] “Effects of Human Hair Additives in Compressive Strength of Asphalt Cement Mixture”. The experiments made were asphalt mixture with human hair as the experimental group and standard asphalt mixture . Human hair added to standard asphalt mixture with three different proportions varying from 3% to 12% by mass of with respect to bitumen. Adding cement and human hair to asphalt mixture greatly upsurge the strength of the mixture thus making it a good material for the construction of road pavement.

G. Sreevani [8] “Human Hair as Fibre Reinforcement in Concrete”. The human hair fiber concrete has the high compressive strength compared to the normal Concrete. When compared to that of the conventional concrete specimen. It is well observed that the maximum increase is noticed in the

addition of 1.5 % hair fiber, by weight of concrete, in all the mixes. It modifies various properties of concrete like tensile strength, compressive strength and also enhances the binding properties, micro cracking control and also increases spalling resistance.

AchalAgrawal, Abhishek Shrivastava ,SiddharthPastariya, Anant Bhardwaj [9] "A Concept of Improving Strength of Concrete using Human Hair as Fiber Reinforcement" This research work can be concluded under following points as

• For 7 days curing period 6.29% compressive and 6.82% flexural strength increment was marked when compared with conventional mix.

• For 14 days it was 7.89% and 9.7% increment in compressive and flexural strength respectively when compared with conventional concrete.

• For 28 days a maximum of 9.18% and 6.55% increment in compressive and flexural strength respectively was achieved when compared with conventional concrete.

It has been noted that on an average the increment in the compressive strength of FRC is about 9% & that of flexural strength is 6.50% when compared with Plain cement concrete (PCC).

4. EXPERIMENTAL ANALYSIS

4.1 Methodology

The methodology adopted to test the properties, strength and effect of hair reinforced concrete is governed by.

- **Compressive Strength Test**
- **Flexural Strength Test**

4.2 Laboratory Test Conducted

Design Stipulations:

Following design stipulations are considered based on the site condition and requirements of IS: 456-2000.

Grade of Concrete	M25
Maximum Size of Metal	20mm
Degree of Quality of Control	Good
Degree of Exposure	Moderate
Degree of Workability (Compaction Factor)	0.85
Desired Slump	60-70mm
Minimum Cement content	300 Kg/cu.m
Maximum Water Cement Ratio	0.5
Shape of CA	Angular
Water absorption	
Coarse aggregate	0.8%
Fine Aggregate	0.6%
Free (surface) moisture	
Coarse aggregate	Nil
Fine Aggregate	Nil
Fineness of Cement	7%
Specific gravity of cement	3.15
Normal consistency of cement	34% on the vicat apparatus
Specific gravity of FA	2.63
Specific gravity of CA	2.86
Fineness Modulus of Fine Aggregate	2.88
Fineness Modulus of Fine Aggregate	7.45
Method of concrete placing	Manually

Treatment of hair fibre:

The hair needed for the preparation of concrete cubes was collected from salons. It needs treatment before to be added in the concrete specimens. It is carried out as in the following steps.

Separating hair from other waste: Depending on the source, the collected hair may contain wastes. This has to be removed.

• **Washing:** After sorting, the hair is washed with acetone to remove impurities.

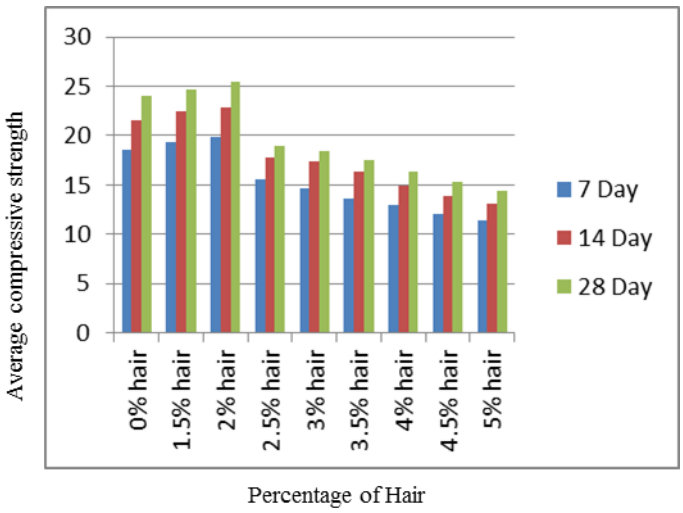
• **Drying:** The hair is then dried under sun or in oven. After drying, the hair can be stored without any concern for decay or odor.

• **Sorting:** The hair is then sorted according to length, color, and quality. The hair fibers are checked at random for its length and diameter.

5. RESULTS AND DISCUSSIONS

Mix	Average Compressive Strength 7 Day's (N/mm^2)	Average Compressive Strength 14Day's (N/mm^2)	Average Compressive Strength 28 Day's (N/mm^2)
0% hair	18.51	21.55	24.00
1.5% hair	19.40	22.51	24.66
2% hair	**19.84**	**22.81**	**25.44**
2.5% hair	15.52	17.76	18.96
3% hair	14.69	17.44	18.40
3.5% hair	13.64	16.39	17.52
4% hair	13.00	14.87	16.38
4.5% hair	11.78	13.84	15.36
5% hair	10.55	13.07	14.35

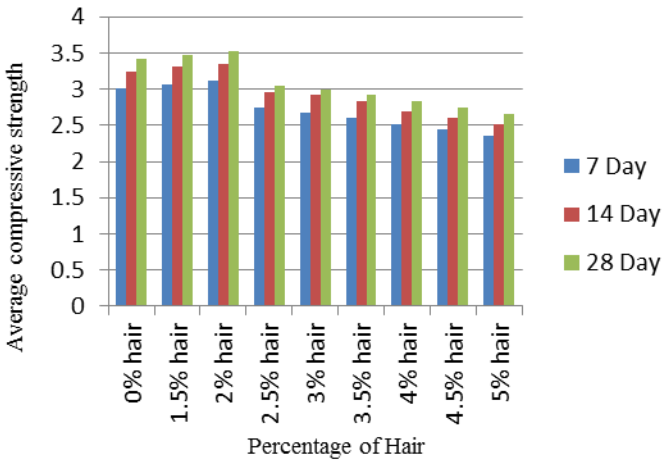
Table-1: Average Compressive Strength



Graph -1: Comparison on the basis of average compressive strength with varying percentages of hair fibre.

Mix	Average Flexural Strength 7 Day's (N/mm^2)	Average Flexural Strength 14Day's (N/mm^2)	Average Flexural Strength 28 Day's (N/mm^2)
0% hair	3.01	3.24	3.42
1.5% hair	3.07	3.32	3.47
2% hair	3.11	3.34	3.53
2.5% hair	2.75	2.95	3.04
3% hair	2.67	2.92	3.00
3.5% hair	2.61	2.83	2.92
4% hair	2.52	2.69	2.83
4.5% hair	2.44	2.60	2.74
5% hair	2.36	2.52	2.65

Table-2: Average Flexural Strength.



Graph – 2: Comparison on the basis of average Flexural strength with varying percentages of hair fibre.

6. CONCLUSIONS

• Human hair waste can be adequately figured out how to be used in fiber strengthened solid developments. As indicated by the test performed it is watched that there is surprising addition in properties of cement as indicated by the rates of hairs by weight of bond in concrete.

• There was a general increment of in the compressive quality of cement and the flexural quality of solid test examples by the expansion of hair fiber in various amounts.

• It is very much watched that the most extreme increment is seen in the expansion of 2% hair fiber, by weight of bond in concrete, in all the blends.

• The expansion of human hairs to the solid not just adjusts different properties of solid like rigidity, compressive quality yet in addition improves the coupling properties, smaller scale breaking control and furthermore increments spalling opposition. The break width is diminished to a more prominent degree.

• Crack arrangement and engendering are especially lessened demonstrating that hair fiber strengthened cement can have different applications in seismic safe and break safe developments, street asphalt developments and so forth.

7. FUTURE SCOPE

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.

8. APPLICATION

• Used of hair fiber fortified cement diminishes the development of moment breaks which can limit the spillage issues, making it appropriate for water verification developments.

• Human hair added substances and black-top bond blend go about as a potential folio in street asphalt and those demonstrate that adding concrete and human hair to black-top blend enormously increment the compressive quality of the blend consequently making it a decent material for the development of street asphalt. It enhances the heap bearing limit of the blend. Subsequently, hair fiber strengthened cement has its application in development of asphalts too.

• In strengthened bond concrete, if measure of steel support c lessened by receiving required level of hair fiber fortification which makes the segment light in weight. Diminishment in break development under administration loads gives better life time for the steel support as it will oppose erosion of steel through the splits. The likelihood of halfway supplanting of bond with fiber in fiber strengthened cement can give seismic opposition in structures.

• It strengthens the mortar and shields it from spalling. Established an inventive substance procedure of enhancing the dirt fruitfulness by utilizing human hair filaments.

• .Adding of both cement and human hair to asphalt mixture increases the load bearing capacity of the mixture.

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