HUMAN HAIR FIBRE REINFORCED CONCRETE

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Abstract-**A practical and affordable solution for overcoming cracks and other similar types of inadequacies is provided by fibre reinforced concrete. Fibre helps concrete make up for its weakness in stress. Human hair is utilised here as a fibre. It is inexpensive and non-biodegradable. Additionally, it lessens environmental issues. Various percentages of human hair fibre, 0.5%, 1%, 1.5%, and 2% by weight of cement, were added in experiments on concrete cubes, beams, and cylinders of typical sizes. At 7, 14, and 28 days, compressive strength, split tensile strength, and flexural strength are evaluated. By adding more human hair to concrete, the density is decreased. As per the tests, the strength of the concrete can be increased.**

Keywords: Fibre reinforced concrete, Human hair, Compressive strength, Split tensile strength, Flexural strength and non-degradable.

I. Introduction

The most typical building material is concrete. It is ductile and has a low tensile strength. Fibrous material is present in fibre reinforced concrete, which improves structural integrity and is becoming more and more significant. A fibre is a tiny particle of reinforcing material with a specific set of properties. The length and proportion of the fibres have a considerable impact on the mechanical characteristics of the concrete, which are affected by their addition. Concrete's tensile strength is low thus fibres are added to increase it while also improving the properties of building materials. Concrete uses fibres to prevent cracking. Additionally, they lessen concrete's permeability, which in turn lessens water leakage. The fiber's aspect ratio is determined by the relationship between its length and diameter. For various fibres, it has a distinct value. It was discovered that reinforced concrete with a high aspect ratio performed better.

In concrete, hair is utilized as a fibre reinforcing material. Its strong tensile strength is comparable to copper wire of a comparable diameter. It is a cheap material that is non-degradable. By strengthening it, the mortar is kept from bulging. The presence of various types of human hair in different parts of our nation may be the result of environmental change as a waste product. Individual differences exist in terms of thickness and stiffness. It disrupts our ecosystem and causes several environmental problems. The environment is being negatively impacted by this. This study's major goal is to investigate if human hair can used as a fibrous material to enhance the mechanical properties of concrete. Various percentages of human hair fibre, 0.5%, 1%, 1.5%, and 2% by weight of cement, were added in experiments on concrete cubes, beams, and cylinders of typical sizes. At 7, 14, and 28 days, the mechanical parameters are measured for changes in compressive strength, split tensile strength, and flexural strength and are compared to plain cement concrete.

II. Materials used

1. Cement: Cement is mainly used as a binding ingredient in concrete mix. It gives high strength to structural elements. It has high resistance to cracking and shrinkage. The cement used here is Ordinary Portland Cement (OPC) having grade 53 and the specific gravity of the cement is 3.06.

2. Fine aggregate: Any naturally occurring sand fragments that are taken from the soil by mining are considered fine aggregates. These are particles that are retained in a 0.075mm sieve after passing through a 4.75mm sieve. It helps to make concrete mix more compact. The fine aggregate used here is sand and is obtained from grading zone III.

3. Coarse aggregate: A coarse aggregate is a particle with a diameter greater than 0.19 inches, which commonly ranges from 3/8 to 1.5 inches. Examples of coarse aggregates, which are granular and uneven materials used to produce concrete, include sand, gravel, or crushed stone. It provides a strong connection between cement plate and finer material. It provides durable and stable building material.

4. Human hair: Human hair is used as a fibre here and is of length 60mm. Hair improves the performance of concrete by improving its mechanical properties. It has high tensile strength and is also easily available. The hair is collected from different saloons in Kottayam. It is treated before adding to the concrete specimen (Separating, washing, drying and sorting).

III. Mix Design Proportion

M35 grade concrete is designed here. The weight ratio of mix proportion is 1:1.33:1.91 and water cement ratio is 0.6.

Table 1: Mix design proportion for cube

Sl. No	Hair	Cement	Fine aggregate	Coarse aggregate	Water
1	0	1.762	2.60	4.20	0.688l
2	0.5%	1.762	2.60	4.20	0.688l
3	1%	1.762	2.60	4.20	0.688l
4	1.5%	1.762	2.60	4.20	0.688l
5	2%	1.762	2.60	4.20	0.688l

Table 2: Mix design proportion for cylinder

Sl. No	Hair	Cement	Fine aggregate	Coarse aggregate	Water
1	0	2.772	4.480	5.70	1.053l
2	0.5%	2.772	4.480	5.70	1.053l
3	1%	2.772	4.480	5.70	1.053l
4	1.5%	2.772	4.480	5.70	1.053l
5	2%	2.772	4.480	5.70	1.053l

Table 3: Mix design proportion for beam

Sl. No	Hair	Cement	Fine aggregate	Coarse aggregate	Water
1	0	2.61	3.81	6.05	0.991l
2	0.5%	2.61	3.81	6.05	0.991l
3	1%	2.61	3.81	6.05	0.991l
4	1.5%	2.61	3.81	6.05	0.991l
5	2%	2.61	3.81	6.05	0.991l

IV. Methodology

1. Compressive Strength Test:

Concrete cubes measuring 150mm x 150mm x 150mm are tested for compressive strength using a Universal Testing Machine (UTM) at 7, 14, and 28 days after curing. The specimens must be set up in the compressive testing machine before a uniform load is given until the cube fails. The compressive strength is then determined after noting the maximum load.

Fig 1. Compression Testing Machine

Fig. 2 Failure of cube

2. Split Tensile Strength:

Tensile strength is measured by testing concrete cylinders of 150mm diameter and 300mm length after 7, 14 and 28 days of curing. It is also tested under Universal Testing Machine (UTM) and the specimen is placed in horizontal position. Up until the cylinder fails, a uniform load is applied. The split tensile strength is estimated after noting the maximum value of the load.

Fig. 3 Compression Testing Machine

Fig. 4 Failure of cylinder

3. Flexural Strength Test:

Flexural strength test is measured by testing concrete beams of size 500mm x 100mm x 100mm under Universal Testing Machine (UTC) after 7, 14 and 28 days of curing. The specimen is to be simply placed between the two rollers of the flexure testing machine. The two rollers on the beam apply the load at a constant rate. The load is gradually raised until the specimen breaks and note the maximum load value.

Fig. 5 Flexural Strength Testing

Fig.6 Failure of beam

V. Results and Discussion

1. Compressive Strength Test:

It is found that compressive strength decreases with increasing human hair content. The results are shown in Table 4.

Table 4: Results of Compressive Strength

Sl. No	Number of days	Compressive Strength (N/mm^2)				
		0% hair	0.5% hair	1% hair	1.5% hair	2% hair
1	7	20.6	20.9	21.6	21.1	20.3
2	14	24.4	23.8	25.2	23.3	22.9
3	28	36.6	38.1	40.2	36.2	33.4

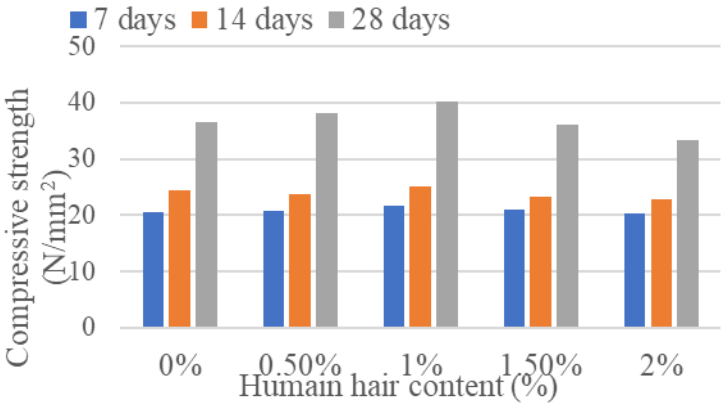

Fig. 7 Variation of compressive strength of concrete

2. Split Tensile Strength Test:
It is found that split tensile strength is increased by adding different percentages of human hair. The results are shown in Table 5.

Table 5: Results of Split Tensile Strength

Sl. No	Number of days	Split Tensile Strength (N/mm^2)				
		0% hair	0.5% hair	1% hair	1.5% hair	2% hair
1	7	2.2	2.3	2.4	2.5	2.6
2	14	2.6	2.7	2.8	2.9	3
3	28	3.2	3.3	3.4	3.5	3.7

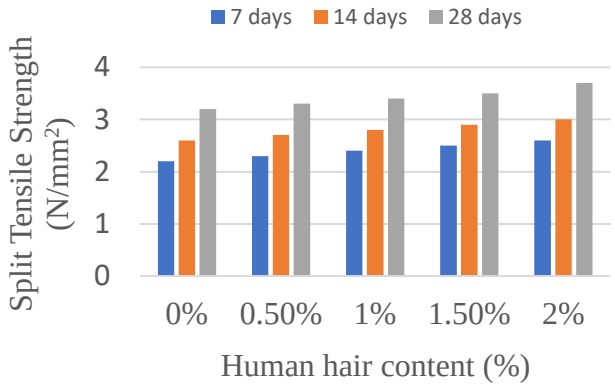

Fig. 8 Variation of split tensile strength of concrete

3. Flexural Strength Test:
Here, it is found that there is an increase in the flexural strength. The results are shown in Table 6.

Table 6: Results of Flexural Strength

Sl. No	Number of days	Flexural Strength (N/mm^2)				
		0% hair	0.5% hair	1% hair	1.5% hair	2% hair
1	7	2.3	2.4	2.6	2.7	2.8
2	14	2.4	2.5	2.7	2.8	2.9
3	28	4.4	5.3	5.7	6	6.6

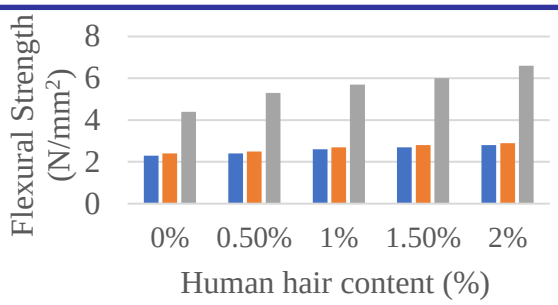

Fig. 9 Variation of flexural strength of concrete

VI. Conclusion

Waste human hair can be used to make fiber-reinforced concrete structures. When human hair is added to concrete, it is shown that the material's characteristics enhance. In comparison to normal concrete, the human hair fibre reinforced concrete has a higher compressive strength. In addition to altering the concrete's tensile and compressive strengths, adding human hair also improves the material's ability to bind together and manage microcracks. Therefore, adding hair as a fibre to concrete improves the material's qualities. The use of human hair is both convenient and environmentally friendly.

VII. References

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